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Foreign exchange
Jeffrey A. Frankel

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The *foreign exchange market* is the market in which foreign currency—e.g., the yen or euro or pound—is traded for domestic currency—e.g., the U.S. dollar. It is not in a centralized location and, instead, is a decentralized network that is, nevertheless, highly integrated via modern information and telecommunications technology.

According to a triennial survey, average daily global turnover (i.e., amount exchanged) in traditional foreign exchange markets reached $1.9 trillion in April 2004.[1] In addition, there was $1.2 trillion of trading in *derivatives* such as forwards and options. In the spot market, parties contract for delivery of the foreign exchange immediately. In the forward market, they contract for delivery at some point, such as three months in the future. In the option market, they enter a contract that allows one party to buy or sell foreign exchange in the future, but does not require it (thus the word "option.") Most of the trading is among banks, either on behalf of customers or on their own account. The counterparty to the transaction could be another dealer, another financial institution, or a non-financial customer. The survey reported that 89 percent of the trading involved the dollar on one side of the transaction or the other. (That the dollar is used as a *vehicle currency* explains why its trading volume is so high: someone wanting to go from the Malaysian ringgit to the South African rand passes through the dollar on the way.) Next, 37 percent of foreign exchange transactions involved the euro, 20 percent the yen, 17 percent the British pound, six percent the Swiss franc, five percent the Australian dollar, and four percent the Canadian dollar. London is the world's largest center for trading foreign exchange; turnover there is 31 percent of the global total. Next comes New York at 19 percent, Tokyo at eight percent, and Singapore and Frankfurt at five percent each.

The exchange rate is the price of foreign currency. For example, the exchange rate between the British pound and the U.S. dollar is usually stated in dollars per pound sterling ($/£); an *increase* in this exchange rate from, say, $1.80 to say, $1.83, is a *depreciation* of the dollar. The exchange rate between the Japanese yen and the U.S. dollar is usually stated in yen per dollar (¥/$); an increase in this exchange rate from, say, ¥108 to ¥110 is an *appreciation* of the dollar. Some countries *float* their exchange rate, which means that the central bank (the country's monetary authority) does not buy or sell foreign exchange, and the price is instead determined in the private marketplace. Like other market prices, the exchange rate is determined by supply and demand—in this case, supply of and demand for foreign exchange.

[1] In the most recent survey from the Bank for International Settlements, published September 2004, Basel.

Some countries' governments, instead of floating, *fix* their exchange rate, at least for periods of time, which means that the government's central bank is an active trader in the foreign exchange market. To do so, the central bank buys (or sells) foreign currency depending on which is necessary to peg the currency at a fixed exchange rate with the chosen foreign currency. An increase in foreign exchange reserves will add to the money supply, which could lead to inflation if it is not offset by the monetary authorities via what are called *sterilization* operations. Sterilization by the central bank means responding to increases in reserves so as to leave the total money supply unchanged. A common way to accomplish it is by selling bonds on the open market; a less-common way is to increase in reserve requirements placed on commercial banks.

Still other countries follow some regime *intermediate* between pure fixing and pure floating. (Examples include bands or target zones, basket pegs, crawling pegs, and adjustable pegs). Many central banks practice *managed floating,* whereby they intervene in the foreign exchange market by *leaning against the wind.* To do so, a central bank sells foreign exchange when the exchange rate is going up, thereby dampening its rise, and buying when it is going down. The motive is to reduce the variability in the exchange rate. Private speculators may do the same thing: such "stabilizing speculation"—buying low with the plan of selling high—is profitable if the speculators correctly anticipate the direction of future exchange rates.

Until the 1970s, exports and imports of merchandise were the most important sources of supply and demand for foreign exchange. Today, financial transactions overwhelmingly dominate. When the exchange rate rises, it is generally because market participants decided to buy assets denominated in that currency in the hope of further appreciation. Economists believe that macroeconomic fundamentals determine exchange rates in the long run. The value of a country's currency is thought to react positively, for example, to such fundamentals as: an increase in the growth rate of the economy; an increase in its trade balance; a fall in its inflation rate; or an increase in its real—that is, inflation-adjusted—interest rate.

One simple model for determining the long-run equilibrium exchange rate is based on the quantity theory of money. The domestic version of the quantity theory says that a one-time increase in the money supply is soon reflected as a proportionate increase in the domestic price level. The international version says that the increase in the money supply is also reflected as a proportionate increase in the exchange rate. The exchange rate, as the relative price of money (domestic per foreign) can be viewed as determined by the demand for money (domestic relative to foreign), which is in turn influenced positively by the rate of growth of the real economy, and negatively by the inflation rate.

A defect of the international quantity theory of money is that it cannot account for fluctuations in the *real* exchange rate, as opposed to simply the nominal exchange rate. The real exchange rate is defined as the nominal exchange rate deflated by price levels (foreign relative to domestic). It is the real exchange rate that matters most for

the real economy. If a currency has a high value in real terms, this means that its products are selling at less-competitive prices on world markets, which will tend to discourage exports and encourage imports. If the real exchange rate were constant, then *purchasing power parity* would hold: the exchange rate would be proportionate to relative price levels. Purchasing power parity does not, in fact, hold in the short run, not even approximately. It does not hold even for goods and services that are traded internationally. But purchasing power parity does tend to hold in the long run.

One elegant theory of exchange-rate determination is the late Rudiger Dornbusch's "*overshooting model.*" In this theory, an increase in the real interest rate—due, for example, to a tightening monetary policy—causes the currency to appreciate more in the short run than it will in the long run. The explanation is that the only way international investors will be willing to hold any foreign assets, given that the rate of return on domestic assets is higher because of the monetary tightening, is if they expect the value of the domestic currency to fall in the future. This fall in the value of the domestic currency would make up for the lower rate of return on foreign assets. The only way the value of the domestic currency will fall in the future, given that the domestic currency's value rises in the short run, is if it rises more in the short run than in the long run. Thus the term "overshooting." An advantage of this theory over the international quantity theory of money is that it can account for fluctuations in the real exchange rate.

It is extremely difficult to predict in which direction exchange rates will move in the short run. Economists often view changes in exchange rates as following a random walk, which means that a future increase is as likely as a decrease. Short-run fluctuations are difficult to explain even after the fact. Some short-run movements no doubt reflect attempts by market participants to ascertain the future direction of macroeconomic fundamentals. But many short-run movements are hard to explain and may be due to ineffable determinants such as some vague "market sentiment" or *speculative bubbles*. Speculative bubbles are movements of the exchange rate that are not related to macroeconomic fundamentals, but that instead result from self-fulfilling changes in expectations. Those who trade foreign exchange for a living generally look at economists' models of fundamentals when thinking about horizons of one year or longer. At horizons of a month or less, they tend to rely more on methods unrelated to economic fundamentals, such as "technical analysis." A common technical-analysis strategy is to buy currency whenever the short-run moving average rises above the long-run moving average, and sell when it goes the other way.

Exchange rate volatility is very high. During the period since the major exchange rates began to float in 1971, there have been 36 months in which the change in the dollar/pound rate exceeded five percent. These 36 months were 12.7 percent of the total months (through 2004). By contrast, consider the period 1955-1970, when exchange rates were "pegged" under the Bretton Woods system (named after Bretton Woods, the town in New Hampshire where a 1944 conference decided the post-War international monetary order). In only one month, which was only 0.5 percent of the

total months, did the change in the dollar/pound rate exceed 5 percent. Similarly higher volatility occurred during the period 1971-2004 for the exchange rate between the dollar and the mark (later euro) and between the dollar and the yen.

Businesspeople have long been concerned that a high level of exchange-rate volatility would impose costs on importers, exporters, and those wishing to borrow or lend across national borders. Until recently, economists were skeptical of the importance of this effect. In theory, importers, exporters, and others could hedge the foreign exchange risk on the forward exchange market. And statistically it was difficult to discern that increases in exchange-rate volatility had historically been associated with decreases in trade. More recently, however, this effect has been taken more seriously. Forward exchange markets do not exist for many smaller currencies and rarely exist beyond a one-year horizon. Even when the relevant forward market does exist, there are costs to using it: transactions costs plus, perhaps, a foreign-exchange premium. Statistically, econometricians have now discovered important effects: when countries eliminate bilateral exchange rate variability, and especially if they form a currency union, bilateral trade among the member countries rises significantly. Trade among countries that adopted the euro, for example, increased by roughly 30 percent within the first few years alone.

Given the high volatility of exchange rates, even those with strong and well-founded theories about the likely direction of future movements must acknowledge the high level of uncertainty. Indeed, differences in opinion are what give rise to much of the very high volume of trade in foreign exchange. In other words, in every transaction there is a buyer and a seller, and usually they have opposite views regarding likely future movements in the exchange rate.

The most common way of trying to ascertain the average opinion of market participants is to look at the forward exchange rate. In the forward exchange market, participants exchange dollars for foreign currency for delivery, say, one year in the future, but at a price determined today. If a currency is selling at a forward premium against the dollar—i.e., the dollar price of the currency is higher on the one-year forward market than on the spot market—the situation is sometimes described as "the forward market thinks the currency will appreciate against the dollar" over the coming year. Unfortunately, the forward rate seems, in practice, to be a bad predictor of the future exchange rate. The future spot rate tends to move in the *opposite* direction from that forecasted by the forward rate, at least as often as in the indicated direction! Researchers have never been able to decide definitively whether this is a sign of irrationality on the part of speculators or something else. The usual technical explanation is called an *exchange-risk premium*. Exchange-risk premiums are compensation that risk-averse investors require in order to expose themselves to risk. Risk premiums may be small. But they are positively influenced both by uncertainty and by the quantity of assets, such as bonds, that governments issue.

By the 1990s, the richer countries had all but eliminated capital controls—that is, restrictions on buying and selling financial assets across their borders. The poorer countries, despite a degree of market opening, still have substantial restrictions. In the absence of barriers to movement of financial capital across borders, capital is highly mobile and financial markets are highly integrated. In this case, *arbitrage* is free to operate: investors buy assets in countries where they are cheap and sell them where they are expensive, and thereby bring prices into line. Arbitrage works to bring interest rates into parity across countries. The surest form of arbitrage brings about *covered interest parity*: it drives the forward discount into equality with the differential in interest rates.

Covered interest arbitrage brings about covered interest parity in the absence of major transactions costs, capital controls, or other barriers to the international movement of money. Again, the definition of covered interest parity is that the forward discount is equal to the differential in interest rates.

It is less clear if *uncovered* interest parity holds. Under uncovered interest parity, the differential in interest rates would equal not only the forward discount, but also the expected rate of future change in the exchange rate. It is hard to measure whether this condition in fact holds, because it is hard to measure investors' private expectations. One reason uncovered interest parity could easily fail is the existence of an exchange-risk premium. If uncovered-interest parity holds, then countries can finance unlimited deficits by borrowing abroad, so long as they are willing and able to pay the going world rate of return. But if uncovered interest parity does not hold, then countries will find that the more they borrow, the higher the rate of interest they must pay.

About the Author

Jeffrey Frankel is Harpel Professor of Capital Formation and Growth at Harvard University's Kennedy School of Government. He directs the program in International Finance and Macroeconomics at the National Bureau of Economic Research, where he is also a member of the Business Cycle Dating Committee. From 1996 to 1999, Professor Frankel was a member of President Clinton's Council of Economic Advisers, with responsibility for international economics, macroeconomics, and the environment.

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