chapter 16

# The Price Adjustment Mechanism with Flexible and Fixed Exchange Rates

**LEARNING GOALS:**

After reading this chapter, you should be able to:

- Understand the effect of a change in the exchange rate on the nation's current account
- Understand the meaning and importance of the "stability of the foreign exchange market"
- Understand the meaning and importance of the exchange rate "pass-through"
- Explain how the gold standard operated

## 16.1 Introduction

In this chapter, we examine how a nation's current account is affected by price changes under flexible and fixed exchange rate systems. How the nation's current account is affected by income changes in the nation and abroad is examined in Chapter 17. Chapter 17 also presents a synthesis of the *joint* effect of price and income changes on the nation's current account and level of national income.

For simplicity, in this chapter we assume that there are no autonomous international private capital flows. That is, international private capital flows take place only as passive responses to cover (i.e., to pay for) temporary trade imbalances. We also assume that the nation wants to correct a deficit in its current account (and balance of payments) by exchange rate changes. (The correction of a current account and balance-of-payments *surplus* would generally require the opposite techniques.) Since this traditional exchange rate model is based on trade flows and the speed of adjustment depends on how responsive (elastic) imports and exports are to price (exchange rate) changes, it is called the trade or elasticity approach.

As we have seen in Chapter 15, international private capital flows are much larger than trade flows today, and so exchange rates reflect mostly financial rather than trade flows, especially in the short run. Trade flows, however, do have a strong effect on exchange rates in the long run. It is to isolate and identify the effect of trade flows on exchange rates and the effect of exchange rate changes on trade flows that we make the simplifying assumption of no autonomous international private capital flows in this chapter. Of course, in the real world both international financial and trade flows jointly determine exchange rates, but a fully acceptable theory of exchange rate determination that incorporates both financial and trade flows has not yet been developed. The closest we come to such a general theory is the portfolio balance model examined in Section 15.4.

In this chapter, Section 16.2 examines how the nation's current account is affected by exchange rate changes. Section 16.3 looks at the effect of exchange rate changes on domestic prices (the rate or inflation) in the country. Section 16.4 deals with the closely related topic of the stability of foreign exchange markets. Section 16.5 presents estimates of trade elasticities and explains why the current account usually responds with a time lag and only partially to a change in the nation's exchange rate. Finally, Section 16.6 describes the adjustment mechanism under the gold standard (the so-called price-specie-flow mechanism). In the appendix, we illustrate graphically the effect of a change in the exchange rate on domestic prices, derive mathematically the Marshall–Lerner condition for stability in foreign exchange markets, and show graphically how the gold points and international gold flows were determined under the gold standard.

## 16.2 Adjustment with Flexible Exchange Rates

In this section, we examine the method of correcting a deficit in a nation's current account or balance of payments by a depreciation or a devaluation of the nation's currency. A depreciation implies a flexible exchange rate system. A devaluation, on the other hand, refers to the deliberate (policy) increase in the exchange rate by the nation's monetary authorities from one fixed or pegged level to another. However, since both a depreciation and a devaluation operate on prices to bring about adjustment in the nation's current account and the balance of payments, they are both referred to as the *price adjustment mechanism* and are discussed together here. This is to be distinguished from the *income adjustment mechanism*, which relies on income changes in the nation and abroad and will be examined in the next chapter. We begin by examining the process of adjustment itself, and then show how the demand and supply schedules of foreign exchange are derived.

### 16.2A Balance-of-Payments Adjustments with Exchange Rate Changes

The process of correcting a deficit in a nation's balance of payments by a depreciation or devaluation of its currency is shown in Figure 16.1. In the figure, it is assumed that the United States and the European Monetary Union are the only two economies in the world and that there are no international capital flows, so that the U.S. demand and supply curves for euros reflect only trade in goods and services. The figure shows that at the exchange rate of $R = \$1/€1$, the quantity of euros demanded by the United States is €12 billion per year, while the quantity supplied is €8 billion. As a result, the United States has a deficit of €4 billion ($AB$) in its balance of payments.

If the U.S. demand and supply curves for euros were given by $D_€$ and $S_€$, a 20 percent devaluation or depreciation of the dollar, from $R = \$1/€1$ to $R = \$1.20/€1$, would completely eliminate the U.S. deficit. That is, at $R = \$1.20/€1$, the quantity of euros demanded

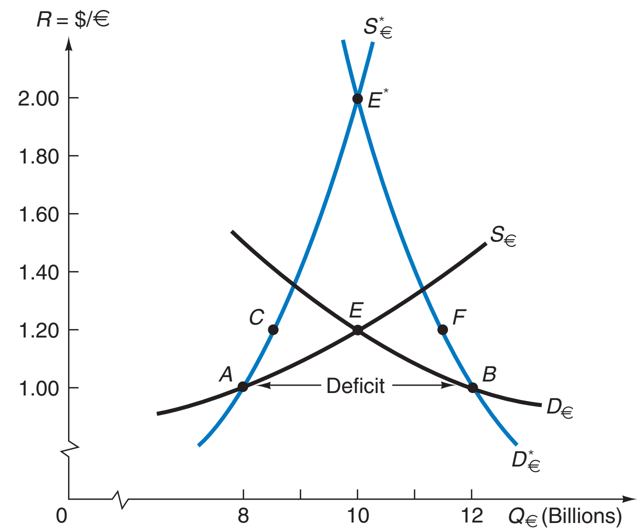


**FIGURE 16.1. Balance-of-Payments Adjustments with Exchange Rate Changes.**
At $R = \$1/€1$, the quantity of euros demanded by the United States is €12 billion per year, while the quantity supplied is €8 billion, so that the United States has a deficit of €4 billion (*AB*) in its balance of payments. With $D_€$ and $S_€$, a 20 percent depreciation or devaluation of the dollar would completely eliminate the deficit (point *E*). With $D^*_€$ and $S^*_€$, a 100 percent depreciation or devaluation would be required to eliminate the deficit (point $E^*$).

and the quantity supplied would be equal at €10 billion per year (point *E* in the figure), and the U.S. balance of payments would be in equilibrium. If, however, the U.S. demand and supply curves for euros were less elastic (steeper), as indicated by $D^*_€$ and $S^*_€$, the same 20 percent devaluation would only reduce the U.S. deficit to €3 billion (*CF* in the figure), and a 100 percent devaluation or depreciation of the dollar, from $R = \$1/€1$ to $R = \$2/€1$, would be required to completely eliminate the deficit (point $E^*$ in the figure). Such a huge devaluation or depreciation of the dollar might not be feasible (for reasons examined later).

Thus, it is very important to know how elastic the U.S. demand and supply curves for euros are. In some cases, the shape of the deficit nation's demand and supply curves for foreign exchange may be such that a devaluation or depreciation would actually increase, rather than reduce or eliminate, the deficit in its balance of payments. These crucial questions are examined next by showing how a nation's demand and supply schedules for foreign exchange are derived.

## 16.2B Derivation of the Demand Curve for Foreign Exchange

The U.S. demand curve for euros ($D_€$) shown in Figure 16.1 is derived from the demand and supply curves of U.S. imports in terms of euros (shown in the left panel of Figure 16.2). On the other hand, the U.S. supply curve for euros ($S_€$) shown in Figure 16.1 is derived from the demand and supply curves of U.S. exports in terms of euros (shown in the right panel of Figure 16.2). Let us start with the derivation of the U.S. demand curve for euros ($D_€$).

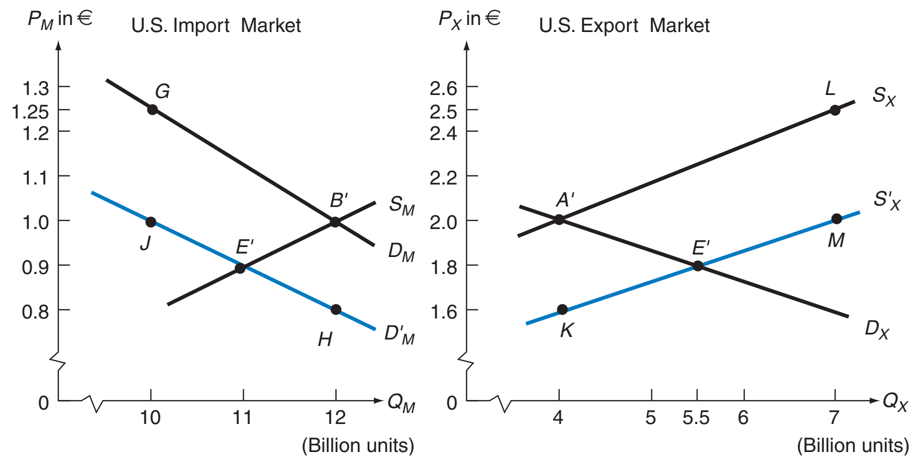


**FIGURE 16.2. Derivation of the U.S. Demand and Supply Curves for Foreign Exchange.** With $D_M$ (at $R$ = \$1/€1) and $S_M$ in the left panel, $P_M$ = €1 and $Q_M$ = 12 billion units per year, so that the quantity of euros demanded by the United States is €12 billion (point $B'$). This corresponds to point $B$ in Figure 16.1. With a 20 percent depreciation of the dollar, $D_M$ shifts down to $D'_M$. Then $P_M$ = €0.9 and $Q_M$ = 11 billion units, so that the quantity of euros demanded by the United States falls to €9.9 billion (point $E'$ in the left panel). This corresponds to point $E$ (with €9.9 billion rounded to €10 billion) in Figure 16.1.

With $D_X$ and $S_X$ (at $R$ = \$1/€1) in the right panel, $P_X$ = €2 and $Q_X$ = 4 billion, so that the quantity of euros supplied to the United States is €8 billion (point $A'$). This corresponds to point $A$ in Figure 16.1. With a 20 percent depreciation or devaluation of the dollar, $S_X$ shifts down to $S'_X$. Then $P_X$ = €1.8 and $Q_X$ = 5.5 billion units, so that the quantity of euros supplied to the United States rises to €9.9 billion (point $E'$). This corresponds to point $E$ in Figure 16.1.

In the left panel of Figure 16.2, $D_M$ is the U.S. demand for imports from the European Monetary Union in terms of euros at $R$ = \$1/€1, while $S_M$ is the EMU supply of imports to the United States. With $D_M$ and $S_M$, the euro price of U.S. imports is $P_M$ = €1, and the quantity of U.S. imports is $Q_M$ = 12 billion units per year, so that the quantity of euros demanded by the United States is €12 billion (point $B'$ in the left panel of Figure 16.2). This corresponds to point $B$ on the U.S. $D_€$ in Figure 16.1.

When the dollar depreciates by 20 percent to $R$ = \$1.20/€1, $S_M$ remains unchanged, but $D_M$ shifts down by 20 percent to $D'_M$ (see the left panel of Figure 16.2). The reason is that for the United States to continue to demand 12 billion units of imports (as at point $B'$ on $D_M$), the euro price of U.S. imports would have to fall from $P_M$ = €1 to $P_M$ = €0.8, or by the full 20 percent of the depreciation of the dollar, in order to leave the dollar price of imports unchanged (point $H$ on $D'_M$). However, at euro prices below $P_M$ = €1, the European Monetary Union will supply smaller quantities of imports to the United States (i.e., the European Monetary Union will move down along $S_M$), while the United States will demand smaller quantities of imports at euro prices above $P_M$ = €0.8 (i.e., the United States will move up along), until a compromise on price at the new equilibrium point $E'$ is reached (see the left panel of Figure 16.2). The student should reread this paragraph and the previous one, and carefully study the left panel of Figure 16.2 and its relationship to Figure 16.1 because this is a rather important topic and one of the most challenging in international finance.

Note that $D'_M$ is not parallel to $D_M$ because the shift is of a *constant percentage*. Thus, a 20 percent downward shift from point $B'$(€1.00) is only €0.20, while the same 20 percent downward shift from point $G$ (€1.25) is €0.25. With $D'_M$ and $S_M$, $P_M$ = €0.9 and $Q_M$ = 11 billion, so that the quantity of euros demanded by the United States falls to €9.9 billion (point $E'$ in the left panel of Figure 16.2). This corresponds to point $E$ (with €9.9 billion rounded to €10 billion) on $D_€$ in Figure 16.1. Thus, the quantity of euros demanded by the United States falls from €12 billion (given by point $B'$ in the left panel of Figure 16.2) at $R$ = \$1/€1 to €10 billion (given by point $E'$) at $R$ = \$1.20/€1. This corresponds to a movement from point $B$ to point $E$ along $D_€$ in Figure 16.1.

Only in the unusual case when $D_M$ has zero elasticity (is vertical) will the U.S. quantity demanded of euros remain exactly the same after the devaluation or depreciation of the dollar as it was before, because in that case the downward shift in $D_M$ leaves $D_M$ unchanged (this is assigned as an end-of-chapter problem). Thus, aside from the unusual case where $D_M$ is vertical, a devaluation or depreciation of the dollar always leads to a reduction in the U.S. quantity demanded of euros, so that $D_€$ (in Figure 16.1) is always negatively sloped. The reduction in the U.S. quantity demanded of euros when the dollar is devalued or is allowed to depreciate results because both the euro price of U.S. imports and the quantity of U.S. imports fall (see the left panel of Figure 16.2).

Furthermore, given $S_M$, the less elastic (steeper) is $D_M$, the smaller is the reduction in the U.S. quantity demanded of euros and the less elastic (steeper) is the U.S. demand curve for euros. (This is assigned as another end-of-chapter problem.) In that case, a 20 percent devaluation of the dollar might be represented by a movement from point $B$ to point $F$ along $D^*_€$ rather than by a movement from point $B$ to point $E$ along $D_€$ in Figure 16.1.

## 16.2c Derivation of the Supply Curve for Foreign Exchange

In the right panel of Figure 16.2, $D_X$ is the EMU demand for U.S. exports in terms of euros, and $S_X$ is the U.S. supply of exports to the European Monetary Union at $R$ = \$1/€1. With $D_X$ and $S_X$, the euro price of U.S. exports is $P_X$ = €2, and the quantity of U.S. exports is $Q_X$ = 4 billion units, so that the U.S. quantity of euros earned or supplied is €8 billion (point $A'$ in the right panel of Figure 16.2). This corresponds to point $A$ on $S_€$ in Figure 16.1.

When the dollar is devalued or is allowed to depreciate by 20 percent to $R$ = \$1.20/€1, $D_X$ remains unchanged, but $S_X$ shifts down by 20 percent to $S'_X$ (see the right panel of Figure 16.2). The reason is that the United States would now be willing to export 4 billion units (the same as at point $A'$ on $S_X$) at the euro price of $P_X$ = €1.6, or 20 percent lower than before the depreciation of the dollar, because each euro is now worth 20 percent more in terms of dollars (point $K$ on $S'_X$ in the figure). However, at euro prices below $P_X$ = €2, the European Monetary Union will demand greater quantities of U.S. exports (i.e., the European Monetary Union will move down along $D_X$), while the United States will supply greater quantities of exports at euro prices above $P_X$ = €1.6 (i.e., the United States will move up along $S'_X$), until the new equilibrium point $E'$ is reached (see the right panel of Figure 16.2).

Note that $S'_X$ is not parallel to $S_X$ because the shift is of a constant percentage. With $D_X$ and $S'_X$, $P_X$ = €1.8 and $Q_X$ = 5.5 billion units, so that the quantity of euros supplied to the United States increases to €9.9 billion (1.8 times 5.5). This is given by point $E'$ in the right panel of Figure 16.2 and corresponds to point $E$ (with €9.9 billion rounded to €10 billion) on $S_€$ in Figure 16.1. Thus, the quantity of euros supplied to the United States rises from €8 billion (given by point $A'$ in the right panel of Figure 16.2) at $R$ = \$1/€1 to €10 billion (given by point $E'$) at $R = \$1.20/€1$. This corresponds to a movement from point $A$ to point $E$ along $S_€$ in Figure 16.1.

Devaluation of the dollar reduces the euro price but increases the quantity of U.S. exports (compare point $E'$ to point $A'$ in the right panel of Figure 16.2). What happens to the quantity of euros supplied to the United States then depends on the price elasticity of $D_X$ between points $A'$ and $E'$. Since in this case the percentage increase in $Q_X$ exceeds the percentage reduction in $P_X$, $D_X$ is price elastic, and the quantity of euros supplied to the United States increases. If $D_X$ in the right panel of Figure 16.2 had been less elastic (steeper), the same 20 percent devaluation might have resulted in a movement from point $A$ to point $C$ along $S^*_€$ in Figure 16.1 rather than from point $A$ to point $E$ along $S_€$. Thus, the less elastic is $D_X$, the less elastic is the derived U.S. supply curve for euros ($S_€$).

If $D_X$ had been unitary elastic, the devaluation or depreciation of the dollar would have left the U.S. quantity supplied of euros completely unchanged, so that the U.S. supply curve of euros would have been vertical, or have zero elasticity. (The same would be true if $S_X$ were vertical, so that a depreciation or devaluation of the dollar would leave $S_X$ unchanged.) Finally, if $D_X$ had been price inelastic, a devaluation or depreciation of the dollar would have actually reduced the U.S. quantity supplied of euros, so that the U.S. supply curve of euros would have been negatively sloped. (These are assigned as end-of-chapter problems.) Thus, while the U.S. demand curve for euros is almost always negatively sloped, the U.S. supply curve of euros could be positively sloped, vertical, or even negatively sloped, depending on whether $D_X$ is elastic, unitary elastic, or inelastic, respectively. In Section 16.4, we will see that this is crucial in determining the stability of the foreign exchange market.

## 16.3 Effect of Exchange Rate Changes on Domestic Prices and the Terms of Trade

Up to now, we have discussed the demand and supply curves of U.S. imports and exports in *terms of the foreign currency* (the euro) because we were interested in the effect of a devaluation or depreciation of the dollar on the U.S. balance of payments. However, a devaluation or depreciation of the dollar also has very important effects on U.S. prices *in terms of dollars*. That is, the depreciation or devaluation of the dollar stimulates the production of U.S. import substitutes and exports and will lead to a *rise* in prices in the United States. Thus, while a devaluation or depreciation of the dollar reduces the euro price of U.S. imports and exports (see Figure 16.2), it increases the dollar price of U.S. import substitutes and exports and is inflationary. This is illustrated graphically in Section A16.1 in the appendix for the more advanced or eager student.

The greater the devaluation or depreciation of the dollar, the greater is its inflationary impact on the U.S. economy and the less feasible is the increase of the exchange rate as a method of correcting the deficit in the U.S. balance of payments. Note that the increase in the dollar price of import substitutes and exports in the United States is a necessary incentive to U.S. producers to shift resources from the production of nontraded or purely domestic goods to the production of import substitutes and exports. But this also reduces the price advantage conferred on the United States by the devaluation or depreciation of the dollar. This is even more so for developing countries (see Case Study 16-1).

## CASE STUDY 16-1 Currency Depreciation and Inflation in Developing Countries during the 1997–1998 East Asian Crisis

Table 16.1 gives the percentage of the currency depreciation and resulting inflation in four Asian countries (Thailand, Korea, Malaysia, and Indonesia) that faced serious financial and economic crises, including steep depreciation of their currencies, from the middle of 1997 to the fall of 1999 (refer to Case Study 11-1). These are some of the countries that grew so fast up to 1997 that they were called the "Asian Tigers." The table also provides data for three Latin American countries (Brazil, Chile, and Mexico) that also faced large currency depreciation and inflationary pressures during the same period of time (the second quarter of 1997 to the third quarter of 1999).

Table 16.1 shows that, except for Indonesia, the inflation rate in the Asian countries considered was less than one-third of the rate of depreciation of their currencies. In other words, about one-third of the price advantage that these nations received from currency depreciation was wiped out by the resulting inflation. In Indonesia, the rate was 72.5 percent (49.0/67.6). In Latin America, it was about 20 percent for Brazil and 46 percent for Chile. In Mexico, the rate of inflation was almost double the rate of depreciation of its currency. As we will see in Chapters 18 and 19, inflation does not depend only on the rate of depreciation of the nation's currency, but also on structural conditions and other forces at work in the nation.

**TABLE 16.1.** Currency Depreciation and Inflation, Selected Asian and Latin American Countries (in percentages, 1997:II to 1999:III)

| Asian Countries | Currency Depreciation | Inflation |
|---|---|---|
| Indonesia | 67.6 | 49.0 |
| Malaysia | 40.0 | 8.6 |
| Korea | 25.4 | 8.1 |
| Thailand | 32.1 | 9.3 |
| **Latin American Countries** | | |
| Brazil | 42.6 | 8.3 |
| Chile | 19.4 | 8.9 |
| Mexico | 15.5 | 27.7 |

*Source:* International Monetary Fund, *International Financial Statistics* (Washington, D.C.: IMF, 2000).

A depreciation or devaluation is also likely to affect the nation's terms of trade. In Section 4.6, we defined the terms of trade of a nation as the ratio of the price of its export commodity to the price of its import commodity. Export and import prices must both be measured in terms of either the domestic or the foreign currency. Since the prices of both the nation's exports and imports rise in terms of the domestic currency as a result of its depreciation or devaluation, the terms of trade of the nation can rise, fall, or remain unchanged, depending on whether the price of exports rises by more than, less than, or the same percentages as the price of imports.

From Figure 16.2 we already know the exact change in the euro prices of U.S. exports and imports as a result of the 20 percent depreciation or devaluation of the dollar and we can use these prices to measure the change in the U.S. terms of trade. Before the depreciation or devaluation of the dollar, $P_X = €2$ (see point $A'$ in the right panel of Figure 16.2) and $P_M = €1$ (point $B'$ in the left panel), so that $P_X/P_M = 2/1 = 2$, or 200 percent. After the 20 percent depreciation or devaluation of the dollar, $P_X = €1.8$ (point $E'$ in the right panel) and $P_M = €0.9$ (point $E'$ in the left panel), so that $P_X/P_M = 1.8/0.9 = 2$, or 200 percent. Therefore, the U.S. terms of trade in this case remain unchanged. The conclusion would be the same if we used the *dollar* prices of U.S. exports and imports to measure the change in the U.S. terms of trade (see Figure 16.7 in the appendix). In general, however, we can expect the terms of trade of a nation to change (as discussed at the end of Section A16.2 in the appendix) when its currency is devalued or allowed to depreciate.

An interesting situation arises when an industrial nation begins to exploit a domestic natural resource that it previously imported. An example of this is provided by Great Britain when it started to extract substantial quantities of petroleum from the North Sea in 1976, thus eliminating the need to import it. The nation's exchange rate might then appreciate so much as to cause the nation to lose international competitiveness in its traditional industrial sector and even face deindustrialization. This is known as the Dutch disease. The name is derived from the Netherlands' loss of relative competitiveness in its traditional industrial sector as a result of the appreciation of the Dutch florin after the development of the Dutch natural gas industry, which eliminated the need for the Netherlands to import natural gas.

## 16.4 Stability of Foreign Exchange Markets

In this section, we examine the meanings of and the conditions for stability of the foreign exchange market. We have a stable foreign exchange market when a disturbance from the equilibrium exchange rate gives rise to automatic forces that push the exchange rate back toward the equilibrium level. We have an unstable foreign exchange market when a disturbance from equilibrium pushes the exchange rate further away from equilibrium.

### 16.4A Stable and Unstable Foreign Exchange Markets

A foreign exchange market is stable when the supply curve of foreign exchange is positively sloped or, if negatively sloped, is less elastic (steeper) than the demand curve of foreign exchange. A foreign exchange market is unstable if the supply curve is negatively sloped *and* more elastic (flatter) than the demand curve of foreign exchange. These conditions are illustrated in Figure 16.3.

The left panel of Figure 16.3 repeats $D_€$ and $S_€$ from Figure 16.1. With $D_€$ and $S_€$, the equilibrium exchange rate is $R = \$1.20/€1$, at which the quantity of euros demanded and the quantity supplied are equal at €10 billion per year (point $E$ in the left panel of Figure 16.3). If, for whatever reason, the exchange rate fell to $R = \$1/€1$, there would be an excess demand for euros (a deficit in the U.S. balance of payments) of €4 billion *(AB)*, which would automatically push the exchange rate back up toward the equilibrium rate of $R = \$1.20/€1$. On the other hand, if the exchange rate rose to $R = \$1.40/€1$, there would be an excess quantity supplied of euros (a surplus in the U.S. balance of payments) of €3 billion *(NR)*, which would automatically drive the exchange rate back down toward

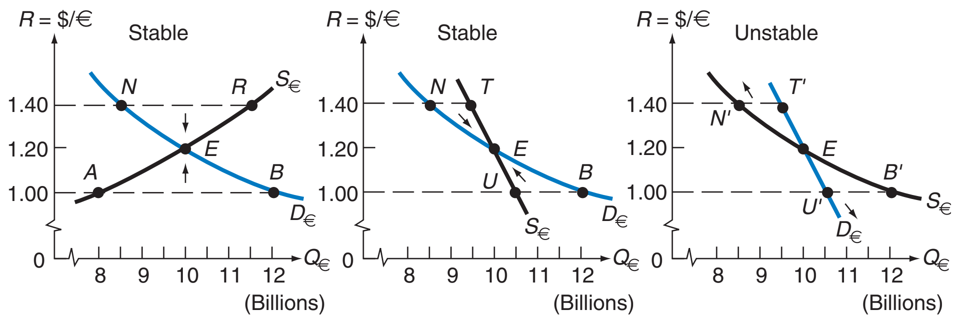


**FIGURE 16.3. Stable and Unstable Foreign Exchange Markets.**
In all three panels, the equilibrium exchange rate is $R = \$1.20/€1$, at which €10 billion are demanded and supplied per year. If, for whatever reason, the equilibrium is disturbed and the exchange rate falls, say to $R = \$1/€1$, the excess demand for foreign exchange in the left and center panels will push the exchange rate back up toward the equilibrium rate, but the excess supply of foreign exchange in the right panel will cause the exchange rate to fall even lower. Similarly, at $R = \$1.40/€1$, the excess supply in the left and center panels will drive the exchange rate down toward $R = \$1.20/€1$, but the excess demand in the right panel will push the exchange rate even higher. Thus, the left and center panels depict stable markets, while the right panel depicts an unstable market.

the equilibrium rate of $R = \$1.20/€1$. Thus, the foreign exchange market shown in the left panel of Figure 16.3 is *stable*.

The center panel of Figure 16.3 shows the same $D_€$ as in the left panel, but $S_€$ is now negatively sloped but steeper (less elastic) than $D_€$. Once again, the equilibrium exchange rate is $R = \$1.20/€1$ (point $E$). At the lower than equilibrium exchange rate $R = \$1/€1$, there is an excess demand for euros (a deficit in the U.S. balance of payments) equal to €1.5 billion *(UB)*, which automatically pushes the exchange rate back up toward the equilibrium rate of $R = \$1.20/€1$. At the higher than equilibrium exchange rate of $R = \$1.40/€1$, there is an excess supply of euros (a surplus in the U.S. balance of payments) of €1 billion *(NT)*, which automatically pushes the exchange rate back down toward the equilibrium rate of $R = \$1.20/€1$. In this case also, the foreign exchange market is *stable*.

The right panel of Figure 16.3 looks the same as the center panel, but the labels of the demand and supply curves are reversed, so that now $S_€$ is negatively sloped and flatter (more elastic) than $D_€$. The equilibrium exchange rate is still $R = \$1.20/€1$ (point $E$). Now, however, at any exchange rate lower than equilibrium, there is an excess quantity supplied of euros, which automatically drives the exchange rate even lower and farther away from the equilibrium rate. For example, at $R = \$1/€1$, there is an excess quantity supplied of euros of €1.5 billion *(U′B′)*, which pushes the exchange rate even lower and farther away from $R = \$1.20/€1$. On the other hand, at $R = \$1.40/€1$, there is an excess quantity demanded for euros of €1 billion *(N′T′)*, which automatically pushes the exchange rate even higher and farther away from the equilibrium rate. Thus, the foreign exchange market in the right panel is *unstable*.

When the foreign exchange market is unstable, a flexible exchange rate system increases rather than reduces a balance-of-payments disequilibrium. Then a revaluation or an appreciation rather than a devaluation of the deficit nation's currency is required to eliminate or reduce a deficit, while a devaluation would be necessary to correct a surplus. These policies are just the opposite of those required under a stable foreign exchange market. Determining whether the foreign exchange market is stable or unstable is, therefore, crucial. Only after the foreign exchange market has been determined to be stable will the elasticity of $D_€$ and $S_€$ (and thus the feasibility of correcting a balance-of-payments disequilibrium with a depreciation or devaluation of the deficit nation's currency) become important.

## 16.4B The Marshall–Lerner Condition

If we knew the exact shape of the demand and supply curves of foreign exchange in the real world, it would be rather easy (as indicated above) to determine whether the foreign exchange market in a particular case was stable or unstable and, if stable, the size of the depreciation or devaluation required to correct a deficit in the balance of payments. Unfortunately, this is not the case. As a result, we can only infer whether the foreign exchange market is stable or unstable and the elasticity of the demand and supply of foreign exchange from the demand for and supply of the nation's imports and exports.

The condition that tells us whether the foreign exchange market is stable or unstable is the Marshall–Lerner condition. The general formulation of the Marshall–Lerner condition is very complex and is presented in Section A16.2 in the appendix. Here we present and discuss the simplified version that is generally used. This is valid when the supply curves of imports and exports (i.e., $S_M$ and $S_X$) are both infinitely elastic, or horizontal. Then the Marshall–Lerner condition indicates a stable foreign exchange market if the sum of the price elasticities of the demand for imports $(D_M)$ and the demand for exports $(D_X)$, in absolute terms, is greater than 1. If the sum of the price elasticities of $D_M$ and $D_X$ is less than 1, the foreign exchange market is unstable, and if the sum of these two demand elasticities is equal to 1, a change in the exchange rate will leave the balance of payments unchanged.

For example, from the left panel of Figure 16.2 we can visualize that if $D_M$ were vertical and $S_M$ horizontal, a depreciation or devaluation of the dollar would leave the U.S. demand for imports and thus the quantity of euros demanded by the United States completely unchanged. By itself, this would leave the U.S. balance of payments unchanged. From the right panel of Figure 16.2, we can visualize that given a horizontal $S_X$ that shifts down by the percentage depreciation or devaluation of the dollar, the quantity of euros supplied to the United States rises, remains unchanged, or falls, depending on whether $D_X$ is price elastic, unitary elastic, or inelastic, respectively. Thus, the sum of the price elasticities of $D_M$ and $D_X$ is equal to the price elasticity of $D_X$ (because we have here assumed $D_M$ to have zero price elasticity), and the U.S. balance of payments improves if the elasticity of $D_X$ is greater than 1.

If $D_M$ is negatively sloped so that it falls or shifts down by the amount of the depreciation of the dollar, the quantity of euros demanded by the United States falls, and this, by itself, improves the U.S. balance of payments. The reduction in the quantity of euros demanded by the United States is greater the larger is the price elasticity of $D_M$. Now, even if the price elasticity of $D_X$ is less than 1 so that the quantity of euros supplied falls as a result of the depreciation of the dollar, the U.S. balance of payments will still improve as long as the *reduction in the quantity of euros demanded by the United States is greater than the reduction in the quantity of euros supplied to the United States*. For this to be the case, the sum of the elasticities of $D_M$ and $D_X$ must be greater than 1. The greater the amount by which the sum of these two elasticities exceeds 1, the greater is the improvement in the U.S. balance of payments for a given depreciation or devaluation of the dollar.

# 16.5 Elasticities in the Real World

In this section, we examine how the price elasticity of demand for imports and exports is measured and present some real-world estimates, discuss the J-curve effect, and examine the "pass-through" of exchange rate changes to domestic prices.

## 16.5A Elasticity Estimates

The Marshall–Lerner condition postulates a stable foreign exchange market if the sum of the price elasticities of the demand for imports and the demand for exports exceeds 1 in absolute value. However, the sum of these two elasticities will have to be substantially greater than 1 for the nation's demand and supply curves of foreign exchange to be sufficiently elastic to make a depreciation or devaluation feasible (i.e., not excessively inflationary) as a method of correcting a deficit in the nation's balance of payments. Thus, it is very important to determine the real-world value of the price elasticity of the demand for imports and exports.

Before World War II, it was widely believed not only that the foreign exchange market was stable but that the demand for and the supply of foreign exchange were very elastic. *Marshall*, among others, advanced this view in his *Money, Credit and Commerce*, published in 1923, but offered no empirical support for his belief.

During the 1940s, a number of econometric studies were undertaken to measure price elasticities in international trade. Two representative studies were undertaken by *Chang*, one in 1945 to measure the price elasticity of the demand for imports in 21 nations for which data existed from 1924 to 1938, and the other in 1948 to measure the price elasticity of the demand for exports of 22 nations over the same period. Chang found that the sum of the demand elasticities on the average barely exceeded 1, so that while the foreign exchange market was stable, the demand and supply curves of foreign exchange were probably fairly steep and inelastic (i.e., as $D^*_€$ and $S^*_€$ rather than as $D_€$ and $S_€$ in Figure 16.1). Other studies reached similar conclusions, confirming that the sum of the elasticities of the demand for imports and the demand for exports was either below or very close to 1 in absolute value. Thus, the prewar elasticity optimism was replaced by postwar elasticity pessimism.

However, writing in 1950, *Orcutt* provided some convincing reasons for the view that the regression technique used to estimate elasticities led to gross underestimation of the true elasticities in international trade. In short, it was likely that Marshall had been broadly correct, while the new econometric estimates, though seemingly more precise, were in fact likely to be far off the mark.

One reason advanced by Orcutt for the belief that the early econometric studies of the 1940s grossly underestimated the price elasticity of the demand for imports and exports results from the identification problem in estimation. This is explained with the aid of Figure 16.4. This figure is similar to the right panel of Figure 16.2 in that it shows the effect of a depreciation or devaluation of the dollar on the U.S. export market when the foreign demand curve and the U.S. supply curve of exports are expressed in terms of the foreign currency (euros). Suppose that points $E$ and $E^*$ are, respectively, the equilibrium points actually observed before and after the United States devalues its currency or allows it to depreciate (with none of the curves in Figure 16.4 being observed). The downward shift from $S_X$ to $S^*_X$ in Figure 16.4 is due to the depreciation or devaluation of the dollar (as in the right panel of Figure 16.2). The depreciation or devaluation of the dollar does not affect the foreign demand for U.S. exports.

If no other change (such as a change in tastes for U.S. exports) occurs, then the estimated foreign demand curve of U.S. exports is inelastic, as shown by $D_X$ in Figure 16.4. However, equilibrium points $E$ and $E^*$ are also consistent with elastic demand curve $D'_X$, which shifts down to $D''_X$ as a result, for example, of reduced foreign tastes for U.S. exports. Regression analysis will always measure the low elasticity of demand $D_X$ even if the true demand is elastic and given by $D'_X$ and $D''_X$ (i.e., regression techniques fail to identify demand curves $D'_X$ and $D''_X$). Since shifts in demand due to changes in tastes or other unaccounted forces frequently occur over time, estimated elasticities are likely to greatly underestimate true elasticities.

The estimated elasticities of the 1940s also measured short-run elasticities in that they were based on quantity responses to price changes over a period of one year or less. *Junz and Rhomberg* (1973) have identified five possible lags in the quantity response to price changes in international trade. These are the *recognition* lag before the price change becomes evident, the *decision* lag to take advantage of the change in prices, the *delivery* lag of new orders placed as a result of price changes, the *replacement* lag to use up available inventories before new orders are placed, and finally the *production* lag to change the output mix as a result of price changes. Junz and Rhomberg estimated that it takes about three years for 50 percent of the final long-run quantity response to take place and five years for 90 percent to occur. By measuring the quantity response only during the year of the price change, the early econometric studies of the 1940s greatly underestimated long-run elasticities.

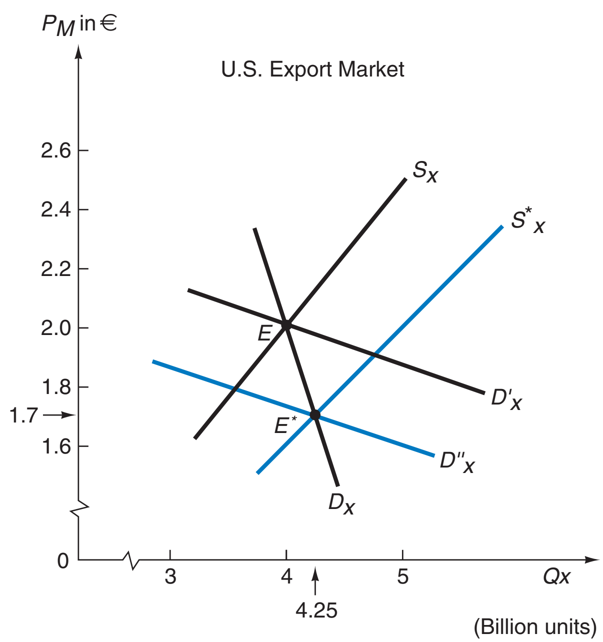


**FIGURE 16.4. The Identification Problem.**
Observed equilibrium points $E$ and $E^*$ are consistent either with nonshifting inelastic demand curve $D_X$ or with elastic demand curve $D'_X$ shifting down to $D''_X$. The estimation techniques used in the 1940s ended up measuring the elasticity of (inelastic) demand curve $D_X$ even when the relevant demand curve was elastic $D'_X$.

## 16.5B The J-Curve Effect and Revised Elasticity Estimates

Not only are short-run elasticities in international trade likely to be much smaller than long-run elasticities, but a nation's trade balance may actually worsen soon after a devaluation or depreciation, before improving later on. This is due to the tendency of the domestic-currency price of imports to rise faster than export prices soon after the devaluation or depreciation, with quantities initially not changing very much. Over time, the quantity of exports rises and the quantity of imports falls, and export prices catch up with import prices, so that the initial deterioration in the nation's trade balance is halted and then reversed. Economists have called this tendency of a nation's trade balance to first deteriorate before improving as a result of a devaluation or depreciation in the nation's currency the J-curve effect. The reason is that when the nation's net trade balance is plotted on the vertical axis and time is plotted on the horizontal axis, the response of the trade balance to a devaluation or depreciation looks like the curve of a *J* (see Figure 16.5). The figure assumes that the original trade balance was zero.

Empirical studies by *Harberger* (1957), *Houthakker and Magee* (1969), *Stern, Francis, and Schumacher* (1976), *Spitaeller* (1980), *Artus and Knight* (1984) (summarized and reviewed by *Goldstein and Khan*, 1985), *Marquez* (1990), and *Hooper*, *Johnson, and Marquez* (1998) attempted to overcome some of the estimation problems raised by Orcutt. These studies generally confirmed the existence of a J-curve effect but also came up with *long-run* elasticities about twice as high as those found in the empirical studies of the 1940s. The upshot of all of this is that real-world elasticities are likely to be high enough to ensure stability of the foreign exchange market in the short run and also to result in fairly elastic demand and supply schedules for foreign exchange in the long run. In the very short run

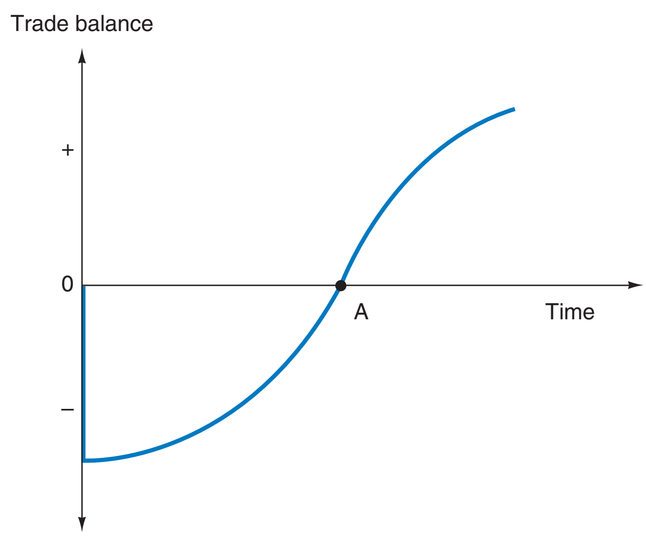


**FIGURE 16.5. The J-Curve.**
Starting from the origin and a given trade balance, a devaluation or depreciation of the nation's currency will first result in a deterioration of the nation's trade balance before showing a net improvement (after time *A*).

(i.e., during the first six months), however, the so-called *impact elasticities* are small enough to result in a deterioration in the current account immediately following a depreciation or a devaluation and before an improvement occurs (the J-curve effect). Case Studies 16-2 and 16-3 give values of estimated price elasticities for imports and exports for various nations or groups of nations. Case Studies 16-4 and 16-5 examine the effect of exchange rate changes on the U.S. current account and trade balances, while Case Study 16-6 examines the effect of exchange rate changes on the current account of the leading European countries during the financial crisis of the early 1990s.

## CASE STUDY 16-2 Estimated Price Elasticities in International Trade

Table 16.2 presents the absolute value of the estimated impact, short-run, and long-run elasticities for the imports and exports of *manufactured goods* of 14 industrial countries. As indicated by the impact elasticities, the foreign exchange market seems to be unstable over a six-month adjustment period or in the very short run, thus confirming the J-curve effect. For a one-year adjustment period, the short-run elasticities indicate that the Marshall–Lerner condition is met for most countries, but just barely. In the long run (i.e., over many years), the unweighted average of the sum of the import and export price elasticities is 1.92 for the seven largest industrial countries, 2.07 for the smaller industrial countries, and 2.00 for all 14 countries. This implies fairly elastic demand and supply curves for foreign exchange.

### TABLE 16.2. Estimated Price Elasticities of Demand for Imports and Exports of Manufactured Goods

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

*Source:* J. R. Artus and M. D. Knight, *Issues in the Assessment of Exchange Rates of Industrial Countries*, Occasional Paper 29 (Washington, D.C.: International Monetary Fund, July 1984), Table 4, p. 26. The dashes indicate values that are not available.

## CASE STUDY 16-3 Other Estimated Price Elasticities in International Trade

Table 16.3 gives the absolute value of the estimated short-run and long-run price elasticity of demand for imports and exports of goods and services of the G-7 countries (United States, Japan, Germany, the United Kingdom, France, Italy, and Canada). The elasticities were estimated using quarterly data from the mid-1950s or early 1960s (depending on the data availability for the different countries) through 1996 or 1997. The results show that short-run price elasticities are very small and that the foreign exchange market seems unstable (i.e., the Marshall–Lerner condition is not met, thus confirming the J-curve effect) for all G-7 countries. In the long run (i.e., over several years), however, the sum of the price elasticity of demand for imports and exports exceeds 1 (so that the Marshall–Lerner condition is satisfied) for five of the seven countries (the exceptions being Germany and France) and for the group as a whole (the unweighted average of the sum of the import and export price elasticities being 1.26). Estimated price elasticities would have been even higher if petroleum imports (which have very low price elasticities) had been excluded from the data. Other estimates by *Chinn* (2005), *Crane, Crowley, and Quayyam* (2007), *Kee, Nicita, and Olarreaga* (2008), and *Imbs and Mejean* (2009) find price elasticities in international trade generally higher than those given in the table below.

### TABLE 16.3. Estimated Price Elasticities for Imports and Exports

| | Imports | | Exports | |
|---|---|---|---|---|
| Country | Short Run | Long Run | Short Run | Long Run |
| United States | 0.1 | 0.3 | 0.5 | 1.5 |
| Japan | 0.1 | 0.3 | 0.5 | 1.0 |
| Germany | 0.2 | 0.6 | 0.1 | 0.3 |
| United Kingdom | 0.0 | 0.6 | 0.2 | 1.6 |
| France | 0.1 | 0.4 | 0.1 | 0.2 |
| Italy | 0.0 | 0.4 | 0.3 | 0.9 |
| Canada | 0.1 | 0.9 | 0.5 | 0.9 |

*Source:* P. Hooper, K. Johnson, and J. Marquez, "Trade Elasticities for the G-7 Countries," Board of Governors of the Federal Reserve System, International Finance Discussion Papers No. 609, April 2008, pp. 1–20.

## CASE STUDY 16-4 Effective Exchange Rate of the Dollar and U.S. Current Account Balance

Figure 16.6 plots the effective exchange rate index of the dollar (defined as the number of foreign currency units per dollar, with 1995 = 100 on the right scale) and the U.S. current account balance (in billions of dollars on the left scale) from 1980 to 2011. The figure shows that the dollar appreciated by almost 40 percent on a trade-weighted basis from 1980 to 1985, but the U.S. current account balance only started to really deteriorate in 1982. The U.S. current account then continued to deteriorate until 1987, even though the dollar started to sharply depreciate in 1985. Thus, the U.S. current account seemed to respond with a long lag (about two years) to changes in

*(continued)*

## CASE STUDY 16-4 Continued

the exchange rate of the dollar. From 1987 to 1991, the U.S. current account improved but then deteriorated until 1994, even though the exchange rate did not change very much from 1987 to 1991. The dollar appreciated from 1995 until 2001 (except in 1999) and the U.S. current account deteriorated (except in 2001), but deteriorated even more sharply from 2002 to 2006, even though the dollar depreciated. In 2009, the dollar appreciated but the current account improved, and afterwards, the dollar depreciated and the U.S. current account. Thus, the U.S. current account seems to respond with about a two-year lag to changes in the effective exchange rate of the dollar in some years and not at all, or even perversely, in other years. Obviously, other powerful forces (discussed in the next chapter) also affect the U.S. current account.

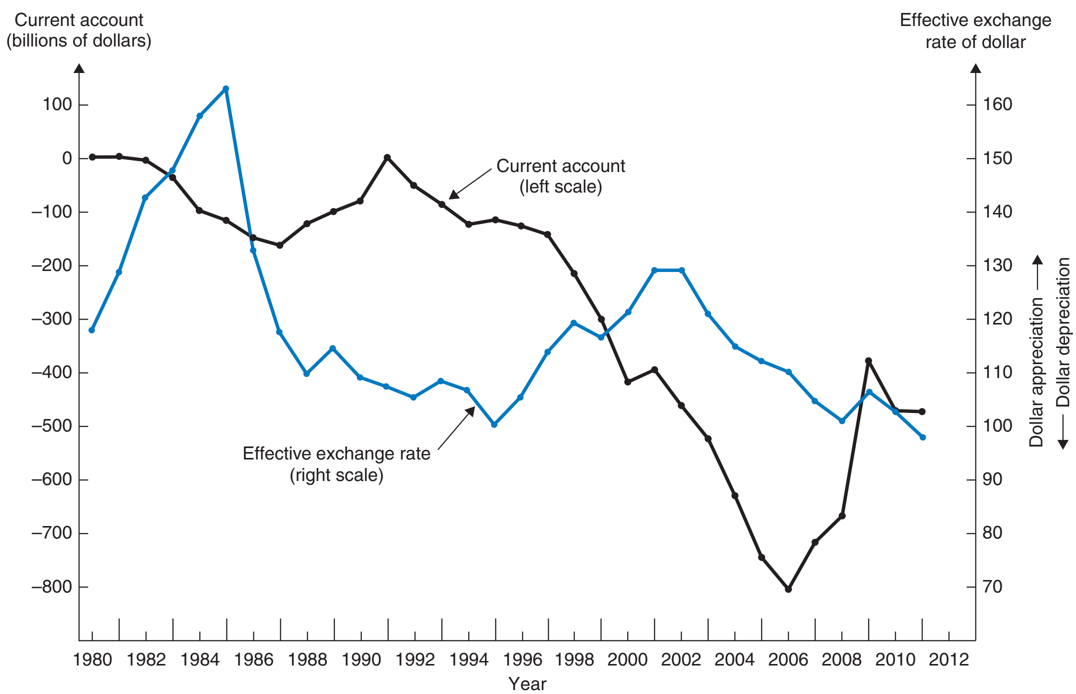


**FIGURE 16.6. Effective Exchange Rate of the Dollar and U.S. Current Account Balance, 1980–2011.**
The U.S. current account seems to respond to exchange rate changes with a long lag (improving when the dollar depreciates and deteriorating when the dollar appreciates), but not always (as in the period from 2002 to 2006 when the dollar depreciated and the U.S. current account deteriorated sharply).
*Sources:* International Monetary Fund, *International Financial Statistics* and U.S. Department of Commerce, *Survey of Current Business*, various issues.

## CASE STUDY 16-5 Dollar Depreciation and the U.S. Current Account Balance

Table 16.4 shows the estimated effect of a dollar depreciation of either 30 percent with respect to other OECD (industrialized) countries or 22.5 percent with respect to all world currencies on the U.S. growth rate, inflation rate, trade balance, current account balance, and short-term interest rates. Effects are measured in relation to what would have been the case in the United States without the dollar depreciation over the 2004–2009 period (base line scenario). The table shows average yearly effects over the 2004–2009 period and the outcome at the end of the period (i.e., in 2009) as compared to the baseline scenario without the dollar depreciation.

From the table, we see that a 30 percent depreciation of the dollar with respect to the currencies of OECD countries (the effects are the same or very similar if the dollar depreciates by 22.5 percent with respect to all currencies) leaves the average growth rate of real GDP at 3.3 percent over the 2004–2009 period. The average inflation rate would be 2.6 percent per year instead of the 1.3 percent rate assumed in the baseline scenario, the average trade balance would be −3.4 percent of GDP instead of −4.7 percent, the average current account balance would be −4.2 percent of GDP instead of −5.1 percent, and the average short-term interest rate would be 6.9 percent instead of 3.9 percent. The directions of these effects are as anticipated; that is, besides improving the trade and current account balance, a dollar depreciation stimulates U.S. exports and growth, but it is also inflationary, which leads to higher interest rates, which in turn dampen growth.

The last two columns of the table show the outcome in 2009 as compared to the baseline scenario; that is, U.S. growth would be only one-half of 1 percent (rounding errors) lower with respect to the baseline scenario, the price level would be 7.6 percent higher, the trade balance would improve by 2.0 percentage points (from −4.7 to −3.3 percent of GDP), the current account balance would also improve by 1.4 percentage points (from −5.1 to −4.2 percent of GDP), and short-term interest rates would be 3 percentage points higher (6.9 instead of 3.9 percent). We could thus conclude that it would take a large dollar depreciation to result in a moderate improvement in the U.S. trade and current account balances.

**TABLE 16.4. Effect of a Dollar Depreciation on the U.S. Trade and Current Account Balances, 2004–2009**

| | Yearly Averages: 2004–2009 | | | End Point (2009) Scenario with Respect to Baseline | |
|---|---|---|---|---|---|
| | Baseline Scenario | Only OECD Exchange Rates Adjust[a] | All Exchange Rates Adjust[b] | Only OECD Exchange Rates Adjust | All Exchange Rates Adjust |
| Growth of real GDP[c] | 3.3 | 3.3 | 3.3 | −0.5 | −0.3 |
| Rate of inflation[c] | 1.3 | 2.6 | 2.2 | 7.6 | 5.1 |
| Trade balance[d] | −4.7 | −3.4 | −3.4 | 2.0 | 1.9 |
| Current account balance[d] | −5.1 | −4.2 | −4.3 | 1.4 | 1.3 |
| Short-term interest rate[e] | 3.9 | 6.9 | 6.9 | 3.0 | 3.0 |

[a] Effective depreciation of the dollar of 30% with respect to OECD currencies.
[b] Effective depreciation of the dollar of 22.5% with respect to all currencies.
[c] Numbers in the first three columns refer to yearly average rates of change; numbers in the last two columns show the *level* in 2009 relative to the baseline.
[d] Percent of GDP; values in last two columns need not add up to the values in the first two columns.
[e] Percent.
*Source:* Organization for Economic Cooperation and Development, *Economic Outlook* (Paris: OECD, June 2004).

## CASE STUDY 16-6 Exchange Rates and Current Account Balances during the European Financial Crisis of the Early 1990s

Table 16.5 shows that the European financial crisis of the early 1990s (examined in detail in Chapter 20) resulted in a currency depreciation of 22.1 percent in Italy and 8.0 percent in the United Kingdom, as contrasted with an appreciation of the real effective exchange rate of Germany and France. The table shows that the current account of all four countries improved between 1992 and 1995, but that of Italy (the country with the largest depreciation) improved the most. Since the current account of Germany and France also improved (despite the appreciation of their currencies), the current account of a nation must reflect other forces at work as well. These will be examined in the next chapter. Note that most of the improvement in Italy's current account occurred within one year of depreciation of the lira.

**TABLE 16.5. Real Effective Exchange Rates and Current Account Balances in Italy, Great Britain, Germany, and France, 1992–1995**

| Country | Real Effective Exchange Rate Index (1995 = 100) | | | | Current Account Balance (in billions of dollars) | | | |
|---|---|---|---|---|---|---|---|---|
| | 1992 | 1993 | 1994 | 1995 | 1992 | 1993 | 1994 | 1995 |
| Italy | 122.1 | 106.0 | 107.2 | 100.0 | 3.1 | 32.9 | 35.4 | 44.1 |
| United Kingdom | 108.0 | 105.0 | 103.3 | 100.0 | −22.9 | −20.0 | −17.0 | −18.5 |
| Germany | 83.0 | 87.6 | 92.5 | 100.0 | 28.2 | 41.2 | 50.9 | 65.1 |
| France | 88.6 | 92.2 | 95.6 | 100.0 | 2.4 | 7.2 | 7.2 | 11.0 |

*Source:* Organization for Economic Cooperation and Development, *Economic Outlook* (Paris: OECD, December 2000).

### 16.5c Currency Pass-Through

Not only are there usually lags in the response of a nation's trade and current account balances to a depreciation of its currency (and there may even be a perverse response for a while—the J-curve effect), but also the increase in the domestic price of the imported commodity may be smaller than the amount of the depreciation—even after lags. That is, the pass-through from depreciation to domestic prices may be less than complete. For example, a 10 percent depreciation in the nation's currency may result in a less than 10 percent increase in the domestic-currency price of the imported commodity in the nation. The reason is that foreign firms, having struggled to successfully establish and increase their market share in the nation, may be very reluctant to risk losing it by a large increase in the price of its exports and are usually willing to absorb at least some of the price increase that they could charge out of their profits. Specifically, a foreign firm may only increase the price of its export commodity by 4 percent and accept a 6 percent reduction in its profits when the other nation's currency depreciates (and its currency appreciates) by 10 percent for fear of losing market share. That is, the pass-through is less than 1. The pass-through is higher in the long run than the short run and higher for industrial goods than for other goods.

In the United States, the pass-through of a dollar depreciation has been estimated to be only about 42 percent in the long run. This means that the dollar price of U.S. imports tends to increase only by about 42 percent of a dollar depreciation after one year, with the remaining 58 percent being absorbed out of exporters' profits (see Case Study 16-7). There is also mounting empirical evidence that the "pass-though" from exchange rate changes to prices (i.e., firm's pricing power) declined during the low-inflationary environment of the past two decades and it is lower for trade in primary commodities than for trade in manufactured products and in trade with China (see *Taylor*, 1999; *McCarthy*, 1999; *Chinn*,

## CASE STUDY 16-7 Exchange Rate Pass-Through to Import Prices in Industrial Countries

Table 16.6 gives the short-run and the long-run exchange rate pass-through elasticities to import prices for the G-7 countries and a number of other countries estimated for the period from 1975 through 2003. From the table, we see that the short-run exchange rate pass-through elasticities range from a low of 0.23 in the United States to a high of 0.79 in the Netherlands, for the unweighted average of 0.53 for all 14 countries included in the table. This means that in the short run, a 10 percent depreciation of dollar results in a 2.3 percent increase in import prices in the United States while a 10 percent depreciation of the Dutch florin leads to an 7.9 percent increase in import prices in the Netherlands. The long-run exchange rate pass-through elasticities range from a low of 0.35 for Italy to a high of 1.13 in Japan, for an unweighted average of 0.70 for all 14 countries included in the table.

### TABLE 16.6. Exchange Rate Pass-Through Elasticities into Import Prices in Industrial Countries

| Country | Short-Run Elasticity | Long-Run Elasticity |
|---|---|---|
| United States | 0.23 | 0.42 |
| Japan | 0.43 | 1.13 |
| Germany | 0.55 | 0.80 |
| United Kingdom | 0.36 | 0.46 |
| France | 0.53 | 0.98 |
| Italy | 0.35 | 0.35 |
| Canada | 0.75 | 0.65 |
| Australia | 0.56 | 0.67 |
| Hungary | 0.51 | 0.77 |
| Netherlands | 0.79 | 0.84 |
| Poland | 0.56 | 0.78 |
| Spain | 0.68 | 0.70 |
| Sweden | 0.48 | 0.38 |
| Switzerland | 0.68 | 0.93 |
| Unweighted Average | 0.53 | 0.70 |

*Source:* J. M. Campa and L. S. Goldberg, "Exchange Rate Pass-Through into Import Prices?" *The Review of Economics and Statistics*, November 2005, pp. 679–690.

2005; *Ihrig, Marazzi, and Rothenberg*, 2006; *Marquez and Schindler*, 2007; *Takhtamanova*, 2008; *Mishkin*, 2008; *Kee, Nicita, and Olarrega*, 2008; and *Imbs and Mejean*, 2009).

Exporters may also be reluctant to increase prices by the full amount of the dollar depreciation if they are not convinced that the depreciation of the dollar will persist and not be reversed in the near future. Since it is very costly to plan and build or dismantle production facilities and enter or leave new markets, they do not want to risk losing their market by a large increase in the price of their exports. This has been referred to as the *beachhead effect*. This effect was clearly evident during the sharp depreciation of the dollar from 1985 to 1988 when Japanese automakers avoided increasing the dollar price of their automobile exports to the United States for as long as possible in order to hold on to their share of the U.S. market and then reluctantly increased prices only by a small amount. In the process, their profit margins fell sharply, and they even incurred losses—prompting accusations of dumping on the part of the American competitors. At the same time, U.S. automakers chose to increase prices in order to rebuild their profit margins instead of holding the line on prices and recapturing market share from the Japanese (refer to Case Study 9-2).

## 16.6 Adjustment under the Gold Standard

In this last section of Chapter 16, we examine the operation of the international monetary system known as the gold standard. The gold standard also relies on an automatic *price* mechanism for adjustment but of a different type from the one operating under a flexible exchange rate system.

### 16.6A The Gold Standard

The gold standard operated from about 1880 to the outbreak of World War I in 1914. An attempt was made to reestablish the gold standard after the war, but it failed in 1931 during the Great Depression. It is highly unlikely that the gold standard will be reestablished in the near future—if ever. Nevertheless, it is very important to understand the advantages and disadvantages inherent in the operation of the gold standard, not only for its own sake, but also because they were (to some extent) also true for the fixed exchange rate system (the Bretton Woods system, or gold-exchange standard) that operated from the end of World War II until it collapsed in 1971.

Under the gold standard, each nation defines the gold content of its currency and passively stands ready to buy or sell any amount of gold at that price. Since the gold content in one unit of each currency is fixed, exchange rates are also fixed. For example, under the gold standard, a £1 gold coin in the United Kingdom contained 113.0016 grains of pure gold, while a \$1 gold coin in the United States contained 23.22 grains. This implied that the dollar price of the pound, or the exchange rate, was $R = \$/£ = 113.0016/23.22 = 4.87$. This is called the mint parity. (Since the center of the gold standard was London, not Frankfurt, our discussion is in terms of pounds sterling and dollars, instead of euros and dollars.)

Since the cost of shipping £1 worth of gold between New York and London was about 3 cents, the exchange rate between the dollar and the pound could never fluctuate by more than 3 cents above or below the mint parity (i.e., the exchange rate could not rise above

4.90 or fall below 4.84). The reason is that no one would pay more than \$4.90 for £1, since he could always purchase \$4.87 worth of gold at the U.S. Treasury (the Federal Reserve Bank of New York was only established in 1913), ship it to London at a cost of 3 cents, and exchange it for £1 at the Bank of England (the U.K. central bank). Thus, the U.S. supply curve of pounds became infinitely elastic (horizontal) at the exchange rate of $R =$ \$4.90/£1. This was the gold export point of the United States.

On the other hand, the exchange rate between the dollar and the pound could not fall below \$4.84. The reason for this is that no one would accept less than \$4.84 for each pound he wanted to convert into dollars because he could always purchase £1 worth of gold in London, ship it to New York at a cost of 3 cents, and exchange it for \$4.87 (thus receiving \$4.84 net). As a result, the U.S. demand curve of pounds became infinitely elastic (horizontal) at the exchange rate of $R =$ \$4.84/£1. This was the gold import point of the United States.

The exchange rate between the dollar and the pound was determined at the intersection of the U.S. demand and supply curves of pounds between the gold points and was prevented from moving outside the gold points by U.S. gold sales or purchases. That is, the tendency of the dollar to depreciate, or the exchange rate to rise above $R =$ \$4.90/£1, was countered by gold shipments from the United States. These gold outflows measured the size of the U.S. balance-of-payments deficit. On the other hand, the tendency of the dollar to appreciate, or the exchange rate to fall below $R =$ \$4.84/£1, was countered by gold shipments to the United States. These gold inflows measured the size of the surplus in the U.S. balance of payments. (For the interested reader, this process is shown graphically in Section A16.4 in the appendix.)

Since deficits are settled in gold under this system and nations have limited gold reserves, deficits cannot go on forever but must soon be corrected. We now turn to the adjustment mechanism that automatically corrects deficits and surpluses in the balance of payments under the gold standard.

## 16.6B The Price-Specie-Flow Mechanism

The automatic adjustment mechanism under the gold standard is the price-specie-flow mechanism. This operates as follows to correct balance-of-payments disequilibria. Since each nation's money supply under the gold standard consisted of either gold itself or paper currency backed by gold, the money supply would fall in the deficit nation and rise in the surplus nation. This caused internal prices to fall in the deficit nation and rise in the surplus nation. As a result, the exports of the deficit nation would be encouraged and its imports would be discouraged until the deficit in its balance of payments was eliminated.

The reduction of internal prices in the deficit nation as a result of the gold loss and reduction of its money supply was based on the quantity theory of money. This can be explained by using Equation (16-1),

$$MV = PQ \tag{16-1}$$

where $M$ is the nation's money supply, $V$ is the velocity of circulation of money (the number of times each unit of the domestic currency turns over on the average during one year),

$P$ is the general price index, and $Q$ is physical output. Classical economists believed that $V$ depended on institutional factors and was constant. They also believed that, apart from temporary disturbances, there was built into the economy an automatic tendency toward full employment without inflation (based on their assumption of perfect and instantaneous flexibility of all prices, wages, and interests). For example, any tendency toward unemployment in the economy would be automatically corrected by wages falling sufficiently to ensure full employment. Thus, $Q$ was assumed to be fixed at the full-employment level. With $V$ and $Q$ constant, a change in $M$ led to a direct and proportional change in $P$ (see Equation (16-1)).

Thus, as the deficit nation lost gold, its money supply would fall and cause internal prices to fall proportionately. For example, a deficit in the nation's balance of payments and gold loss that reduced $M$ by 10 percent would also reduce $P$ by 10 percent in the nation. This would encourage the exports of the deficit nation and discourage its imports. The opposite would take place in the surplus nation. That is, the increase in the surplus nation's money supply (due to the inflow of gold) would cause its internal prices to rise. This would discourage the nation's exports and encourage its imports. The process would continue until the deficit and surplus were eliminated.

Note that the adjustment process is automatic; it is triggered as soon as the balance-of-payments disequilibrium arises and continues to operate until the disequilibrium is entirely eliminated. Note also that the adjustment relies on a change in internal prices in the deficit and surplus nations. Thus, while adjustment under a flexible exchange rate system relies on changing the external value of the national currency, adjustment under the gold standard relies on changing internal prices in each nation. Adjustment under the gold standard also relies on high price elasticities of exports and imports in the deficit and surplus nations, so that the volumes of exports and imports respond readily and significantly to price changes.

*David Hume* introduced the price-specie-flow mechanism in 1752 and used it to demonstrate the futility of the mercantilists' belief that a nation could continuously accumulate gold by exporting more than it imported (refer to Section 2.2). Hume pointed out that as a nation accumulated gold, domestic prices would rise until the nation's export surplus (which led to the accumulation of gold in the first place) was eliminated. The example Hume used to make this point is unsurpassed: That is, it is futile to attempt to raise the water level (the amount of gold) above its natural level in some compartment (nation) as long as the compartments are connected with one another (i.e., as long as nations are connected through international trade).

Passively allowing the nation's money supply to change for balance-of-payments considerations meant that nations could not use monetary policy for achieving full employment without inflation. Yet, this created no difficulties for classical economists, since (as pointed out earlier) they believed that there was an automatic tendency in the economic system toward full employment without inflation. Note, however, that for the adjustment process to operate, nations were not supposed to *sterilize* (i.e., neutralize) the effect on their money supply of a deficit or surplus in their balance of payments. On the contrary, the rules of the game of the gold standard required a deficit nation to reinforce the adjustment process by further restricting credit and a surplus nation to expand credit further. (The actual experience under the gold standard is discussed in Chapter 21.)

## SUMMARY

1. In this chapter, we examined the traditional trade or elasticity approach to exchange rate determination. This assumes that there are no autonomous international private financial flows (i.e., international private capital flows take place only as passive responses to cover or pay for temporary trade imbalances) and shows how a current account (and balance-of-payments) deficit can be corrected automatically by a depreciation of the nation's currency under flexible exchange rates or by (the policy of) devaluing the nation's currency with fixed exchange rates. The opposite would be the case for a current account (and balance-of-payments) surplus.

2. A nation can usually correct a deficit in its balance of payments by devaluing its currency or allowing it to depreciate. The more elastic are the demand and supply curves of foreign exchange, the smaller is the devaluation or depreciation required to correct a deficit of a given size. The nation's demand for foreign exchange is derived from the demand for and supply of its imports in terms of the foreign currency. The more elastic is the latter, the more elastic is the former.

3. A devaluation or depreciation of a nation's currency increases the domestic currency prices of the nation's exports and import substitutes and is inflationary.

4. The foreign exchange market is stable if the supply curve of foreign exchange is positively sloped or, if negatively sloped, is steeper (less elastic) than the demand curve of foreign exchange. According to the Marshall–Lerner condition, the foreign exchange market is stable if the (absolute value of the) sum of the price elasticities of the demands for imports and exports exceeds 1. This holds when the supply elasticities of imports and exports are infinite. If the sum of the two demand elasticities equals 1, a change in the exchange rate will leave the nation's balance of payments unchanged. If, on the other hand, the sum of the two demand elasticities is less than 1, the foreign exchange market is unstable, and a depreciation will increase rather than reduce the nation's deficit.

5. Empirical estimates of elasticities in international trade conducted during the 1940s found that foreign exchange markets were either unstable or barely stable and led to the so-called elasticity pessimism. However, these econometric studies seriously underestimated true elasticities, especially because of the problem of identifying shifts in demand and because they estimated short-run rather than long-run elasticities. More recent empirical studies have shown that foreign exchange markets are generally stable and that demand and supply curves of foreign exchange may be fairly elastic in the long run. Current account disequilibria seem to respond only with a long lag and not sufficiently to exchange rate changes. A devaluation or depreciation may result in a deterioration in the nation's trade balance before an improvement takes place (the J-curve effect). There is usually only a partial pass-through of a depreciation in a nation's currency to the price of its imports.

6. Under the gold standard, each nation defines the gold content of its currency and passively stands ready to buy or sell any amount of gold at that price. This results in a fixed exchange rate called the mint parity. The exchange rate is determined at the intersection of the nation's demand and supply curves of the foreign currency between the gold points and is prevented from moving outside the gold points by the nation's sales or purchases of gold. The adjustment mechanism under the gold standard is the price-specie-flow mechanism. The loss of gold by the deficit nation reduces its money supply. This causes domestic prices to fall, thus stimulating the nation's exports and discouraging its imports until the deficit is eliminated. The opposite process corrects a surplus.

## A LOOK AHEAD

In Chapter 17, we examine in detail the automatic income adjustment mechanism. This relies on induced changes in the national income of the deficit and surplus nations to bring about adjustment. The examination of the income adjustment mechanism requires a review of the concept of the equilibrium level of national income and the multiplier. Since the automatic price, income, and monetary adjustment mechanisms operate side-by-side in the real world, the last two sections of Chapter 17 present a synthesis of their operation. Chapters 18 and 19 will then deal with adjustment policies or open-economy macroeconomics.

## KEY TERMS

Devaluation, p. 508
Dutch disease, p. 514
Elasticity pessimism, p. 517
Gold export point, p. 527
Gold import point, p. 527
Gold standard, p. 526
Identification problem, p. 517
J-curve effect, p. 519
Marshall–Lerner condition, p. 516
Mint parity, p. 526
Pass-through, p. 524
Price-specie-flow mechanism, p. 527
Quantity theory of money, p. 527
Rules of the game of the gold standard, p. 528
Stable foreign exchange market, p. 514
Trade or elasticity approach, p. 507
Unstable foreign exchange market, p. 514

## QUESTIONS FOR REVIEW

**1.** How does a depreciation or devaluation of a nation's currency operate to eliminate or reduce a deficit in its current account or balance of payments?

**2.** Why is a depreciation or devaluation of the nation's currency not feasible to eliminate a deficit if the nation's demand and supply curves of foreign exchange are inelastic?

**3.** How is the nation's demand curve for foreign exchange derived? What determines its elasticity?

**4.** How is the nation's supply curve of foreign exchange derived? What determines its elasticity?

**5.** Why is a devaluation or depreciation inflationary?

**6.** What shape of the demand and supply curves of foreign exchange will make the foreign exchange market stable? unstable?

**7.** What is the Marshall–Lerner condition for a stable foreign exchange market? for an unstable market? for a depreciation to leave the nation's balance of payments unchanged?

**8.** Why will a depreciation of the deficit nation's currency increase rather than reduce the balance-of-payments deficit when the foreign exchange market is unstable?

**9.** What is meant by elasticity pessimism? How did it arise?

**10.** What is the J-curve effect?

**11.** Why may elasticity pessimism be unjustified? What is the prevailing view today as to the stability of foreign exchange markets and the elasticity of the demand and supply curves of foreign exchange?

**12.** What is meant by a currency pass-through? What is its relevance for international competitiveness?

**13.** How are exchange rates determined under the gold standard?

**14.** How are trade deficits and trade surpluses automatically eliminated under the gold standard?

## PROBLEMS

***1.** From the negatively sloped demand curve and the positively sloped supply curve of a nation's tradeable commodity (i.e., a commodity that is produced at home but is also imported or exported), derive the nation's demand curve of imports of the tradeable commodity for below-equilibrium prices. (*Hint*: See Figure 4.1.)

*2. For the same given as in Problem 1, derive the supply curve of exports of the tradeable commodity for above-equilibrium prices.

3. Draw a figure similar to the left-hand panel of Figure 16.2, but with $D_M$ vertical. Explain why $D_€$ would also be vertical.

4. Draw a figure similar to the right-hand panel of Figure 16.2, but with $S_X$ vertical. Explain why $S_€$ would also be vertical.

5. Draw a figure similar to the left-hand panel of Figure 16.2 but with $D_M$ steeper (less elastic) than in Figure 16.2 and explain why $D_€$ would be steeper (less elastic) than in Figure 16.1.

6. Draw a figure similar to the right-hand panel of Figure 16.2 but with $S_X$ steeper (less elastic) than in Figure 16.2 and explain why $S_€$ would be steeper (less elastic) than in Figure 16.1 if $D_X$ is price elastic in the relevant range.

*7. Explain why $S_M$ and $D_X$ are horizontal for a small nation.

8. Explain why the balance of payments of a small nation always improves with a devaluation or depreciation of its currency.

9. Draw a figure similar to Figure 16.2 but referring to an unstable foreign exchange market.

10. In what way can the United States be said to have a trade problem with Japan?

11. Since the U.S. trade deficit with Japan has not been reduced as a result of the sharp depreciation of the dollar with respect to the yen during the 1990s, can we conclude that the trade or elasticity approach to balance-of-payments adjustment does not work? Explain.

12. Suppose that under the gold standard the price of 1 ounce of gold is set at \$35 by U.S. monetary authorities and at £14 by the U.K. monetary authorities. What is the relationship between the dollar and the pound? What is this called?

13. If to ship any amount of gold between New York and London costs 1 percent of the value of the gold shipped, define the U.S. gold export point or upper limit in the exchange rate between the dollar and the pound ($R$ = \$/£). Why is this so?

14. Define the U.S. gold import point or the lower limit in the exchange rate ($R$ = \$/£). Why is this so?

*= Answer provided at www.wiley.com/college/salvatore.

# APPENDIX

In this appendix, Section A16.1 shows graphically the effect of a change in the exchange rate on the domestic-currency price of traded commodities. Section A16.2 presents the formal mathematical derivation of the Marshall–Lerner condition for stability in foreign exchange markets. Finally, Section A16.3 shows graphically how the gold points and international gold flows are determined under the gold standard.

## A16.1 The Effect of Exchange Rate Changes on Domestic Prices

We said in Section 16.3 that a depreciation or devaluation of the dollar stimulates the production of import substitutes and exports in the United States and leads to a rise in dollar prices in the United States. This can be shown with Figure 16.7.

In the left panel of Figure 16.7, $S'_M$ is the EMU supply curve of imports to the United States expressed in dollars when the exchange rate is $R$ = \$1/€1, and $D'_M$ is the U.S. demand curve for imports in dollars. With $D'_M$ and $S'_M$, equilibrium is at point $B'$, with $P_M$ = \$1 and $Q_M$ = 12 billion units per year. When the dollar is devalued or allowed to

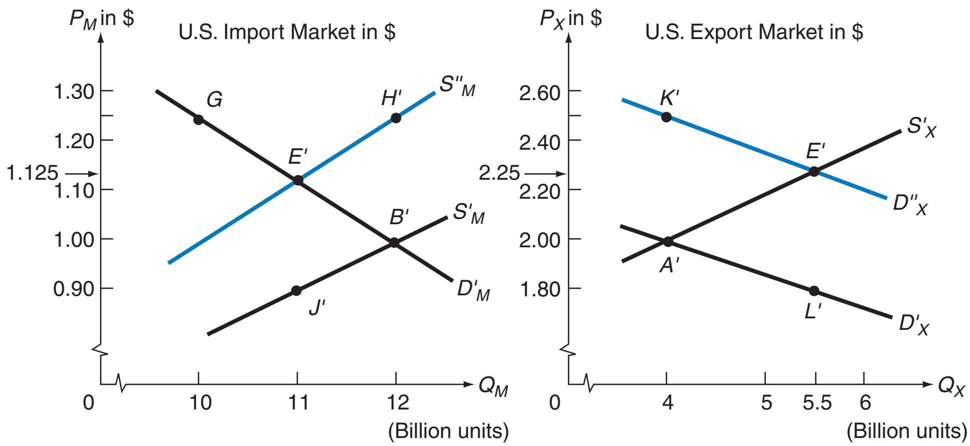


**FIGURE 16.7. Effect of a Depreciation or Devaluation on Domestic Prices.**
In the left panel, $D'_M$ is the U.S. demand curve of imports in terms of dollars, and $S'_M$ is the EMU supply curve of imports to the United States at $R = \$1/€1$. With $D'_M$ and $S'_M$, $P_M = \$1$ and $Q_M = 12$ billion units per year. When the dollar depreciates or is devalued by 20 percent, $S'_M$ shifts up to $S''_M$, but $D_M$ remains unchanged. With $D'_M$ and $S''_M$, $P_M = \$1.125$ and $Q_M = 11$ billion units.

In the right panel, $D'_X$ is the EMU demand curve of U.S. exports at $R = \$1/€1$, and $S'_X$ is the U.S. supply curve of exports to the EMU, both in terms of dollars. With $D'_X$ and $S'_X$, $P_X = \$2$ and $Q_X = 4$ billion units per year. When the dollar depreciates or is devalued by 20 percent to $R = \$1.20/€1$, $D'_X$ shifts up to $D''_X$, but $S'_X$ remains unchanged. With $D'_X$ and $S'_X$, $P_X = \$2.25$ and $Q_X = 5.5$ billion units. Thus, a depreciation or devaluation increases dollar prices in the United States.

depreciate by 20 percent to $R = \$1.20/€1$, the EMU supply curve of imports to the United States in terms of dollars falls (i.e., shifts up) by 20 percent to $S''_M$ because each dollar that EMU exporters earn in the United States is now worth 20 percent less in terms of euros. This is like a 20 percent-per-unit tax on EMU exporters. Note that $S''_M$ is not parallel to $S'_M$ because the shift is of a constant percentage, and observe that $S''_M$ is used as the base to calculate the 20 percent upward shift from $S'_M$. Also, $D'_M$ does not change as a result of the depreciation or devaluation of the dollar. With $D'_M$ and $S''_M$, $P_M = \$1.125$ and $Q_M = 11$ billion (point $E$). Thus, the dollar price of U.S. imports rises from \$1.00 to \$1.125, or by 12.5 percent, as a result of the 20 percent depreciation or devaluation of the dollar.

In the right panel of Figure 16.8, $D'_X$ is the EMU demand curve for U.S. exports expressed in dollars at $R = \$1/€1$, and $S'_X$ is the U.S. supply curve of exports in terms of dollars. With $D'_X$ and $S'_X$, equilibrium is at point $A'$, with $P_X = \$2.00$ and $Q_X = 4$ billion units. When the dollar is devalued or allowed to depreciate by 20 percent to $R = \$1.20/€1$, the EMU demand curve for U.S. exports in terms of dollars rises (shifts up) by 20 percent to $D'_X$ because each euro is now worth 20 percent more in terms of dollars. This is like a 20 percent-per-unit subsidy to EMU buyers of U.S. exports. Note that $D''_X$ is not parallel to $D'_X$ because the shift is of a constant percentage, and observe that $D''_X$ is used as the base to calculate the 20 percent upward shift from $D'_X$. Also, $S'_X$ does not change as a result of the depreciation or devaluation of the dollar. With $D''_X$ and $S'_X$, $P_X = \$2.25$ and

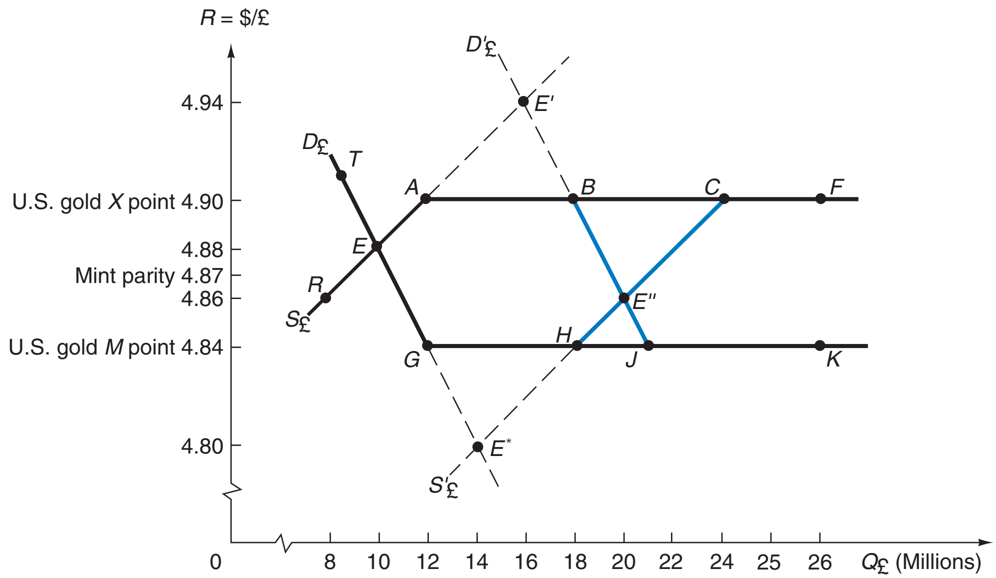


**FIGURE 16.8. Gold Points and Gold Flows.**
With $D_£$ and $S_£$, the equilibrium exchange rate is $R = \$4.88/£1$ (point $E$) without any international gold flow, and the U.S. balance of payments is in equilibrium. With $D'_£$ and $S_£$, the exchange rate would be $R = \$4.94$ under a freely flexible exchange rate system, but would be prevented under the gold standard from rising above $R = \$4.90$ (the U.S. gold export point) by U.S. exports of £6 million ($AB$) of its gold. This represents the U.S. balance-of-payments deficit under the gold standard. With $D_£$ and $S'_£$, the exchange rate would be $R = \$4.80$ under a freely flexible exchange rate system but would be prevented under the gold standard from falling below $R = \$4.84/£1$ (the U.S. gold import point) by U.S. gold imports of £6 million ($HG$). This represents the U.S. balance-of-payments surplus under the gold standard.

$Q_X = 5.5$ billion units (point $E'$). Thus, the dollar price of U.S. exports rises from \$2.00 to \$2.25, or by 12.5 percent, as a result of the 20 percent depreciation or devaluation of the dollar.

The rise in the dollar price of import substitutes and exports is necessary to induce U.S. producers to shift production from nontraded to traded goods, but it also reduces the price advantage the United States gained from the depreciation or devaluation. Since the prices of import substitutes and exportable commodities are part of the U.S. general price index, and they both rise, the depreciation or devaluation of the dollar is inflationary for the United States. As a result, the greater the devaluation or depreciation required to correct a deficit of a given size, the less feasible is depreciation or devaluation as a method of correcting the deficit. The elasticity of the demand for and supply of the nation's imports and exports is simply a short-cut indication of the ease or difficulty of shifting domestic resources from nontraded to traded commodities as a result of a devaluation or depreciation of the nation's currency, and of how inflationary the shift will be.

***Problem*** From Figure 16.7, calculate the U.S. terms of trade before and after the 20 percent depreciation or devaluation of the dollar. How do your results compare with those obtained in Section 16.3?

## A16.2 Derivation of the Marshall–Lerner Condition

We now derive mathematically the Marshall–Lerner condition that the sum of the elasticities of the demand for imports and the demand for exports must exceed 1 for the foreign exchange market to be stable. This condition holds when the *supply* curves of imports and exports are infinitely elastic, or horizontal.

To derive the Marshall–Lerner condition mathematically, let:

$P_X$ and $P_M$ = foreign currency price of exports and imports, respectively
$Q_X$ and $Q_M$ = the quality of exports and imports, respectively
$V_X$ and $V_M$ = the foreign currency value of exports and imports, respectively

Then the trade balance *(B)* is

$$B = V_X - V_M = Q_X \cdot P_X - P_M \cdot Q_M \tag{16A-1}$$

For a small devaluation, the change in the trade balance ($dB$) is

$$dB = P_X \cdot dQ_X + Q_X \cdot dP_X - (P_M \cdot dQ_M + Q_M \cdot dP_M) \tag{16A-2}$$

This was obtained by the product rule of differentials ($duv = v{\cdot}du + u{\cdot}dv$). Since $S_M$ is horizontal, $P_M$ does not change (i.e., $dP_M = 0$) with a depreciation or devaluation of the dollar, so that the last term in Equation (16A-2) drops out. By then rearranging the first and third terms, we get

$$dB = dQ_X \cdot P_X + Q_X \cdot dP_x - dQ_M \cdot P_M \tag{16A-3}$$

We now define Equation (16A-3) in terms of price elasticities. The price elasticity of the demand for exports ($n_X$) measures the percentage change in $Q_X$ for a given percentage change in $P_X$. That is,

$$n_X = -\frac{dQ_X}{Q_X} \div \frac{dP_X}{P_X} = \frac{dQ_X}{Q_X} \div k\left(\frac{P_X}{P_X}\right) = \frac{dQ_X \cdot P_X}{Q_X \cdot k \cdot P_X} \tag{16A-4}$$

where $k = -dP_X/P_X$ (the percentage of depreciation or devaluation of the dollar).

Similarly, the coefficient of price elasticity of the demand for imports ($n_M$) is

$$n_M = -\frac{dQ_M}{Q_M} - \frac{dP_M}{P_M} = \frac{dQ_M \cdot P_M}{Q_M \cdot k \cdot P_M} \tag{16A-5}$$

From Equation (16A-4), we get

$$dQ_X \cdot P_X = n_X \cdot Q_X \cdot P_X \cdot k \tag{16A-6}$$

This is the first term in Equation (16A-3). We can also rewrite the second term in Equation (16A-3) as

$$Q_X \cdot dP_X = Q_X(dP_X/P_X)P_X = Q_X(-k)P_X = -Q_X \cdot k \cdot P_X \tag{16A-7}$$

Finally, from Equation (16A-5), we get

$$dQ_M \cdot P_M = -n_M \cdot Q_M \cdot dP_M = -n_M \cdot Q_M \cdot P_M \cdot k \tag{16A-8}$$

where $k = dP_M/P_M$. While $dP_M = 0$ in terms of the foreign currency, it is positive in terms of the domestic currency. Equation (16A-8) is the third term in Equation (16A-3).

Substituting Equations (16A-6), (16A-7), and (16A-8) into Equation (16A-3), we get

$$dB = n_X \cdot Q_X \cdot P_X \cdot k - Q_X \cdot P_X \cdot k - (-n_M \cdot Q_M \cdot P_M \cdot k) \tag{16A-9}$$

Simplifying algebraically, we get

$$dB = k[Q_X \cdot P_X(n_X - 1) + n_M \cdot Q_M \cdot P_M] \tag{16A-10}$$

If to begin with

$$B = Q_X \cdot P_X - Q_M \cdot P_M = 0 \tag{16A-11}$$

then

$$dB = k[Q_X \cdot P_X(n_X + n_M - 1)] \tag{16A-12}$$

and $dB > 0$ if

$$n_X + n_M - 1 > 0 \text{ or } n_X + n_M > 1 \tag{16A-13}$$

where both $n_X$ and $n_M$ are positive.

If the devaluation or depreciation takes place from the condition of $V_M > V_X$, $n_M$ should be given a proportionately greater weight than $n_X$, and the Marshall–Lerner condition for a stable foreign exchange market becomes more easily satisfied and is given by

$$n_X + (V_M/V_X)n_M > 1 \tag{16A-14}$$

If the price elasticities of the foreign supply of the United States imports $(e_M)$ and the United States supply of exports $(e_X)$ are not infinite, then the smaller are $e_M$ and $e_X$, the more likely it is that the foreign exchange market is stable even if

$$n_X + n_M < 1 \tag{16A-15}$$

The Marshall–Lerner condition for stability of the foreign exchange market when $e_M$ and $e_X$ are not infinite is given by

$$\frac{e_X(n_X - 1)}{e_X + n_X} + \frac{n_M(e_M + 1)}{e_M + n_M} \tag{16A-16}$$

or combining the two components of the expression over a common denominator:

$$\frac{e_M e_X(n_M + n_X - 1) + n_M \cdot n_X(e_M + e_X + 1)}{(e_x + n_X)(e_M + n_M)} \tag{16A-17}$$

The foreign exchange market is stable, unstable, or remains unchanged as a result of a depreciation or devaluation to the extent that Equation (16A-16) or (16A-17) is larger than, smaller than, or equal to 0, respectively. The mathematical derivation of Equation (16A-16) is given in *Stern* (1973).

The condition for a deterioration in the terms of trade of the devaluing nation is also derived in Stern and is given by

$$e_X \cdot e_M > n_X \cdot n_M \tag{16A-18}$$

If the direction of the inequality sign in Equation (16A-18) is the reverse, the devaluing country's terms of trade improve, and if the two sides are equal, the terms of trade remain unchanged.

***Problem*** Explain why a depreciation or devaluation of a small country's national currency is not likely to affect its terms of trade. (*Hint*: Refer to the statement of Problem 9.)

## A16.3 Derivation of the Gold Points and Gold Flows under the Gold Standard

Figure 16.8 shows graphically how the gold points and international gold flows are determined under the gold standard. In the figure, the mint parity is \$4.87 = £1 (as defined in Section 16.6A). The U.S. supply curve of pounds ($S_£$) is given by *REABCF* and becomes infinitely elastic, or horizontal, at the U.S. gold export point of \$4.90 = £1 (the mint parity plus the 3 cents cost to ship £1 worth of gold from New York to London). The U.S. demand curve of pounds ($D_£$) is given by *TEGHJK* and becomes infinitely elastic, or horizontal, at the U.S. gold import point of \$4.84 = £1 (the mint parity minus the 3 cents cost to ship £1 worth of gold from London to New York). Since $S_£$ and $D_£$ intersect at point E within the gold points, the equilibrium exchange rate is $R$ = \$4.88/£1 without any international gold flow (i.e., the U.S. balance of payments is in equilibrium).

If subsequently the U.S. demand for pounds increases (shifts up) to $D'_£$, there is a tendency for the exchange rate to rise to $R$ = \$4.94/£1 (point $E'$ in the figure). However, because no one would pay more than \$4.90 for each pound under the gold standard (i.e., the U.S. supply curve of pounds becomes horizontal at $R$ = \$4.90/£1), the exchange rate only rises to $R$ = \$4.90/£1, and the United States will be at point $B$. At point $B$, the U.S. quantity demanded of pounds is £18 million, of which £12 million (point $A$) are supplied from U.S. exports of goods and services to the United Kingdom and the remaining £6 million ($AB$) are supplied by U.S. gold exports to the United Kingdom (and represent the U.S. balance-of-payments deficit).

If, on the other hand, the U.S. demand curve of pounds does not shift but continues to be given by $D_£$, while the U.S. supply of pounds increases (shifts to the right) to $S'_£$, equilibrium would be at point $E^*$ (at the exchange rate of $R$ = \$4.80/£1) under a flexible exchange rate system. However, since no one would accept less than \$4.84/£1 under the gold standard (i.e., the U.S. demand curve of pounds becomes horizontal at $R$ = \$4.84/£1), the exchange rate falls only to $R$ = \$4.84/£1, and the United States will be at point $H$. At point $H$, the U.S. quantity supplied of pounds is £18 million, but the U.S. quantity demanded of pounds is only £12 million (point $G$). The excess of £6 million *(HG)* supplied to the United States takes the form of gold imports from the United Kingdom and represents the U.S. balance-of-payments surplus.

The operation of the price-specie-flow mechanism under the gold standard would then cause $D_£$ and $S_£$ to shift so as to intersect once again within the gold points, thus automatically correcting the balance-of-payments disequilibrium of both nations.

***Problem*** Determine from Figure 16.8 the exchange rate and the size of the deficit or surplus in the U.S. balance of payments under the gold standard and under a flexible exchange rate system if $D_£$ shifts to $D'_£$, and $S_£$ shifts to $S'_£$ at the same time.

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## INTERNet

Data on exchange rates (daily, monthly, and trade-weighted average from 1971 or 1973) for the United States and the world's most important currencies, as well as data on current account balances, that can be used to find the effect of exchange rate changes on the trade and current account balances of the United States and other nations are found on the Federal Reserve Bank of St. Louis web site at:

http://research.stlouisfed.org/fred2

Some recent studies on the effect of international trade and finance on the U.S. economy are found on the web site of the Institute for International Economics and the Council of Foreign Relations at:

http://www.iie.com

http://www.cfr.org

Data to examine the effect of changes in the trade and current account balances on the economy of the United States are found on the Bureau of Economic Analysis and the Federal Reserve Bank of St. Louis websites, respectively, at:

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http://ecb.int/home/html/index.en.html

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Data for measuring the effect of exchange rate changes on trade and current account balances and inflation in Latin American and Asian countries are found on the web sites of the Inter-American Development Bank and the Asian Development Bank, respectively, at:

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