

Microeconomics

Topic 10: “Explain why exchange rates indicate the price of international currencies and how exchange rates are determined by supply and demand for currencies in international markets.”

Reference: Gregory Mankiw’s *Principles of Macroeconomics*, 2nd edition, Chapter 17 (p. 380-88, 394-96). Note: This is Mankiw’s macro textbook, not the micro textbook referenced in the other topics.

Foreign Exchange Markets and Exchange Rates

When Americans buy goods or services produced in foreign countries, they normally must first buy the currencies used in those foreign countries. For example, when an importing firm in New York buys European beer, payment to the European brewery must be made in euros, not dollars. Similarly, if a European resident wants to vacation in Florida or buy goods from the U.S., he or she must buy dollars. A market for currencies, known as the foreign exchange market, thus arises alongside the world market for goods and services. However, it is not only trade in goods and services that generates trade in foreign exchange. World capital markets also result in foreign exchange transactions. For example, if an American resident wishes to buy stocks, bonds, real estate, or other assets in Europe, he or she must first buy euros.

The price at which a currency exchanges for another currency in the foreign exchange market is referred to as an exchange rate. An exchange rate is a *relative price* of one currency in terms of another. For example, in May 2002, the price of a European euro in U.S. currency was about \$0.92. But if the exchange rate of the euro was \$0.92, this also meant that the exchange rate of the dollar in terms of euros was about 1.09 euros ($1/0.92 = 1.09$). The dollar price of the euro is just the reciprocal of the euro price of the dollar, and vice versa.

Supply and Demand for Currencies

In order to understand the following model of exchange rates, you first need to understand the basic model of supply and demand. For more information, refer to the notes for Micro Topic 3.

Assume that the world consists of two countries, the U.S. and Europe. Individuals in these two countries trade with one another in goods and services, as well as in financial assets. Consequently, a market for foreign exchange arises, which can be characterized in two ways -- as a demand and supply of dollars, or as a demand and supply of euros. Because the price of dollars in terms of euros is just the inverse of the price of euros in terms of dollars, these two ways of characterizing the foreign exchange market are really equivalent. It doesn't matter whether we draw supply and demand curves for dollars or supply and demand curves for euros, as long as we remember how to interpret the price in each case, and remember that if the dollar price of euros rises then, by definition, the euro price of dollars falls, and vice versa.

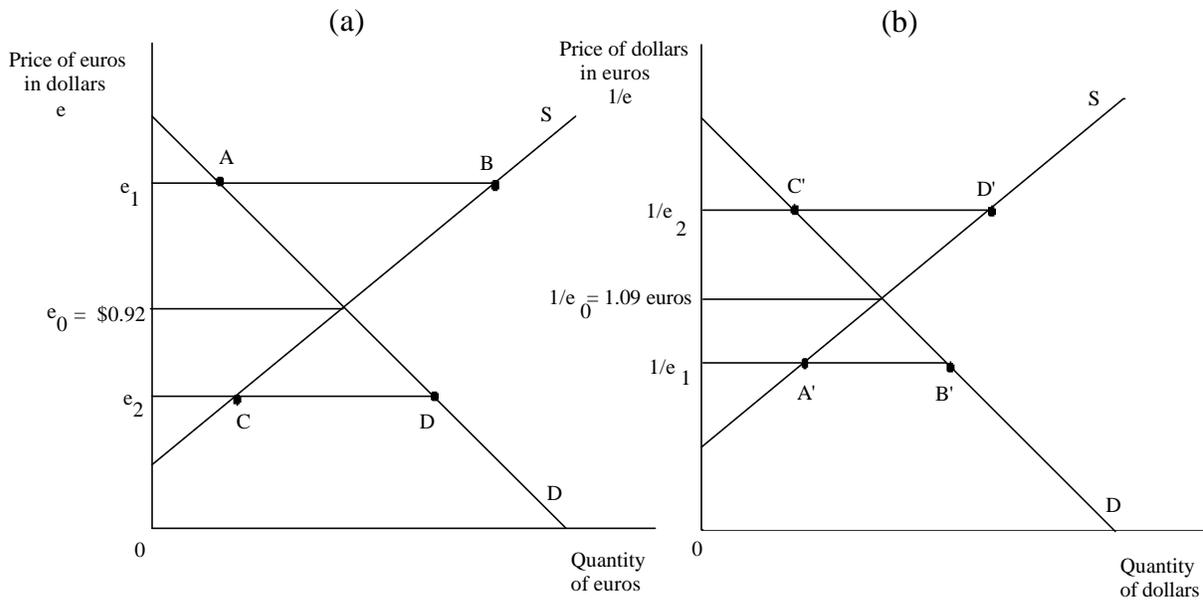


Figure 8.1

To illustrate, consider Figure 8.1. In panel (a) we illustrate the market for euros. On the vertical axis we measure the exchange rate, e , which in this case is defined as the price of euros in terms of dollars (dollars per euro, or $\$/\epsilon$). On the horizontal axis is the quantity of euros traded in the foreign exchange market. The demand for euros represents the behavior of Americans and others who wish to buy European goods and assets. The demand is downward sloping. Why? As the euro weakens against the dollar, i.e., as e falls, each dollar buys more euros, and therefore the dollar prices of European goods and assets fall. This induces Americans to buy more European goods and assets, and consequently increases the quantity of euros demanded by Americans.

The supply curve of euros in Figure 8.1 (a) represents the behavior of Europeans and others who wish to buy American goods and assets. The supply is upward sloping. Why? As the euro strengthens against the dollar, i.e., as e increases, each euro buys more dollars, so the euro prices of American goods and assets fall. This induces Europeans to buy more American goods and assets, which means they are supplying a greater quantity of euros to the foreign exchange market.

The equilibrium exchange rate in Figure 8.1 (a) is e_0 , which is \$0.92. This is the market-clearing exchange rate, where the quantity of euros demanded in the foreign exchange market is exactly equal to the quantity of euros supplied. If the actual exchange rate exceeded e_0 , for example if the exchange rate were e_1 instead, then there would be an excess supply of euros equal to AB. At a price of e_1 , more euros are offered for sale than buyers wish to purchase, and competition among sellers will drive the exchange rate down until quantity supplied once again equals quantity demanded at e_0 . If the actual exchange rate were to drop below e_0 , say to e_2 , then there would be an excess demand for euros equal to CD. At a price of e_2 , buyers wish to purchase more euros than sellers are offering for sale, and competition among buyers will drive the exchange rate back up to e_0 .

Note that, since the supply of euros arises from purchases of American goods by European residents, and since the demand for euros derives from Americans' purchases of European goods, it follows that if there is an excess supply of euros in Figure 1 (a), this means that at the prevailing exchange rate of e_1 , Europeans are buying more goods from Americans than Americans are buying from Europeans. Consequently, an excess supply of euros means that Europe has a trade deficit (European imports exceed European exports) while the U.S. has a trade surplus (U.S. exports exceed U.S. imports). Conversely, if there is an excess demand for euros in Figure 8.1 (a), this means that at the prevailing exchange rate of e_2 , Americans are buying more goods from Europeans than Europeans are buying from Americans. Therefore, at e_2 the U.S. has a trade deficit and Europe has a trade surplus.

However, excess demands and excess supplies of foreign exchange are eliminated automatically, in a regime of flexible exchange rates, by adjustments of the exchange rate toward market-clearing equilibrium. It follows that under flexible exchange rates, trade deficits and surpluses are likewise eliminated through changes in market exchange rates. For example, if there is an excess supply of euros, as at e_1 in Figure 8.1 (a), the resulting fall in the euro exchange rate to e_0 will raise the euro prices of American goods and lower the dollar prices of European goods, therefore reducing the quantity of American goods demanded by Europeans and increasing the quantity of European goods demanded by Americans, and hence eliminating both Europe's trade deficit and the U.S.'s trade surplus.

An equilibrium exchange rate of \$0.92 per euro in Figure 8.1 (a) corresponds to an equilibrium exchange rate of 1.09 euros per dollar in Figure 8.1 (b). ($1/0.92 = 1.09$.) In fact, panel (b) is a mirror image of panel (a). On the vertical axis in panel (b) we have the price of dollars in terms of euros ($\text{€}/\text{\$}$), which is the inverse of e (the price of euros in terms of dollars). On the horizontal axis of panel (b) we have the quantity of dollars traded in the foreign exchange market. As e falls in panel (a), the quantity of euros demanded increases as we have seen. But demanding euros is exactly equivalent to supplying dollars (in our two-country model), and therefore the quantity of dollars supplied increases as $1/e$ rises in panel (b). Hence, the upward sloping supply curve of dollars in panel (b) corresponds to the downward sloping demand curve for euros in panel (a). Similarly, as e rises in panel (a), the quantity of euros supplied increases, but supplying euros is exactly equivalent to demanding dollars, and therefore the quantity of dollars demanded rises as $1/e$ falls in panel (b). The downward sloping demand curve for dollars in panel (b) corresponds to the upward sloping supply curve of euros in panel (a). In panel (b), the higher is the dollar exchange rate, $1/e$, the more expensive are American goods and assets to Europeans and the cheaper are European goods and assets to Americans. Consequently, a rising value of $1/e$ implies a decreasing quantity of dollars demanded by Europeans to buy American goods and assets, and an increasing quantity of dollars supplied by Americans in exchange for euros to buy European goods and assets.

Again, in Figure 8.1 (b), if the actual exchange rate were above the market-clearing exchange rate (which is $1/e_0 = 1.09$ euros), there would be an excess supply of dollars. For example, at an exchange rate of $1/e_2$, there is an excess supply of dollars equal to

C'D'. If suppliers of dollars (demanders of euros) are offering more dollars for sale (demanding more euros) than buyers of dollars (suppliers of euros) wish to purchase (sell), then not only is there an excess supply of dollars equal to C'D' in panel (b), but there is also an exactly corresponding excess demand for euros equal to CD in panel (a). In this case, competition among suppliers of dollars (demanders of euros) will drive the dollar exchange rate back down to $1/e_0$ (or the euro exchange rate back up to e_0). At the dollar exchange rate of $1/e_2$, Americans are buying more goods from Europeans than Europeans are buying from Americans, so there is a trade deficit in the U.S. and a trade surplus in Europe. These trade imbalances are eliminated automatically as the fall in the dollar exchange rate from $1/e_2$ to $1/e_0$ reduces the quantity of European goods demanded by Americans and increases the quantity of American goods demanded by Europeans, thereby eliminating the excess supply of dollars (and the excess demand for euros).

Similarly, if the dollar exchange rate falls below $1/e_0$, say to $1/e_1$, then there will be an excess demand for dollars equal to A'B' in panel (b), which corresponds to the excess supply of euros at the euro exchange rate of e_1 , equal to AB in panel (a). Competition among buyers of dollars (or suppliers of euros) will drive the dollar exchange rate back up to $1/e_0$ (or the euro exchange rate back down to e_0). At $1/e_1$, Europeans are buying more goods from Americans than Americans are buying from Europe, so the U.S. has a trade surplus and Europe has a trade deficit. Again, however, these surpluses and deficits are eliminated automatically as the rise in the exchange rate from $1/e_1$ to $1/e_0$ reduces the quantity of American goods demanded by Europeans and increases the quantity of European goods demanded by Americans, thereby wiping out the excess demand for dollars (and the excess supply of euros).

The market-clearing equilibrium exchange rate is called the purchasing power parity (PPP) exchange rate. PPP means that a dollar, when converted into the foreign currency at the equilibrium exchange rate, will buy exactly the same basket of goods and services in the foreign country as it buys in the U.S.

Changes in Supply and Demand

In a world of flexible exchange rates, market equilibrium exchange rates will change continuously in response to changing supply and demand conditions in the foreign exchange market. Supply and demand curves for currencies shift as a result of changes in a number of parameters, the most important of which are income, price levels, and interest rates. We will examine each of these in turn.

Changes in Income

Suppose that Europe's real national income rises while that of the U.S. remains constant. An increase in European income will cause an increase in demand for imports, and therefore Europeans will offer to sell more euros in exchange for dollars at any given exchange rate. This is illustrated in Figure 8.2 as a rightward shift of the supply curve of euros. Although it is not shown, there is, of course, a corresponding supply and demand graph for dollars in which the demand for dollars increases as Europeans buy more goods

from the U.S. and consequently demand more dollars at any given exchange rate. As indicated in Figure 8.2, the net effect of the increase in European income is a depreciation of the euro and an appreciation of the dollar, i.e., the equilibrium dollar price of euros falls from e_0 to e_1 , meaning that fewer dollars are now required to buy any given number of euros, or, equivalently, more euros are needed to buy any given number of dollars.

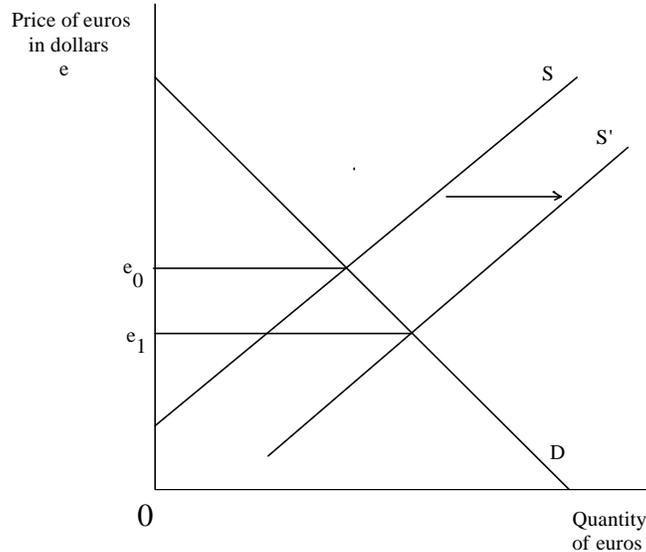


Figure 8.2

If real national income in the U.S. were to rise, while that of Europe remained unchanged, then Americans would buy more imports from Europe at any given price of imports, which means that Americans would demand more euros, or offer more dollars for sale, at any given exchange rate. This is illustrated in Figure 8.3 as an increase in the demand for euros in the foreign exchange market, causing an increase in the equilibrium dollar price of euros from e_0 to e_1 . As a result of the increase in U.S. real income, the euro has appreciated and the dollar has depreciated.

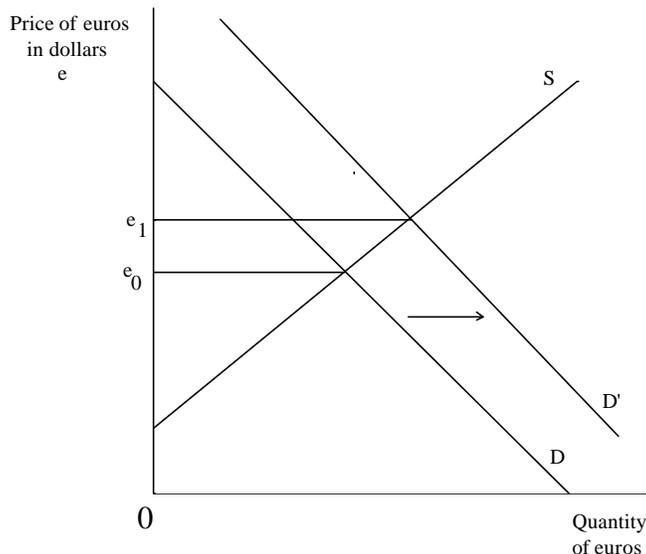


Figure 8.3

Changes in price levels

Figure 8.4 illustrates the effects of an increase in the price level in the U.S. relative to the price level in Europe, which could occur for example if the U.S. had a higher inflation rate than Europe. In this case, prices of American goods and services are rising relative to prices of European-produced goods and services. Consequently, Americans buy fewer domestically-produced goods and services and import more goods and services from Europe, which causes an increase in the demand for euros and an increase in the supply of dollars -- i.e., more dollars are offered in exchange for euros at any given exchange rate as Americans buy more goods and services from Europe. The increase in the demand for euros is illustrated in Figure 8.4 (a) as a rightward shift of the demand curve for euros, and the increase in the supply of dollars is shown in panel (b) as a rightward shift of the supply curve of dollars. But Europeans, too, will buy more of their own domestically-produced goods and services and they will import fewer goods and services from the U.S. Consequently, the demand for dollars decreases, as illustrated by the leftward shift of the demand curve for dollars in panel (b), and the supply of euros decreases, as shown by the leftward shift of the supply curve of euros in panel (a). In effect, Europeans offer to sell fewer euros (buy fewer dollars) at any given exchange rate, because they are buying fewer American goods and services.

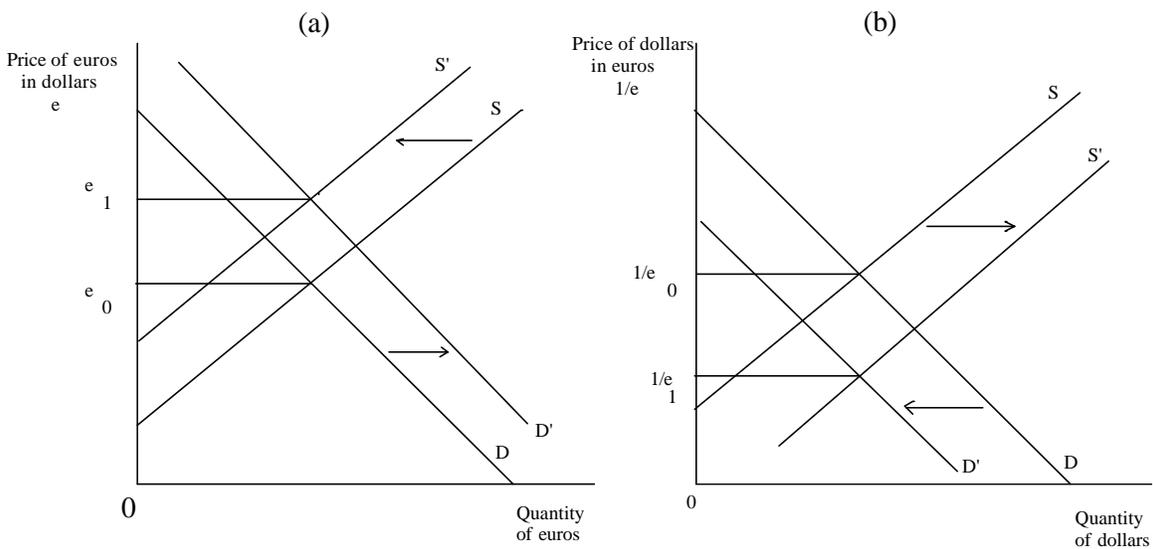


Figure 8.4

As a result of the supply and demand shifts in Figure 8.4, the euro appreciates from e_0 to e_1 and the dollar depreciates from $1/e_0$ to $1/e_1$. By how much will the euro appreciate and the dollar depreciate? As long as American tradeable goods are more expensive than European tradeable goods, U.S. imports will continue to rise and European imports to fall, so that the dollar will continue to depreciate and the euro to appreciate. A new exchange rate equilibrium will be attained once currency values have changed by enough

to exactly compensate for the divergence in price levels between the two countries, so that purchasing power parity once again prevails.

If Europe were experiencing a higher inflation rate than the U.S., then the European price level would rise relative to the U.S. price level, European imports would rise, U.S. imports would fall, the supply of euros and the demand for dollars would both increase while the demand for euros and the supply of dollars would both decrease, leading to a depreciation of the euro and an appreciation of the dollar until purchasing power parity is restored. The shifts of the supply and demand curves for euros and dollars would be just the opposite of those shown in Figure 8.4.

Changes in interest rates

Suppose that real interest rates were to rise in Europe relative to U.S. real interest rates. We can use the same picture, Figure 8.4, to see the effects of this change. With higher European interest rates, individuals in both countries would now find European bonds more attractive than U.S. bonds. Before buying European securities, however, U.S. residents would first have to buy euros, so an increased demand for European bonds by Americans translates into an increased demand for euros at any given exchange rate, as illustrated in Figure 8.4 (a). Equivalently, U.S. residents will offer to supply more dollars in exchange for euros, in order to buy more European bonds. This is shown as an increase in the supply of dollars in Figure 8.4 (b). At the same time, Europeans will now prefer to hold their own European bonds rather than U.S. bonds. Because Europeans are now less interested in buying American bonds, they are also less interested in buying dollars, or, equivalently, in selling euros. Thus there is a decrease in the supply of euros in Figure 8.4 (a) and a corresponding decrease in the demand for dollars in Figure 8.4 (b). As can be seen from Figure 8.4, the combined effect of the increased demand for euros (increased supply of dollars) and decreased supply of euros (decreased demand for dollars) is an appreciation of the euro from e_0 to e_1 and a depreciation of the dollar from $1/e_0$ to $1/e_1$.

If U.S. real interest rates were to rise relative to European real interest rates, the shifts of the supply and demand curves in the foreign exchange market would be just the opposite of those illustrated in Figure 8.4. Individuals in both countries would now find U.S. bonds more attractive than European bonds. Before buying American securities, however, European residents would first have to buy dollars, so an increased demand for U.S. bonds by Europeans translates into an increased demand for dollars at any given exchange rate. Equivalently, European residents will offer to supply more euros in exchange for dollars, in order to buy more U.S. bonds, so there will be an increase in the supply of euros. At the same time, Americans will now prefer to hold their own U.S. bonds rather than European bonds. Because Americans are now less interested in buying European bonds, they are also less interested in buying euros, or, equivalently, in selling dollars. Thus there is a decrease in the supply of dollars and a corresponding decrease in the demand for euros. The combined effect of the increased demand for dollars (increased supply of euros) and decreased supply of dollars (decreased demand for euros) is an appreciation of the dollar and a depreciation of the euro.

