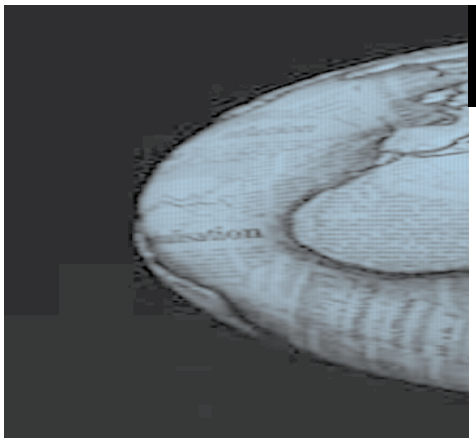

CHAPTER 18

Exchange Rate Theories

TOPICS TO BE COVERED

The Asset Approach
Sterilization
Exchange Rates and the Trade Balance
Overshooting Exchange Rates
Currency Substitution
The Role of News
Foreign Exchange Market Microstructure

KEY WORDS

Perfect capital mobility
Portfolio-balance approach
Sterilized intervention
Currency union

Prior to the monetary-approach emphasis of the 1970s, it was common to emphasize international trade flows as primary determinants of exchange rates. This was due, in part, to the fact that governments maintained tight restrictions on international flows of financial capital. The role of exchange rate changes in eliminating international trade imbalances suggests that we should expect countries with current trade surpluses to have an appreciating currency, whereas countries with trade deficits should have depreciating currencies. Such exchange rate changes would lead to changes in international relative prices that would work to eliminate the trade imbalance.

In recent years, it has become clear that the world does not work in the simple way just considered. For instance, with financial liberalization we have seen that the volume of international trade in financial assets now dwarfs trade in goods and services. Moreover, we have seen some instances where countries with trade surpluses have depreciating currencies, whereas countries with trade deficits have appreciating currencies. Economists have responded to such real-world events by devising several alternative views of exchange rate determination. These theories place a much greater emphasis on the role of the exchange rate as one of many prices in the worldwide market for financial assets. This chapter considers some of the recent advances in exchange rate theory.

THE ASSET APPROACH

Modern exchange rate models emphasize financial-asset markets. Rather than the traditional view of exchange rates adjusting to equilibrate international trade in goods, the exchange rate is viewed as adjusting to equilibrate international trade in financial assets. Because goods prices adjust slowly relative to financial asset prices and financial assets are traded continuously each business day, the shift in emphasis from goods markets to asset markets has important implications. Exchange rates will change every day or even every minute as supplies of and demands for financial assets of different nations change.

An implication of the asset approach is that exchange rates should be much more variable than goods prices. This seems to be an empirical fact. Table 18.1 lists the standard deviations of percentage changes in prices and exchange rates for two countries. In the 1990s period covered in the table, we observe that spot rates for

TABLE 18.1 *Standard Deviations of Prices and Exchange Rates*[1]

Country	Price	Exchange Rate
Canada	.003	.013
Switzerland	.003	.038

[1]The table reports the standard deviations of the percentage changes in the consumer price index and the spot exchange rate of each country's currency against the U.S. dollar for the period March 1990 to March 1999.

the countries were much more volatile than prices. Comparing the prices with the exchange rates, we find that the volatility of exchange rates averaged anywhere from 4 to 12 times the volatility of prices. Such figures are consistent with the fact that exchange rates respond to changing conditions in financial-asset markets and are not simply reacting to changes in international goods trade.

Perfect capital mobility
A situation in which there are no barriers to international capital flows.

Exchange rate models emphasizing financial-asset markets typically assume perfect capital mobility. In other words, capital flows freely between nations as there are no significant transactions costs or capital controls to serve as barriers to investment. In such a world, covered interest arbitrage will ensure covered interest rate parity:

$$\frac{i - i_f}{1 + i_f} = \frac{F - E}{E}$$

where i is the domestic interest rate and i_f is the foreign interest rate. Since this relationship will hold continuously, spot and forward exchange rates as well as interest rates adjust instantaneously to changing financial-market conditions.

Portfolio-balance approach
A theory of exchange rate determination arguing that the exchange rate is a function of relative supplies of domestic and foreign bonds.

Within the family of asset-approach models, there are two basic groups: the monetary approach and the portfolio-balance approach.* The monetary approach to the exchange rate was introduced in Chapter 17. As we stated there, in the monetary approach the exchange rate for any two currencies is determined by relative money demand and money supply between the two countries. Relative supplies of domestic and foreign bonds are unimportant. The portfolio-balance approach allows relative bond supplies and demands as well as relative money-market conditions to determine the exchange rate. Table 18.2 summarizes the differences between the two approaches.

The essential difference is that monetary-approach (MA) models assume domestic and foreign bonds to be perfect substitutes, whereas portfolio-balance (PB) models assume imperfect substitutability. If domestic and foreign bonds are perfect substitutes, then demanders are indifferent toward the currency of denomination of the bond as long as the expected return is the same. In this case, bond holders do not require a premium to hold foreign bonds—they would just as soon hold foreign bonds as domestic ones—so there is no risk premium, and uncovered interest rate parity holds in MA models.

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*Early "classics" in the monetary-approach group include Jacob Frenkel, "A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence," *Scandinavian Journal of Economics* (May 1976); Michael Mussa, "The Exchange Rate, the Balance of Payments, and Monetary and Fiscal Policy under a Regime of Controlled Floating," *Scandinavian Journal of Economics* (May 1976); and John Bilson, "The Monetary Approach to the Exchange Rate: Some Evidence," *IMF Staff Papers* (March 1978). Some early portfolio-balance classics are William Branson, Hanna Halttunen, and Paul Masson, "Exchange Rates in the Short Run: The Dollar-Deutschemark Rate," *European Economic Review* 3 (1977); Pentti Kouri and Jorge de Macedo, "Exchange Rates and the International Adjustment Process," *Brookings Papers on Economic Activity* 1 (1978); Stanley Black, "International Money Markets and Flexible Exchange Rates," *Princeton Studies in International Finance* (March 1973); and Polly Allen and Peter Kenen, *Asset Markets, Exchange Rates, and Economic Integration* (New York: Cambridge University Press, 1980).

TABLE 18.2 *The Asset Approach to the Exchange Rate*

Characteristic	Monetary Approach	Portfolio-Balance Approach
Perfect capital mobility (implies covered interest rate parity)	Yes	Yes
Domestic and foreign bonds perfect substitutes (implies uncovered interest rate parity and no foreign-exchange risk premium)	Yes	No

With imperfect substitutability, demanders have preferences for distributing their portfolio over the assets of different countries. That is, asset holders have a desired portfolio share for any particular country's assets due to the portfolio diversification incentives discussed in Chapter 16. If the supply of one country's assets increases, they will hold a greater proportion of that country's assets only if they are compensated. This requires a premium to be paid on these assets. In general, then, PB models have risk premiums in the forward exchange rate that are a function of relative asset supplies. As the supply of country *A*'s financial assets rises relative to *B*'s, there will be a higher premium paid on *A*'s assets. An implication of this premium is that uncovered interest rate parity will not hold because risk premiums will exist in the forward market. This premium is missing in the MA model because there it is assumed that investors don't care whether they hold country *A* or country *B* bonds or in what mix they are held.

We might guess that the PB approach is more relevant if we doubt the MA assumption of perfect substitutability of assets internationally. In such cases, we would view the exchange rate as being determined by relative supplies of domestic and foreign bonds as well as domestic and foreign money. We may then modify the monetary approach to the exchange rate equation found in Chapter 17 to incorporate this additional effect. The basic floating exchange rate MA equation presented in Chapter 17 is

$$-\hat{E} = \hat{P}^F + \hat{Y} - \hat{D} \tag{18.1}$$

where $\hat{E}$ is the percentage change in the exchange rate, $\hat{P}^F$ is the foreign inflation rate, $\hat{Y}$ is the percentage change in domestic income, and $\hat{D}$ is the percentage change in domestic credit. Equation 18.1 has the change in the exchange rate as a function of money supply $\hat{D}$ and money demand $\hat{P}^F + \hat{Y}$ variables. If domestic and foreign bonds are perfect substitutes, then Equation 18.1 is a useful MA description of exchange rate determination. The PB approach assumes that assets are imperfect substitutes internationally because investors perceive foreign-exchange risk to be attached to foreign-currency-denominated bonds. As the supply of domestic bonds rises relative to foreign bonds, there will be an increased risk premium on the domestic bonds that will cause the domestic currency to depreciate in the spot market. If the spot

exchange rate depreciates today, and if the expected future spot rate is unchanged, the expected rate of appreciation (depreciation) over the future increases (decreases).

For instance, if the dollar-pound spot rate is initially $E_{\$/£} = 2.00$ and the expected spot rate in one year is $E_{\$/£} = 1.90$, then the expected rate of dollar appreciation is 5 percent [(1.90 − 2.00)/2.00]. Now, suppose an increase in the outstanding stock of dollar-denominated bonds results in a depreciation of the spot rate today to $E_{\$/£} = 2.05$. The expected rate of dollar appreciation is now approximately 7.3 percent [(1.90 − 2.05)/2.05].

If the spot exchange rate is a function of relative asset supplies, then the MA equation, Equation 18.1, should be modified to include the percentage change in the supply of foreign bonds $\hat{B}^F$ relative to the percentage change in the supply of domestic bonds $\hat{B}$:

$$-\hat{E} = \hat{P}^F + \hat{Y} - \hat{D} + \hat{B}^F - \hat{B} \tag{18.2}$$

An increase in foreign-bond supplies $\hat{B}^F$ causes the domestic currency to appreciate at a faster rate ($\hat{E}$ falls) or depreciate at a slower rate. An increase in domestic-bond supplies $\hat{B}$ causes the domestic currency to depreciate at a faster rate ($\hat{E}$ increases) or appreciate at a slower rate. This broader PB view might be expected to explain exchange rate changes better than the MA equation, Equation 18.1. However, the empirical evidence is not at all clear on this matter.* One potential problem for analyzing the MA and PB models of exchange rate determination is central-bank activities aimed at insulating the domestic money supply from international events. The next section discusses the importance of this issue.

STERILIZATION

In recent years, an important topic of debate has emerged from the literature on the monetary approach regarding the ability of central banks to sterilize reserve flows. Sterilization refers to central banks offsetting international reserve flows to follow an independent monetary policy. Under the monetary approach to the balance of payments (with fixed exchange rates), if a country had an excess supply of money, this country would tend to lose international reserves or run a deficit until money supply equals money demand. If, for some reason, the central bank desires this higher money supply and reacts to the deficit by further increasing the money supply, then the deficit will increase and persist as long as the central bank tries to maintain a money supply in excess of money demand. For an excess demand for money, the process is reversed. The excess demand results in reserve inflows to equate money supply to money demand. If the central bank tries to decrease the money supply so that the excess demand still exists, its efforts will be thwarted by further

*Several researchers have shown that it is difficult to demonstrate that one model of exchange rate determination clearly dominates all others. An example is Ronald MacDonald and Mark P. Taylor, "Exchange Rate Economics: A Survey," *International Monetary Fund Staff Papers* (March 1992).

reserve inflows persisting as long as the central bank tries to maintain the policy of a money supply less than money demand. The discussion so far relates to the standard monetary-approach theory with no sterilization.

If sterilization is possible, then the monetary authorities may, in fact, be able to determine the money supply in the short run without having reserve flows offset the monetary authorities' goals. This would be possible if the forces that lead to international arbitrage are slow to operate. For instance, if there are barriers to international capital mobility, then we might expect international asset return differentials to persist after a change in economic conditions. In this case, if the central bank wants to increase the growth of the money supply in the short run, it can do so regardless of money demand and reserve flows. In the long run, when complete adjustment of asset prices is possible, the money supply must grow at a rate consistent with money demand; in the short run, the central bank can exercise some discretion.

The use of the word *sterilization* is due to the fact that the central bank must be able to neutralize, or sterilize, any reserve flows induced by monetary policy if the policy is to achieve the central bank's money-supply goals. For instance, if the central bank is following some money-supply growth path and then money demand increases, leading to reserve inflows, the central bank must be able to sterilize these reserve inflows to keep the money supply from rising to what it considers undesirable levels. This is done by decreasing domestic credit by an amount equal to the growth of international reserves, thus keeping base money and the money supply constant.

In Chapter 17 the fixed exchange rate monetary approach to the balance-of-payments equation was

$$\hat{R} = \hat{P}^F + \hat{Y} - \hat{D} \tag{18.3}$$

where $\hat{R}$ is the percentage change in international reserves. Given money demand, an increase in domestic credit would be reflected in a fall in $\hat{R}$, or lower growth of reserves. If sterilization occurs, then the causality implied in Equation 18.3 is no longer true.

Instead of the monetary-approach equation previously written, where changes in domestic credit $\hat{D}$ (on the right-hand side of the equation) lead to changes in reserves $\hat{R}$ (on the left-hand side), with sterilization we also have changes in reserves inducing changes in domestic credit to offset the reserve flows. With sterilization, the causality implied in Equation 18.3 with domestic credit causing reserve changes must be reconsidered. Sterilization means that there is also a causality flowing from reserve changes to domestic credit, as in

$$\hat{D} = \alpha - \beta \hat{R} \tag{18.4}$$

where β is the sterilization coefficient, ranging in value from 0 (when there is no sterilization) to 1 (complete sterilization). Equation 18.4 states that the percentage change in domestic credit will be equal to some constant amount α determined by the central bank's domestic-policy goals minus some number β times the percentage

change in reserves; β reflects the central bank's ability to use domestic credit to offset reserve flows. Of course, it is possible that the central bank cannot fully offset international reserve flows, yet some sterilization is possible, in which case β will lie between 0 and 1. Evidence has, in fact, suggested both extremes as well as intermediate values for β. It is reasonable to interpret the evidence regarding sterilization as indicating that central banks are able to sterilize a significant fraction of reserve flows in the short run.* This means that the monetary authorities are likely to choose the growth rate of the money supply in the short run, although long-run money growth must be consistent with money-demand requirements.

So far, we have discussed sterilization in the context of fixed exchange rates. Now, let's consider how a sterilization operation might occur in a floating exchange rate system. Suppose the Japanese yen is appreciating against the dollar, and the Bank of Japan decides to intervene in the foreign-exchange market to increase the value of the dollar and stop the yen appreciation. The Bank of Japan increases domestic credit in order to purchase U.S.-dollar-denominated bonds. The increased demand for dollar bonds will mean an increase in the demand for dollars in the foreign-exchange market. This results in the higher foreign-exchange value of the dollar. Now, suppose the Bank of Japan has a target level of the Japanese money supply that requires the increase in domestic credit to be offset. The central bank will sell yen-denominated bonds in Japan to reduce the domestic money supply. The domestic Japanese money supply was originally increased by the increase in domestic credit used to buy dollar bonds. The money supply ultimately returns to its initial level as the Bank of Japan uses a domestic open-market operation (the formal term for central-bank purchases and sales of domestic bonds) to reduce domestic credit. In this case of managed floating exchange rates, the Bank of Japan uses sterilized intervention to achieve its goal of slowing the appreciation of the yen with no effect on the Japanese money supply. Sterilized intervention is ultimately an exchange of domestic bonds for foreign bonds. We may well ask how sterilized intervention could cause a change in the exchange rate if money supplies are unchanged. It is difficult to explain in terms of a monetary-approach model but not in terms of a portfolio-balance approach. Equation 18.2 showed that the exchange rate will be determined in part by the relative growth of domestic and foreign asset supplies. When the Bank of Japan buys dollar assets, the supply of dollar assets relative to yen assets available to private-market participants is reduced. This should cause the yen to depreciate, an effect that is reinforced by the open-market sale of yen securities by the Bank of Japan.

Sterilized intervention
A foreign exchange market intervention that leaves the domestic money supply unchanged.

Even in a monetary-approach setting, it is possible for sterilized intervention, with unchanged money supplies, to have an effect on the spot exchange rate if money demand changes. The intervention activity could alter the private-market view of what to expect in the future. If the intervention changes expectations in a

*Evidence is presented in Michael Connolly and Dean Taylor, "Exchange Rate Changes and Neutralization: A Test of the Monetary Approach Applied to Developed and Developing Countries," *Economica* (August 1979); Kathryn M. Dominguez and Jeffrey A. Frankel, *Does Foreign Exchange Intervention Work?* (Washington, D.C.: Institute for International Economics, 1993); and Geert Almekinders, *Foreign Exchange Intervention: Theory and Evidence* (International Monetary Fund, Washington, D.C.; Edward Elgar, 1995).

manner that changes money demand (e.g., money demand in Japan falls because the intervention leads people to expect higher Japanese inflation), then the spot rate could change.*

Equation 18.2 can be used to analyze the intervention process just described. Assume Japan is the domestic country and the United States is the foreign country so that $\hat{E}$ represents the yen per dollar exchange rate. The Bank of Japan increases domestic credit to purchase dollar-denominated bonds. As $\hat{D}$ increases and $\hat{B}^F$ decreases, $\hat{E}$ increases. The yen was initially appreciating against the dollar, or $\hat{E}$ was negative. Due to the central-bank intervention, $\hat{E}$ will rise, or the yen will appreciate at a slower rate than before (perhaps even depreciate, if $\hat{E}$ becomes positive).

If the intervention is sterilized, domestic bonds are exchanged for money. In Equation 18.2, $\hat{D}$ falls and $\hat{B}$ increases. Therefore, even if $\hat{D}$ returns to its initial level, $\hat{B}$ will be higher, so that $\hat{E}$ remains higher than initially.

The portfolio-balance model permits sterilized intervention to alter the exchange rate, even though money supplies are ultimately unchanged. In the monetary approach, the relative bond supplies are deleted from Equation 18.2. The only way that a sterilized intervention could change the exchange rate would be if money demand changed so that income or prices (or perhaps the interest rate, if we added that as a determinant of money demand) changed as well.

EXCHANGE RATES AND THE TRADE BALANCE

The introduction to this chapter discussed the recent shift in emphasis away from exchange rate models that rely on international trade in goods to exchange rate models based on financial assets. However, there is still a useful role for trade flows in asset-approach models, since trade flows have implications for financial-asset flows.

If balance-of-trade deficits are financed by depleting domestic stocks of foreign currency, and trade surpluses are associated with increases in domestic holdings of foreign money, we can see the role for the trade account. If the exchange rate adjusts so that the stocks of domestic and foreign money are willingly held, then the country with a trade surplus will be accumulating foreign currency. As holdings of foreign money increase relative to domestic money, the relative value of foreign money will fall, or the foreign currency will depreciate.

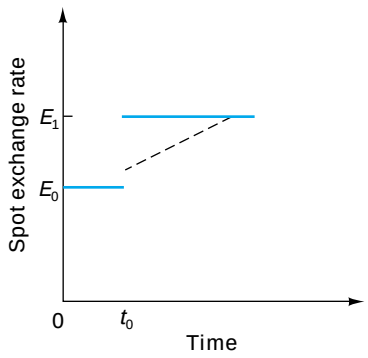
Although realized trade flows and the consequent changes in currency holdings will determine the current spot exchange rate, the expected future change in the spot rate will be affected by expectations regarding the future balance of trade and its implied currency holdings. An important aspect of this analysis is that changes in

*Useful papers on the effects of sterilized intervention include Kenneth Rogoff, "On the Effects of Sterilized Intervention," *Journal of Monetary Economics* (September 1984); Bonnie E. Loopesko, "Relationships among Exchange Rates, Intervention, and Interest Rates: An Empirical Investigation," *Journal of International Money and Finance* (December 1984); and Kathryn Dominguez, "Market Responses to Coordinated Central Bank Intervention," *Carnegie-Rochester Series on Public Policy 32* (Spring 1988). A good review of this literature is found in Hali Edison, "The Effectiveness of Central-Bank Intervention: A Survey of the Literature after 1982," *Princeton Special Papers in International Economics* (July 1993).

the future expected value of a currency can have an immediate impact on current spot rates. For instance, if there is suddenly a change in the world economy that leads to expectations of a larger trade deficit in the future—say, an international oil cartel has developed so that the domestic economy will have to pay much more for oil imports—then forward-looking individuals will anticipate a decrease in domestic holdings of foreign money over time. This anticipation will, in turn, cause expectations of a higher rate of appreciation in the value of foreign currency in the future, or an equivalently faster expected depreciation of the domestic currency, because foreign currency will be relatively more scarce. This higher expected rate of depreciation of the domestic currency leads to an immediate attempt by individuals and firms to shift from domestic to foreign money. Because at this moment the total available stocks of foreign and domestic money have not changed, the attempt to exchange domestic for foreign money will cause an immediate appreciation of the foreign currency to maintain equilibrium so that the existing supplies of domestic and foreign money are willingly held. The point is that events that are anticipated to occur in the future have effects on prices today.

We note that current spot exchange rates are affected by changes in expectations concerning future trade flows, as well as by current international trade flows. As is often the case in economic phenomena, the short-run effect of some new event determining the balance of trade can differ from the long-run result. Suppose the long-run equilibrium under floating exchange rates is balanced trade, where exports equal imports. If we are initially in equilibrium and then experience a disturbance like the oil cartel formation, in the short run we expect large balance-of-trade deficits; but in the long run, as all prices and quantities adjust to the situation, we return to the long-run equilibrium of balanced trade. The new long-run equilibrium exchange rate will be higher than the old rate, because foreigners will have larger stocks of domestic currency, while domestic residents will hold less foreign currency due to the period of the trade deficit. The exchange rate need not move to the new equilibrium immediately. In the short run, during which trade deficits are experienced, the exchange rate will tend to be below the new equilibrium rate. Thus, as the outflow of money from the domestic economy proceeds with the deficits, there is steady depreciation of the domestic currency to maintain the short-run equilibrium, where quantities of monies demanded and supplied are equal. Figure 18.1 illustrates the effects just discussed. Some unexpected event occurs at time t_0 that causes a balance-of-trade deficit. The initial exchange rate is E_0. With the deficit and the consequent outflow of money from home to abroad, the domestic currency will depreciate. Eventually, as prices and quantities adjust to the changes in the structure of trade, a new long-run equilibrium is reached at E_1, where trade balance is restored. This move to the new long-run exchange rate E_1 does not have to come instantaneously, because the deficit will persist for some time. However, the forward rate could jump to E_1 at time t_0, as the market now expects E_1 to be the long-run equilibrium exchange rate. The dashed line in Figure 18.1 represents the path taken by the spot exchange rate in the short run. At t_0, there is an instantaneous jump in the exchange rate even before any trade deficits are realized, because individuals try to exchange domestic money for foreign in anticipation of the domestic-currency depreciation. Over time, as the trade deficits occur, there is a steady depreciation of

FIGURE 18.1 *The path of the exchange rate after a new event causing balance-of-trade deficits.*



the domestic currency, with the exchange rate approaching its new long-run steady-state value E_1 as the trade deficit approaches zero.

The inclusion of the balance of trade as a determinant of exchange rates allows us to reconcile the modern theory of exchange rate determination with accounts in the popular press, which often emphasize the trade account in explanations of exchange rate behavior. As previously shown, it is possible to make sense of balance-of-trade flows in a model where the exchange rate is determined by desired and actual financial-asset flows, so that the role of trade flows in exchange rate determination may be consistent with the modern asset approach to the exchange rate.*

OVERSHOOTING EXCHANGE RATES

Figure 18.1 indicates that, with news regarding a higher trade deficit for the domestic country, the spot exchange rate will jump immediately above E_0 with the news and will then rise steadily until the new long-run equilibrium E_1 is reached. It is possible that the exchange rate may not always move in such an orderly fashion to the new long-run equilibrium after a disturbance.

We know that purchasing power parity does not hold well under flexible exchange rates. Exchange rates exhibit much more volatile behavior than prices do. We might expect that, in the short run, following some disturbance to equilibrium,

*See Peter Hooper and John E. Morton, "Fluctuations in the Dollar: A Model of Nominal and Real Exchange Rate Determination," *Journal of International Money and Finance* (April 1982); and Carlos Alfredo Rodriguez, "The Role of Trade in Exchange Rate Determination: A Rational Expectations Approach," *Journal of Political Economy* (December 1980).

prices will adjust slowly to the new equilibrium level, whereas exchange rates and interest rates will adjust quickly. This different speed of adjustment to equilibrium allows for some interesting behavior regarding exchange rates and prices.

At times, it appears that spot exchange rates move too much given some economic disturbance. Also, we have observed instances when country *A* has a higher inflation rate than country *B*, yet *A*'s currency appreciates relative to *B*'s. Such anomalies can be explained in the context of an "overshooting" exchange rate model.* We assume that financial markets adjust instantaneously to an exogenous shock, whereas goods markets adjust slowly over time. With this setting, we analyze what happens when country *A* increases its money supply.

For equilibrium in the money market, money demand must equal money supply. Thus, if the money supply increases, something must happen to increase money demand. We assume that people hold money for transactions purposes, and they also hold bonds that pay an interest rate *i*. These assumptions allow us to write a money-demand equation of the form

$$L = aY + bi \tag{18.5}$$

where L is the real stock of money demanded (the nominal stock of money divided by the price level), Y is income, and i is the interest rate. Money demand is positively related to income, so a exceeds zero. As Y increases, people tend to demand more of everything, including money. Since the interest rate is the opportunity cost of holding money, there is an inverse relation between money demand and i, or b is negative. It is commonly believed that, in the short run, following an increase in the money supply, both income and the price level are relatively constant. As a result, interest rates must drop to equate money demand to money supply. Now, let's bring into our analysis a second country.

The approximate interest rate parity relation for countries *A* and *B* may be written as

$$i_A = i_B + (F - E)/E \tag{18.6}$$

Thus, if i_A falls, given the foreign interest rate i_B, $(F - E)/E$ or the forward premium on currency *B* must fall. When the money supply in *A* increases, we expect that eventually prices in *A* will rise, because we have more *A* currency chasing the limited quantity of goods available for purchase. This higher future price in *A* will imply a higher future exchange rate to achieve purchasing power parity. We may think of a long-run value of the exchange rate E_{LR} that will be consistent with purchasing power parity:

$$E_{LR} = P_A/P_B \tag{18.7}$$

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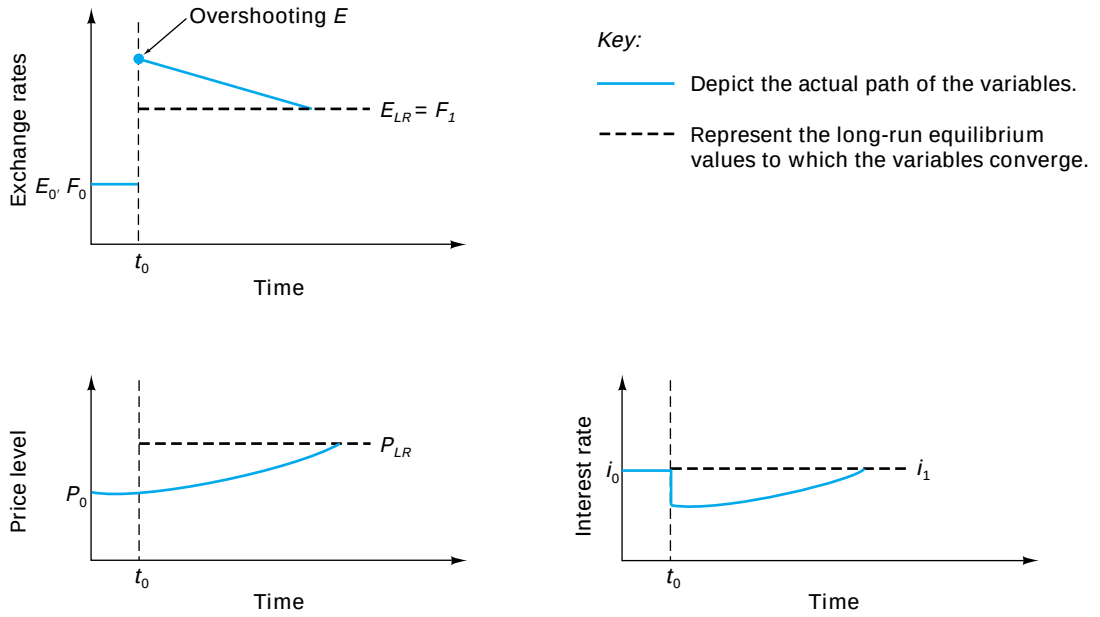
*Examples of overshooting models are provided by Rudiger Dornbusch, "Expectations and Exchange Rate Dynamics," *Journal of Political Economy* (December 1976); Robert A. Driskill, "Exchange Rate Dynamics: An Empirical Investigation," *Journal of Political Economy* (April 1981); David H. Papell, "Activist Monetary Policy, Imperfect Capital Mobility, and the Overshooting Hypothesis," *Journal of International Economics* (May 1985); and Jay H. Levin, "Trade Flow Lags, Monetary and Fiscal Policy, and Exchange Rate Overshooting," *Journal of International Money and Finance* (December 1986).

Since P_A is expected to rise over time, given P_B, E will also rise. This higher expected future spot rate will be reflected in a higher forward rate now. But if F rises while at the same time $F - E$ must fall to maintain interest rate parity, the current E will have to increase more than F. Then, once prices start rising, real money balances fall, so that the domestic interest rate rises. Over time as the interest rate increases, E will fall to maintain interest rate parity. Therefore, the initial rise in E will be in excess of the long-run E_{LR}, or E will overshoot its long-run value. Note that the overshooting exchange rate model revolves around two crucial assumptions: that purchasing power parity does not hold in the short run, and that the spot rate is much more volatile than the forward rate.

If the discussion seems overwhelming at this point, the reader will be relieved to know that a concise summary can be given graphically. Figure 18.2 summarizes the discussion thus far. The initial equilibrium is given by E_0, F_0, P_0, and i_0. When the money supply increases at time t_0, the domestic interest rate falls, and the spot and forward exchange rates increase, while the price level remains fixed. The eventual long-run equilibrium price P_{LR} and exchange rate E_{LR} will rise in proportion to the increase in the money supply. Although the forward rate will move immediately to its new equilibrium F_1, the spot rate will increase above the eventual equilibrium E_{LR}

FIGURE 18.2 *The time path of the forward and spot exchange rate, interest rate, and price level after an increase in the domestic money supply at time* t_0.



due to the need to maintain interest parity (remember, i has fallen in the short run). Over time, as prices start rising, the interest rate increases, and the exchange rate converges to the new equilibrium E_{LR}.

As a result of the overshooting E, we observe a period where country A has rising prices relative to the fixed prices of country B, yet A's currency appreciates along the solid line converging to E_{LR}. We might explain this period as one in which fixed prices increase, lowering real-money balances and raising interest rates. Country A experiences capital inflows in response to the higher interest rates, so that A's currency appreciates steadily at the same rate as the interest rate increase to maintain interest rate parity.

CURRENCY SUBSTITUTION

As is discussed in Chapter 19, economists have long argued that one of the advantages of flexible exchange rates is that countries become independent in terms of their ability to formulate domestic monetary policy. This is obviously not true when exchange rates are fixed. If country A must maintain a fixed exchange rate with country B, then A must follow a monetary policy similar to that of B. Should A follow an inflationary policy where prices are rising 20 percent per year, whereas B follows a policy aimed at price stability, then a fixed rate of exchange between the money of A and B will prove very difficult to maintain. Yet with flexible exchange rates, A and B can each choose any monetary policy they like, and the exchange rate will simply change over time to adjust for the inflation differentials.

This independence of domestic policy under flexible exchange rates may be reduced if there is an international demand for monies. Suppose country B residents desire to hold currency A for future transactions or simply to hold as part of their investment portfolio. As demand for money shifts between A and B currency, the exchange rate will shift as well. In a region with substitutable currencies, shifts in money demand between currencies will add an additional element of exchange rate variability.*

*There is a large and growing literature on currency substitution and its relevance (or, in some cases, irrelevance). Michael Bordo and Ehsan U. Choudhri, "Currency Substitution and the Demand for Money: Some Evidence for Canada," *Journal of Money, Credit, and Banking* (February 1982); John T. Cuddington, "Currency Substitution, Capital Mobility, and Money Demand," *Journal of International Money and Finance* (August 1983); Betty C. Daniel and Harold O. Fried, "Currency Substitution, Postal Strikes, and Canadian Money Demand," *Canadian Journal of Economics* (November 1983); Russell S. Boyer and Geoffrey H. Kingston, "Currency Substitution under Finance Constraints," *Journal of International Money and Finance* (September 1987); Alan G. Isaac, "Exchange Rate Volatility and Currency Substitution," *Journal of International Money and Finance* (June 1989); and Jeffrey H. Bergstrand and Thomas P. Bundt, "Currency Substitution and Monetary Autonomy: the Foreign Demand for U.S. Demand Deposits," *Journal of International Money and Finance* (September 1990). A good review of the literature is found in Alberto Giovannini and Bart Turtelboom, "Currency Substitution," in *The Handbook of International Macroeconomics,* ed. Fredrick Van Der Ploeg (Cambridge, Mass.: Blackwell Economics Handbooks, July 1994).

With fixed exchange rates, central banks make currencies perfect substitutes on the supply side. They alter the supplies of currency to maintain the exchange rate peg. The issue of currency substitution deals with the substitutability among currencies on the demand side of the market. If currencies were perfect substitutes to money demanders, then all currencies would have to have the same inflation rates, or demand for the high-inflation currency would fall to zero (since the inflation rate determines the loss of purchasing power of a money). Perfectly substitutable monies indicates that demanders are indifferent between the use of one currency or another. For instance, people in the United States are basically indifferent as to whether they have a dime or two nickels. The relative values are fixed, and as long as everyone believes that they will remain fixed, people don't worry about whether they should keep dimes or nickels in their pocket. The same would be true of two countries' monies that were fixed in value relative to each other. As long as everyone believes that the exchange value of currency *A* relative to currency *B* will never change, then money demanders will be indifferent between holding *A* or *B*. If this is no longer true, currency substitution becomes an additional source of exchange rate change. If the cost of holding currency *A* rises relative to the cost of holding *B*, say due to a higher inflation rate for currency *A*, then demand will shift away from *A* to *B* if *A* and *B* are substitutes. This would cause the *A* currency to depreciate even more than initially called for by the inflation differential between *A* and *B*.

For instance, suppose Indonesia has a 10 percent annual inflation rate, while Australia has a 5 percent rate. With no currency substitution, we would expect the Indonesian rupiah to appreciate against the Australian dollar on purchasing power parity grounds. Now suppose that Indonesian citizens hold stocks of Australian currency, and these dollars are good substitutes for rupiah. The higher inflation rate on the rupiah means that stocks of rupiah held will lose value more rapidly than dollars, so there is an increased demand for Australian dollar currency. This attempt to exchange rupiah currency for dollars results in a further depreciation of the rupiah. Such shifts in demand between currencies can result in volatile exchange rates and can be very unsettling to central banks desiring exchange rate stability. Therefore, one implication of a high degree of currency substitution is a need for international coordination of monetary policy. In Chapter 18 we discuss in more detail the incentives and benefits of currency unions, where central banks coordinate monetary policy and fix exchange rates, but we may realize now how a high degree of substitutability between monies might lead to a currency union. If money demanders substitute between currencies to force each currency to follow a similar inflation rate, then the supposed independence of monetary policy under flexible exchange rates is largely illusory. Although central banks may attempt to follow independent monetary policies, money demanders will adjust their portfolio holdings away from high-inflation currencies to low-inflation currencies. This currency substitution leads to more volatile exchange rates, because not only does the exchange rate adjust to compensate for the original inflation differential, but it also adjusts as currency portfolios are altered.

Currency union
An agreement between countries to fix exchange rates and coordinate monetary policies.

We should expect currency substitution to be most important in a regional setting where there is a relatively high degree of mobility of resources between countries. For instance, countries using the euro in Western Europe represent a European currency

union and may be evidence of a high degree of currency substitution that once existed among the individual European currencies replaced by the euro.* Alternatively, there is evidence of a high degree of currency substitution existing between the U.S. dollar and Latin American currencies.† In many Latin American countries, dollars serve as an important substitute currency, both as a store of value (the dollar being more stable than the typical Latin American currency) and as a medium of exchange used for transactions. This latter effect is particularly pronounced in border areas.

THE ROLE OF NEWS

Considering the theories of exchange rate determination discussed so far, we might believe that with all this knowledge, experts should be quite adept at forecasting future exchange rates. In fact, forecasting future spot exchange rates is difficult. Although researchers have shown the theories we have covered to be relevant in terms of explaining systematic patterns of exchange rate behavior, the usefulness of these theories for predicting future exchange rates is limited by the propensity for the unexpected to occur. The real world is characterized by unpredictable shocks or surprises. When some unexpected event takes place, we refer to this as news. Since interest rates, prices, and incomes are often affected by news, it follows that exchange rates too will be affected by news. By definition, the exchange rate changes linked to news will be unexpected. We find great difficulty in predicting future spot rates because we know that the exchange rate will be, in part, determined by events that cannot be foreseen.

That the predicted change in the spot rate, as measured by the forward premium, varies less over time than the actual change does indicates how much of the change in spot rates is unexpected. Periods dominated by unexpected announcements or realizations of economic policy changes will have great fluctuations in spot and forward exchange rates as expectations are revised subject to the news.

The news also has implications for purchasing power parity. Because exchange rates are financial-asset prices that respond quickly to new information, news will have an immediate impact on exchange rates.‡ Prices of goods and services, how-

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*See Michael Melvin, "Currency Substitution and Western European Monetary Unification," *Economica* (February 1985).

†See Guillermo Ortiz, "Currency Substitution in Mexico: The Dollarization Problem," *Journal of Money, Credit, and Banking* (May 1983); Jaime Marquez, "Money Demand in Open Economies: A Currency Substitution Model for Venezuela," *Journal of International Money and Finance* (June 1987); Michael Melvin, "The Dollarization of Latin America as a Market Enforced Monetary Reform: Evidence and Implications," *Economic Development and Cultural Change* (April 1988); John H. Rogers, "Convertibility Risk and Dollarization in Mexico: A Vectorautoregressive Analysis," *Journal of International Money and Finance* (April 1992); and Paul D. McNelis and Carlos Asilis, "A Dynamic Simulation Analysis of Currency Substitution in an Optimizing Framework with Transactions Costs," *Revista de Análisis Económico,* (June 1992).

‡Yin-Wong Cheung and Menzie Chinn in "Currency Traders and Exchange Rate Dynamics: A Survey of the U.S. Market," *Journal of International Money and Finance* (forthcoming) survey foreign exchange traders and find that the majority of traders believe that exchange rates fully adjust to most economic news within one minute.

ever, will not be affected by the news in such a rapid manner. One reason is that goods and services are often contracted for in advance, so that prices are inflexible for the duration of the contract. A more basic and general reason is that financial assets, like foreign exchange, have long lives relative to the goods and services that are incorporated in national price indexes. This is important because longer-lived assets or durable-goods prices are more sensitive to changes in expectations than nondurable or relatively short-lived assets are. For this reason, during periods dominated by news, we observe exchange rates varying a great deal relative to prices, so that large deviations from purchasing power parity are realized. The differences between prices and exchange rates are illustrated in Table 18.1. As was discussed earlier, in the context of asset models of exchange rate determination, exchange rates change much more than goods prices do. Periods when many unexpected economic events occur (oil price shocks and international debt problems are two examples) will be periods of large unexpected exchange rate changes and will also be periods when large deviations from PPP occur. For instance, if the Federal Reserve announced a new policy that was expected to increase U.S. inflation, the dollar would immediately depreciate on the foreign exchange market, but prices of goods and services would increase slowly over time.

It is important to realize that the variability of the exchange rate is a result of new developments.* In recent years, research indicates that news regarding unemployment rates has the biggest effect on exchange rates of any regularly scheduled macroeconomic announcement.Volatile exchange rates simply reflect turbulent times. Even with a good knowledge of the determinants of exchange rates, as discussed in this chapter, without perfect foresight exchange rates will always prove to be difficult to forecast in a dynamic world full of surprises.

FOREIGN EXCHANGE MARKET MICROSTRUCTURE

The determinants of the exchange rate discussed so far identify the fundamentals that should cause changes in exchange rates. As news related to money supplies, trade balances, or fiscal policies is received by the market, exchange rates will change to reflect this news. We might think of the discussion as being macro, as such news affects the entire economy and other prices change along with exchange rates. However, there is also a micro level, at which exchange rates are determined by interac-

*This is demonstrated in Takatoshi Ito and V. Vance Roley, "News from the U.S. and Japan: Which Moves the Yen/Dollar Exchange Rate?" *Journal of Monetary Economics* (March 1987); Gikas A. Hardouvelis, "Economic News, Exchange Rates, and Interest Rates," *Journal of International Money and Finance* (March 1988); Keivan Deravi, Philip Gregorowicz, and Charles E. Hegji, "Balance of Trade Announcements and Movements in Exchange Rates," *Southern Economic Journal* (October 1988); Kedreth C. Hogan, Jr., and Michael Melvin, "Sources of Meteor Showers and Heat Waves in the Foreign Exchange Market," *Journal of International Economics* (November 1994); and Torben Andersen and Tim Bollerslev, "Deutsche Mark-Longer-Run Dependencies," *Journal of Finance* (February 1998).

tions among traders. Beyond the macro news or public information shared by all, there also exists private information from which some traders know more than others about the current state of the market. Understanding the "market microstructure" allows us to explain the evolution of the foreign exchange market in an intradaily sense, in which foreign exchange traders adjust their bid and ask quotes throughout the business day in the absence of any macro news.

A foreign exchange trader may be motivated to alter his or her exchange rate quotes in response to changes in their position with respect to orders to buy and sell a currency. For instance, suppose Jose Smith is a foreign exchange trader at Citibank who specializes in the euro/dollar market. The bank management controls risks associated with foreign currency trading by limiting the extent to which traders can take a position that would expose the bank to potential loss from unexpected changes in exchange rates. If Smith has agreed to buy more euros than he has agreed to sell, he has a long position in the euro and will profit from euro appreciation and lose from euro depreciation. If Smith has agreed to sell more euros than he has agreed to buy, he has a short position in the euro and will profit from euro depreciation and lose from euro appreciation. His position at any point in time may be called his inventory. One reason traders adjust their quotes is in response to inventory changes. At the end of the day most traders balance their position and are said to go home "flat." This means that their orders to buy a currency are just equal to their orders to sell.

Suppose Jose Smith has been buying and selling euros for dollars throughout the day. By early afternoon his position is as follows:

dollar purchases:	$100,000,000
dollar sales:	$80,000,000

In order to balance his position Smith will adjust his quotes to encourage fewer purchases and more sales. For instance, if the euro is currently trading at $1.0250–60, then Jose could raise the bid quote relative to the ask quote to encourage others to sell him euros in exchange for his dollars. For instance, if he changes the quote to 1.0255–60, then someone could sell him euros (or buy his dollars) for $1.0255 per euro. Since he has raised the dollar price of a euro, he will receive more offers from people wanting to sell him euros in exchange for his dollars. When Jose buys euros from other traders, he is selling them dollars, and this helps to balance his inventory and reduce his long position in the dollar.

This *inventory control* effect on exchange rates can explain why traders may alter their quotes in the absence of any news about exchange rate fundamentals. Richard Lyons studied the deutsche mark/dollar market and estimated that, on average, foreign exchange traders alter their quotes by 0.00008 for each $10 million of undesired inventory. So a trader with an undesired long mark position of $20 million would, on average, raise his quote by 0.00016.

In addition to the inventory control effect, there is also an *asymmetric information* effect, which causes exchange rates to change due to traders' fears that they are quoting prices to someone who knows more about current market conditions than

they do. Even without news regarding the fundamentals discussed earlier in the chapter, information is being transmitted from one trader to another through the act of trading. If Jose posts a quote of 1.0250–60 and is called by Ingrid Schultz at Chase asking to buy $5 million of euros at Jose's ask price of 1.0260, Jose then must wonder whether Ingrid knows something he doesn't. Should Ingrid's order to trade at Jose's price be considered a signal that Jose's price is too low? What superior information could Ingrid have? Every bank receives orders from nonbank customers to buy and sell currency. Perhaps Ingrid knows that her bank has just received a large order from DaimlerChrysler to sell dollars, and she is selling dollars (and buying euros) in advance of the price increase that will be caused by this nonbank order being filled by purchasing dollars from other traders.

Jose does not know why Ingrid is buying euros at his ask price, but he protects himself from further euro sales to someone who may be better informed than he is by raising his ask price. The bid price may be left unchanged because the order was to buy his euros; in such a case the spread increases, with the higher ask price due to the possibility of trading with a better-informed counterparty. Richard Lyons estimated that the presence of asymmetric information among traders resulted in the average change in the quoted price being 0.00014 per $10 million traded. At this average level, Jose would raise his ask price by 0.00007 in response to Ingrid's order to buy $55 million of euros.

The inventory control and asymmetric information effects can help explain why exchange rates change throughout the day, even in the absence of news regarding the fundamental determinants of exchange rates. The act of trading generates price changes among risk-averse traders who seek to manage their inventory positions to limit their exposure to surprising exchange rate changes and limit the potential loss from trading with better-informed individuals.

SUMMARY

1. Modern exchange rate models emphasize financial-asset markets.
2. Asset-approach models may be divided into monetary-approach models, assuming perfect substitutability of assets internationally, and portfolio-balance models, assuming imperfect substitutability.
3. Portfolio-balance models of exchange rate determination add relative asset supplies as a determinant.
4. Central-bank sterilization occurs when domestic credit is changed to offset international reserve flows.
5. Since balance-of-trade flows are balanced by financial-asset flows, changes in the trade balance have a role in asset-approach views of exchange rate determination.

6. If financial-asset markets clear fast relative to goods markets, then the exchange rate may overshoot the new long-run equilibrium after some shock to the system.
7. International currency substitution will add an additional source of exchange rate variability.
8. A high degree of currency substitution breeds currency union.
9. Exchange rates are difficult to forecast because the market is continually reacting to unexpected events or news.
10. Even in the absence of any major news, exchange rates adjust through the day as foreign exchange dealers manage their inventories and respond to trades with others who may be better informed.

EXERCISES

1. Suppose country *X* discovers a new technology that will result at some time in the future in a doubling of *X*'s exports. As a result, country *X* moves from a position of balance-of-trade deficits to expected long-term surpluses. How will the foreign-exchange value of *X*'s currency be affected? Do you expect any difference between the long run and the short run?
2. A major complaint regarding flexible exchange rates is that the exchange rates are too volatile when they float. Explain how each of the topics considered in this chapter—the trade balance, currency substitution, differential speed of adjustment of asset markets versus goods markets, and news—contributes to exchange rate volatility.
3. Suppose the domestic central bank unexpectedly lowers the money supply. In a world of exchange rate overshooting, how would the spot rate, forward rate, interest rate, and price level change in response? Draw graphs representing the expected time paths. Why does your exchange rate path have the shape that it does?
4. Carefully monitor the local newspaper (better still, the *Wall Street Journal*) for news that should have an impact on the foreign-exchange market. Keep a list of each news event, the effect on the value of the domestic currency you would expect (and why), and the actual effect.
5. Suppose the Federal Reserve in the United States wants to increase the value of the British pound against the dollar. How might it intervene in the foreign-exchange market to accomplish this? If the Fed wants to leave the U.S. money supply unchanged by the foreign-exchange market intervention, how will it conduct a sterilized intervention?

6. Why might governments in small developing countries worry about their citizens substituting among currencies?
7. Explain why overshooting occurs in overshooting exchange rate models. What does it imply about the short-run validity of interest rate parity and purchasing power parity?
8. What is the difference between the monetary approach and the portfolio-balance approach to exchange rate determination? What are the similarities between the two approaches?
9. According to the portfolio-balance approach to exchange rate determination, what will happen to the values of the domestic currency if the supply of foreign bonds rises relative to the supply of domestic bonds? Why?
10. Suppose Taka is a yen-dollar trader who is currently quoting ¥110.20–110.30 for the dollar. So for today he has bought $60,000,000 and sold $30,000,000 of yen. How would he change his quote in order to square his position (equalize amounts bought and sold)?

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INTERNET APPLICATIONS

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