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Introduction to the World of Exchange Rates

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Abstract:

In this paper we discuss the functioning of the foreign exchange rate system. We start by giving a historical account of the different exchange rate systems around the world. Next, we discuss the determinants of a currency's value according to the main theories of exchange rate determination. Subsequently, we discuss the difference between the nominal and real exchange rate. Finally, the paper ends with summary and conclusions and with a list of additional readings on the topic.

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Everyday millions of companies and individuals around the world do business with companies and individuals located in different countries. Often these transactions involve two or more currencies. Juanita, a resident of the United States, wants to send her grandmother in Mexico money to buy a new microwave. Juanita earns income in US dollars but her grandmother needs Mexican pesos in order to buy the microwave in Mexico. Juanita knows that the microwave costs 20,000 Mexican pesos. How many US dollars would she need to send to her grandmother? This example is just one of many situations in which there is a need for a foreign exchange transaction. Individuals and companies enter into millions of foreign exchange transactions everyday. The standard for how many units of one currency (e.g. US dollars) must be surrendered to obtain one unit of another currency (e.g. Mexican pesos) is commonly known as the *exchange rate* between two currencies. That is, the exchange rate is the price of one currency in terms of the another currency.

The value of the currency has huge implications for a nation's economy. If the value of the domestic currency appreciates, that is, more units of the foreign currency are needed in order to buy one unit of the domestic currency, then this country will be able to buy foreign products more cheaply. On the other hand, the products of this country are going to be more expensive in foreign markets and, as a result, the stronger currency may hurt local exporters as foreign demand decreases. It can be argued that not only the value of a currency, but also its predictability can affect international businesses. If one

company is going to have operations in a country whose currency has an uncertain future value then there may be uncertainty about this company's future revenues, operational costs, and therefore profits. As it is well known, risk averse companies prefer to decrease the risk and uncertainty of future revenues and costs.

In addition to its importance for trade and investment across countries the exchange rate is important as the essential component of the foreign exchange market or "FX" market. *The FX market*, the global market for currencies, is the largest and most liquid financial market in the world. According to a survey conducted by the Bank of International Settlements, the average daily trade in the FX market surpasses $ 1.2 trillion US dollars.

All of these reasons and many more, make study of exchange rates an essential component of the curriculum for any student of economics or aspiring economist. In this paper you will learn about the functioning of the foreign exchange rate system. We start by giving a historical account of the different exchange rate systems around the world. In the past, particularly in the period from the Second World War to the end of the Breton Woods era, it was common for many countries around the world to have fixed exchange rates. That is, the value of the currency was pegged to the value of some other currency. This arrangement was adopted by different countries with the hope that it would avoid uncertainty about the value of their currency and the economic consequences of such uncertainty. Nowadays most major currencies are flexible and their values are determined by demand and supply in the foreign exchange market.

Next, we discuss the determinants of a currency's value according to the main theories of exchange rate determination. The determinants of the value of a currency are

far from settled in the academic literature. However, several theories of exchange rate determination provide useful insights about the functioning of the foreign exchange rate market. For example, by looking at theories of exchange rate determination we can relate the exchange rate to other important macroeconomic variables such as interest rates and prices. Once we have a good understanding of the history and determinants of the exchange rate, we discuss the difference between the nominal and real exchange rate. Finally, the chapter ends with summary and conclusions and with a list of additional readings on the topic.

Exchange Rate Regimes: An Historical Perspective

Let's start the discussion by defining three main types of exchange rate regimes differentiated by their degree of flexibility. First, there is the floating exchange rate regime in which currencies are free to float and their values are determined by demand and supply in the foreign exchange rate market. Proponents of the flexible exchange rate system argue that floating exchange rates provide monetary policy autonomy as the central bank is not required to intervene in the foreign exchange market in order to maintain a given value for the currency and insulation from external shocks. In his 1969 article praising the benefits of floating exchange rates, economics professor Harry G. Johnson even argued that floating exchange rates are an essential component of the national autonomy and independence of each country. This national autonomy he argues is essential for the efficient organization and development of the global economy.

On the down side, flexible exchange rates have been often associated with destabilizing speculation. However, proponents of flexible exchange rates argue that, to the contrary, speculation by rational agents should reduce exchange rate volatility and

provide a less disruptive adjustment mechanism in the face of nominal rigidities. Economist and Nobel laureate Milton Friedman argues that if there is a domestic currency appreciation that is expected to be temporary there is an incentive for holders of domestic currency to sell some of their holdings, acquiring foreign currency, and then buying the domestic currency back at a lower price. By behaving this way speculators meet part of the excess demand for domestic currency and accelerate the process of returning to the long term equilibrium value of the currency. Friedman stated that those that argue that speculation can be destabilizing in the foreign exchange market do not realize that this is equivalent to saying that speculators constantly lose money, since speculation can be destabilizing only if speculators sell when the currency is cheap and buy when it is expensive. He suggests that speculators who behave this way will be driven out of the market relatively quickly.

The second type of regime that must be defined is the fixed exchange rate regime, in which the value of the currency is tied to the value of some other currency. The exchange rate uncertainty that may result from floating exchange rates has a negative impact on some types of investments, possibly affecting trade. It is believed that by fixing the value of the domestic currency relative to that of a major economy, a country can lower exchange rate volatility and promote trade and investment. Fixed exchange rates have been seen by some economists as helpful in obtaining several other economic goals. For instance, it has been argued that fixed exchange rates are useful in obtaining price stability. An exchange rate target is straightforward and easily understood by the general public. If this exchange rate target is credible, that is, if the public has confidence that the

monetary authorities will pursue such a target, then it may lower inflation expectations to the level prevailing in the anchor country.

Some fixed exchange rates arrangements imply the surrender of the monetary authorities' control over domestic monetary policy. For some countries (specially developing countries), with a lack of discipline and too many incentives to create revenue from money creation, a surrender of the monetary policy may be a desirable outcome. Even Milton Friedman, who as we mentioned above championed floating exchange rates, admitted that fixed exchange rates can be sometimes preferable for developing countries. However, because fixed exchange rate arrangements limit the monetary policy options of the country, these arrangements can expose the country to international shocks.

Some examples of fixed exchange rates regimes include dollarization and currency boards. In dollarized economies the currency of another country circulates as the sole legal tender. The term dollarization refers to any country that uses a foreign currency as the domestic currency, not only to those countries that adopt the US dollar. Dollarization differs from a monetary union in which members belong to a currency union in which the same legal tender is shared by members of the union. The adoption of a dollarized regime implies the complete surrender of the monetary authorities' control over domestic monetary policy. In the case of currency boards there is an explicit legal commitment to exchange domestic currency for a specified foreign currency at a certain value, combined with restrictions on the monetary authorities' power to ensure the execution of that legal obligation.

Finally, our third type of regime is the intermediate regime. This regime is essentially some type of pegged float in which the exchange rate is free to fluctuate but it

is kept by the country's monetary authorities from deviating from a certain range. There are numerous intermediate arrangements and the possibilities are only limited by the imagination. Some of the intermediate exchange rate regimes recognized by the International Monetary Fund include pegged exchange rates within horizontal bands, crawling pegs, exchange rates within crawling bands, and managed floating with no predetermined path for the exchange rate. Next we discuss the International Monetary Fund definition of each of these regimes.

The pegged exchange rate within horizontal bands is a regime in which the value of the currency is maintained within a range of 1 percent around a fixed value or the difference between the minimum and maximum value of the exchange rate exceeds 2 percent. In a crawling peg regime the exchange rate is adjusted periodically at a fixed rate or in response to changes in several indicators (e.g. relative inflation measures). These two regimes leave the country with a limited degree of monetary policy discretion. The exchange rate within crawling bands is a regime that combines certain aspects of the previous two regimes. Finally, in a regime of managed floating with no predetermined path, the monetary authority influences the exchange rate without having a specific exchange rate path or target.

Across time, countries have moved from one currency regime to another in order to facilitate business and improve national economies. Next we provide a short historical recount of the main trends in exchange rate regimes.

The Gold Standard

Although there were some reappearances of a gold standard, after 1914 and the outbreak of World War I, its is agreed that 1914 marks the end of the classical gold

standard era, during which the majority of countries adhered to some type of gold standard system. Under the gold standard currencies were linked to gold, that is, the value of a country's currency was set at a given rate to gold ounces.

Gold has been traditionally used for commercial purposes as a medium of exchange and store of value because it is rare and durable. Paper currency itself has no intrinsic value (it's just plain paper), but was accepted as payments for goods and services because it could be redeemed any time for its equivalent value in gold. The gold standard also worked as an international pegged exchange rate system. Countries maintained a fixed price for gold and therefore, if we take into account transaction costs, the rates of exchange between currencies were limited by a very tight band. The automatic adjustment process under the gold standard implied that sometimes policy tools were not available to be used for fighting cyclical economic downturns or inflation.

The gold standard regulated the quantity and growth rate of a country's money supply. This, according to economics professor and gold standard expert Michael D. Bordo, implied that the price level should not vary much in the long run. That is, under the gold standard there would be a tendency towards price stability. In 1914, with the advent of World War I and the financing of war related expenses by printing money, the classical gold standard era came to an end.

The Bretton Woods Period

After 1914, there were some efforts to establish a new gold standard that for several reasons, including the great depression, were unsuccessful. Many countries decided to abandon the gold standard and adopt free floating exchange rates.

At the closing of World War II, delegates from Allied nations gathered at the Mount Washington Hotel in Bretton Woods, New Hampshire in the United States. Delegates deliberated extensively in a effort to establish the basic rules of the international monetary system. The goals of the attendees included global economic stability and increased volumes of global trade. The agreements included the creation of the International Bank for Reconstruction and Development (IBRD) (now part of the World Bank Group) and the International Monetary Fund (IMF). Attendees also agreed that there were disadvantages in the use of floating exchange rates. It was, therefore, also agreed that currencies would once again be fixed. World major currencies were pegged to the US dollar. At this point the US dollar was pegged to gold at $ 35 dollars per ounce of gold. The Bretton Woods system lasted until the early 1970's, when the US dollar could no longer hold the peg of $ 35 dollars per ounce of gold and the convertibility of US dollars to gold was suspended.

The Post-Bretton Woods Period

After the Bretton Woods era ended, countries moved in several directions. Several developed countries, like the United States, have since embraced floating exchange rates. These group of countries determined that exchange rates were no longer the optimal method to conduct monetary policy. It has become the convention to argue that exchange rates should be determined directly by market forces and should be free to fluctuate continually. Many developing countries have followed suit and have liberalized their currencies.

However, it is argued that many countries which say they allow their exchange rate to float are not really floaters and intervene frequently in the foreign exchange

market in order to manipulate the value of their currency. Economists Guillermo A. Calvo and Carmen M. Reinhart argue that since countries that are supposedly classified as having a free float mostly resemble non-credible pegs the demise of fixed exchange rates is a myth. They argue that many of these suppose floaters suffer from an epidemic of “fear of floating.”

On the other hand, another series of countries have explicitly decided to adopt fixed or pegged exchange rate systems. Many of these countries have arrangements that fall in one of two categories. The first category includes countries that favor regional arrangements. For instance, during the 1970’s there was a regional movement towards currency integration in Europe, that resulted in the European Monetary System in 1979, a pegged exchange rate regime within horizontal bands. According to Michael D. Bordo the motivation for the European Monetary System (EMS) included the strong dislike by Europeans for flexible exchange rates and the common agricultural policy established in Europe in 1959. Later on it was decided to replace most of the region’s currencies for a single currency. The final result was the euro, (€), the official currency of the European Union (EU). The euro was launched on January 4, 1999 with 11 member states of the EU and is currently used by 15 member states (Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, the Netherlands, Portugal, Slovenia and Spain).

Other countries have decided to dollarize their economies. These countries have decided to relent discretionary monetary policy and use a foreign currency instead of the domestic currency. Some examples of recently dollarized economies include Ecuador and El Salvador. In both cases the US dollar is the sole legal tender.

Given all these examples someone may ask which is the best currency regime? Should countries adopt flexible exchange rates? Are countries better off with a fixed currency? Are intermediate regimes the best alternative? Michael D. Bordo and Jeffrey Frankel, among other economists, argue that no single currency regime is optimal for all countries. The best regime depends on the specific case of each country and a case can be made for each regime under particular circumstances.

The Determinants of the Exchange Rate

Economists have not yet reached a consensus on the factors that should be included as determinants of the exchange rate. Exchange rates may respond to many different variables, some which are real variables (e.g. exports and imports) and some which are financial and monetary variables (e.g. interest rates and inflation). Let's starts the discussion of the determinants of the exchange rate with a simple model of exchange rate determination in which the exchange rate is determined by the interaction of supply and demand for foreign exchange. We assume that domestic and foreign exporters are paid in their respective country's currency. For example, Japanese exporters are paid in yen, while American exporters are paid in US dollars. Both the supply and demand for foreign exchange are determined by the amount exported and imported in each country. For instance, if Americans want to import Japanese cars, then they must pay the Japanese exporters for their cars using yen. Alternatively, if Japanese tourists want to visit New York they need US dollars for expenditures in food, accommodations, entertainment, and shopping. All these expenditures are considered US exports and are a source of demand for US dollars.

The interaction between demand and supply in this market is represented in Figure 1. We label domestic exports as X, domestic imports as M, domestic prices as P, while the foreign prices are labeled P*. The demand for foreign currency is the foreign price multiplied by the amount imported, that is (P*)(M). In our previous example this will be the number of Japanese cars multiplied by the price of those cars. The supply of foreign exchange is the domestic price (adjusted by the exchange rate) multiplied by the amount exported, that is (P/S)X. If a country increases exports then there is an increase in the supply of foreign exchange as foreigners buy domestic currency in order to pay for the exports. On the other hand, imports increase the demand for foreign exchange as more foreign currency is needed to pay for the foreign goods. The equilibrium between demand and supply is point E and the exchange rate that equilibrates demand and supply is S_E.

[Exchange Rates Figure 1 about here]

Suppose that there is an increase in the demand for foreign exchange. As presented at the bottom of Figure 1, as a result of the increase demand for foreign exchange there is a shift of the demand curve from D to D', and a depreciation of the domestic currency. The new equilibrium is point b. At this point more units of the domestic currency are needed in order to buy one unit of the foreign currency. If the monetary authority of the domestic country wants to avoid the domestic currency depreciation, then it must shift the supply curve for foreign exchange from S to S', getting to the new equilibrium point c at which the exchange rate gets back to S_E.

The Forward Exchange Rate, Swaps, Futures and Options

Until now we have been analyzing the current rate of exchange between two currencies, also known as the *spot exchange rate*. That is, we have been referring to the rate of a foreign-exchange contract that is traded today for immediate delivery. In contrast, there is the rate of a foreign-exchange contract that is traded today, but for delivery on a future date, this is what economists refer to as the *forward exchange rate*. The forward exchange rate is a hedging tool against exchange rate risk. By locking the rate at which the currency is going to be exchanged in the future, companies and individuals avoid the risk associated with making payments in other currencies at a future date.

Let's use an example to explain why individuals and businesses around the world may wish to engage in forward exchange transactions. For instance, imagine that a domestic car importer knows that he must pay yen to a Japanese car exporter for ten Toyotas in six months. The domestic car importer sells each car for $10,000 US dollars and must pay the Japanese exporter ¥ 900,000 yens per car. Therefore, the domestic car importer's profit from selling the cars depends on the US dollar/Japanese yen exchange rate. The current US dollar/Japanese yen exchange rate is $0.0094 US dollars per yen and the 180-day forward US dollar/Japanese yen exchange rate is $0.0098 US dollars per yen. Therefore, if the domestic car importer were to pay the Japanese exporter today he would have to pay per car a total of 8,460 US dollars (¥ 900,000 x $0.0094 = $8,460). But remember that the transaction is going to take place in six months. Imagine what will happen if in six months the US dollar/Japanese yen spot rate is $0.012 US dollars per yen. In this case the domestic importer has to pay the Japanese exporter $10,800 US dollars per car (¥ 900,000 x $0.012 = $10,800). He is going to sell each car for $10,000 US dollars and therefore, he is loosing 800 US dollars on each car. One way for the

domestic importer to avoid this risk is to use the forward market. He can make a contract to buy yens in 180 days at a rate of $0.0098, and therefore he will be paying the Japanese exporter $8,820 US dollars per car, making a profit of $1,180 US dollars per car.

It is also possible for companies to combine a spot sale of currency with a forward purchase of the currency in just one transaction, potentially lowering their costs. For instance, suppose that the car domestic importer has ¥ 900,000 yen today. Knowing that he has to pay yen in six months to the Japanese exporters, the domestic importer agrees to convert those ¥ 900,000 yen into US dollars today and reconvert those into yen in six months. In the meantime the domestic importer can invest the US dollars in interest generating assets (e.g. bonds) in the United States. This type of transaction in which there is a spot foreign exchange transaction and a forward foreign exchange transaction is called a *foreign exchange swap*. The spot and forward transactions are called the *legs of the swap*.

Two other financial instruments related to the foreign exchange market that are commonly used are future contracts and foreign exchange options. A *futures contract* is a promise that a specific amount of foreign currency will be delivered on a specific future day. Different from a forward deal, investors can sell futures contracts in an organized market. Hence, if the investor views about the future spot exchange rate change it is possible to sell the futures contract immediately at a profit or loss. A *foreign exchange option* is an option to buy or sell a specified amount of foreign currency at some specified date at a specified price. If the owner of the option exercises his/her right to buy the currency then we say that he/she calls the option. The owner of the option has the right,

but not the obligation, to exchange one currency for another currency at the specified date and price.

Covered Interest Rate Parity

The forward exchange rate may also be used by portfolio managers that want to invest in other countries and earn a return which is free of exchange rate risk. The *covered interest parity condition* (CIP) requires an investor to be indifferent between placing an extra dollar in domestic or foreign investments if the rate of returns are equal and risk free. This concept can be quite easily represented with the following equation:

$$1 + i = \frac{(1 + i^*)F}{S} \qquad (1)$$

Where i (i*) refers to the domestic (foreign) rate of return on investments, F is the forward exchange rate and S is the spot exchange rate. An investor is indifferent between investing in domestic bonds and investing in bonds in the foreign country if there is certainty about the future value of the foreign investment in terms of domestic currency and the returns on both investments are equal. For the future return to be certain in domestic currency the investor buys foreign currency at price S in order to buy bonds in the foreign country and then "covers" the investment by means of the forward exchange rate F. If the returns to the investments are different (the left hand side of (1) different from the right hand side) then investors could take advantage this difference in return and make risk-free profits. It would be possible for an investor to borrow money in the country with the lower interest rate and invest the money in the country with the higher interest rate. The possibility of taking advantage of price or return differences on different markets is commonly known as arbitrage. Any such possibility of arbitrage will be corrected quickly by the market, returning us to equality in Equation (1).

We can re-arrange Equation (1) to obtain:

$$i - i^* = \frac{F - S}{S}$$

or also:

$$i - i^* = p\,, \qquad (2)$$

where *(F-S)/S = p*. The term *p* is known as the forward premium of foreign currency against domestic currency and is the cost of covering the transaction. The domestic interest rate equals the interest rate on foreign deposits plus the forward premium. When the domestic interest rate is below the foreign interest rate ($i < i^*$) the forward price of the foreign currency is below the spot price. Conversely, if the domestic interest rate is above the foreign interest rate ($i > i^*$), the forward price of the foreign currency exceeds the spot price.

Economists Jacob A. Frenkel and Richard M. Levich tested CIP and found that in many instances there was a covered interest rate differential. Is this covered interest rate differential evidence of unexploited profit opportunities? Not really, according to Frenkel and Levich. They argue that after taking into account transaction costs most of the empirical deviations from CIP disappear.

Uncovered Interest Rate Parity

There is another form of interest rate parity known as uncovered interest rate parity (UIP). In this case a risk-neutral investor is indifferent between placing an extra dollar in domestic or foreign investments if the expected rates of return are equal. In this case the foreign investment is not risk free. This concept can be represented with the following equation:

$$1 + i_t = \frac{(1 + i_t^*) ES_{t+n}}{S_t} \quad (3)$$

There are two main differences between Equation (2) and Equation (3). First, we are adding time subscripts to the variables. This is because now we will be referring to variables in different time periods. Second, we are substituting ES_{t+n} for F, where ES_{t+n} refers to the expected spot exchange rate in *n* periods. Under this condition an investor is indifferent between investing in domestic bonds and investing in foreign bonds with a similar expected return. The investor buys foreign currency at price *S* to buy bonds in the foreign country and then return those investments to domestic currency in *n* periods at a rate which he or she thinks will be equal to ES_{t+n}. However, there is no certainty about the future value of the spot rate and hence, the investor is subject to exchange rate risk. We say that his/her transaction is "uncovered".

We can use a common approximation to UIP that assumes among other things that $\frac{ES_{t+n}}{S_t} = \Delta ES_{t+n}$, where ΔES_{t+n} represents the expected change in the exchange rate, to obtain the interest rate differential.

$$i_t - i_t^* = \Delta ES_{t+n} \quad (4)$$

Equation (4) relates the interest rate differential to the exchange rate. When the domestic interest rate is below the foreign interest rate ($i_t < i_t^*$) the domestic currency is expected to appreciate in the future. Hence, individuals that invest money in the domestic market today at a lower interest rate expect to be compensated in the future by the appreciation of the domestic currency. Similarly, if the domestic interest rate is above the foreign interest rate ($i_t > i_t^*$), the domestic currency should be expected to depreciate in the

future. The only reason someone will invest in the foreign country (assuming no transaction costs and a similar level of risk) with a lower interest rate is if he/she expects a depreciation of the domestic currency with respect to the foreign currency.

It is not quite as easy to test empirically for UIP as it is to test for CIP, mainly because it is not possible to observe expected exchange rates. Therefore, the researcher must make an assumption about the formation of agents expectations about the future value of the currency. Often researchers testing the empirical validity of UIP assumed that expectations are formed rationally. Rational expectations assume that economic agents use all the relevant information in forming their expectations of economic variables. The future is not fully predictable, but it is argued that economic agents' expectations are correct on average. In terms of the expected exchange rate, rational expectations imply that the future exchange rate equals the value expected for the currency at time *t*, given all the information at that time, plus an error term that is uncorrelated with that information. As a result, most tests of UIP are joint tests of UIP and the rational expectations hypothesis. Most of the literature has failed to find evidence of UIP.

Purchasing Power Parity

The law of one price states that if markets are efficient, that is markets reflect all relevant information, all identical goods must have only one price. This law has several implications for international transactions. For instance, two identical tradable goods, with no obstacles to international trade and no transactions costs, should have the same price (in the same currency) in two countries. That implies that the price of good *i* in one

country must equal its price in the foreign country multiplied by the exchange rate. This relationship can be represented by Equation (5):

$$S_t P_t^{i*} = P_t^i , \qquad (5)$$

where P_i^{i*} (P_t^i) refers to the foreign (domestic) price of good *i*. The law of one price makes intuitive sense. If P_t^i is greater than $S_t P_t^{i*}$, an investor will buy good *i* in the foreign country transport it to the domestic country and sell it for a profit. But with time these two prices will converge, until it is not possible to take advantage of this arbitrage opportunity. That is, the equality in Equation (5) will be once again restored.

Based on the law of one price we can define the theory of purchasing power parity or PPP. While the law of one price is defined in terms of a certain good, PPP applies to the general price level. PPP states that the exchange rate between two countries' currencies equals the ratio of the countries' price levels. This concept is represented by equation (6):

$$S_t P_t^* = P_t$$

or also,

$$S_t = \frac{P_t}{P_t^*} , \qquad (6)$$

where P_t^* (P_t) is the foreign (domestic) price of a reference commodity basket. Therefore, a relative increase in the domestic price level will be associated with a proportional depreciation of the domestic currency. In this case the domestic currency is loosing relative purchasing power and its value decreases. Note that in (6) we do not need to use the subscript *i*, given that we are referring to the general price level, not the price of specific goods.

We can re-arrange (6) as:

$$s_t = p_t - p_t^* \qquad (7)$$

Where p_t (p_t^*) is the logarithm of P_t (P_t^*) and s_t is the logarithm of S_t. In Equation (7) the logarithm of the exchange rate is simply the difference between the logarithms of the two prices. PPP does not hold empirically, among other things, because of transaction costs and obstacles to international trade. Therefore, economists have decided to call this version of PPP, *absolute PPP*, while a more flexible version of PPP is called *relative PPP*. This relative version of PPP can be represented by Equation (8):

$$\Delta s_t = \Delta p_t - \Delta p_t^* \qquad (8)$$

Where Δs_t represents the change in s_t and Δp_t (Δp_t^*) represents the change in p_t (p_t^*). Relative PPP states that the percentage change in the exchange rate between two currencies equals the difference between the percentage changes in the domestic and foreign price levels. If inflationary pressures force prices higher in one country but not another country, the exchange rate will change to reflect the change in the relative purchasing power of the two currencies.

The empirical evidence on PPP is mixed. Several empirical studies have fail to find evidence on PPP, while others have found some evidence of PPP in the long run. Economist and Nobel laureate Paul Krugman concludes in one his studies that deviations from PPP are large and fairly persistent.

The Monetary Approach to the Exchange Rate

The monetary approach to the exchange rate is a theory of exchange rate determination in which exchange rates depend on the monetary aspects of the economy, that is on money supply and money demand. To develop the predictions of this model let's start by

assuming that we have two countries in which money markets are equilibrated (i.e. money demand is always equal to money supply). The money market in both countries can therefore be described as:

$$m_t - p_t = a_1 y_t - a_2 i_t \quad (9)$$

$$m_t^* - p_t^* = a_1 y_t^* - a_2 i_t^* \quad (10)$$

Where m_t (m_t^*) refers to the logarithm of domestic (foreign) money, y_t (y_t^*) is the logarithm of domestic (foreign) income and p_t (p_t^*) and i_t (i_t^*) maintain the previous definitions as the logarithm of the domestic (foreign) prices and the domestic (foreign) interest rate, respectively. For both cases an increase in interest rates, that is, an increase in the opportunity cost of holding money, causes the demand for money to fall. On the other hand, an increase in income, which encourages consumer spending, results in an increase in the demand for money for transaction purposes.

Equations (9) and (10) can be re-arranged as:

$$p_t = m_t - a_1 y_t + a_2 i_t \quad (11)$$

$$p_t^* = m_t^* - a_1 y_t^* + a_2 i_t^* \quad (12)$$

Solving for the relative price difference ($p_t - p_t^*$) we get:

$$p_t - p_t^* = (m_t - m_t^*) - a_1 (y_t - y_t^*) + a_2 (i_t - i_t^*) \quad (13)$$

Finally, substitute (7) into (13) to obtain:

$$s_t = (m_t - m_t^*) - a_1 (y_t - y_t^*) + a_2 (i_t - i_t^*) \quad (14)$$

Therefore, if we assume that PPP holds we get an equation that relates the exchange rate with money supply, income and interest rates. An increase in the relative money supply ($m_t - m_t^*$) leads to an increase in *s*, a depreciation of the domestic

currency. Therefore, if a country increases its money supply faster than other countries it will suffer a depreciation of its currency. Also, an increase in income leads to a domestic currency appreciation. Under this theory, an increase in income increases the transactions demand for money and because there is a constant money supply, equilibrium in the money market can only be achieve if the domestic price falls. However, given that PPP holds, a drop in the domestic price is only possible if the domestic currency appreciates (see Equations (6) and (7)). In a similar fashion an increase in the domestic interest rate decreases money demand and depreciates the domestic currency.

Table 1 summarizes the predictions of the Monetary Approach to the Exchange Rate. As we mentioned above an increase in the relative money supply and the relative interest rate will depreciate the domestic currency, while an increase in relative income will appreciate the currency. It is also possible to add expectations to the previous model. In a monetary model with rational expectations, the exchange rate not only depends on current excess money supply but also on expected future excess money supplies. In general, the effect of current relative changes in the money supply on the exchange rate depends on the perceived money supply rule. If the relative money supply increases but this change is expected to be just temporary, the expected future exchange rate would be only slightly affected and hence the current exchange rate would simply reflect the current relative money supply change. If in contrast, the increase in the relative money supply leads to the expectation that domestic rates of monetary expansion would be higher than foreign rates in the future, then the domestic currency would depreciate by more than the current relative change in the money supply.

[Exchange Rates Table 1 about here]

Nominal and Real Exchange Rates

Until now we have been referring to what economists call the nominal exchange rate. That is, we have been discussing the number of units of one currency that must be paid to acquire one unit of another currency. However, frequently individuals and companies are also interested in what can be bought with one unit of a currency in a certain country. Is it better to hold one US dollar or one Japanese yen? That may depend on what can be acquired in the United States with a US dollar and what can be acquired in Japan with one yen.

The real exchange rate is a measure of the real value of one unit of one currency with respect to one unit of the other currency. The real exchange rate is the product of the nominal exchange rate and the ratio of prices between the two countries. If absolute PPP holds the real exchange rate is equal to 1. We can confirm this by re-arranging Equation (6) to obtain:

$$S_t(\frac{P_t^*}{P_t}) = 1 \qquad (15)$$

A typical example of the real exchange rate is the relative price of a Big Mac in two countries. For simplicity assume that Big Macs are the only goods in Japan and the United States. If the price of a Big Mac is 3 US dollars in the United States and 1 yen in Japan, while the nominal exchange rate is 0.0094 US dollars for one yen, then the real exchange rate is:

$$.0094(\frac{1}{3}) = .3333$$

The real exchange rate is .3333 which indicates that Big Macs are relatively cheaper in the United States than in Japan. Therefore, it will make economic sense to acquire US dollars and buy Big Macs in the United States, send them to Japan and sell them for a profit there (assuming that Big Macs can survive the trip overseas!). Of course any such opportunity for arbitrage will be short lived, the additional demand for US dollars is going to appreciate the US dollar and the real exchange rate will eventually converge to one. However, as mentioned above PPP does not hold in the real world because of transaction costs and obstacles to international trade. Therefore, the real exchange rate may deviate permanently from the value of 1. Still, the concept of the real exchange rate can be quite useful for determining whether a currency is overvalued or undervalued.

In the real world it is also the case that there are many goods in a country and therefore instead of using the price of just one good (e.g. Big Mac) economists use price indices from both countries to construct the real exchange rate. It is also the case that in the real world, countries have more than one trading partner. Therefore, it is important to look at more than one bilateral real exchange rate for each country. A useful measure in this regard is the *real effective exchange rate* (REER). The REER is the average of the bilateral real exchange rates between one country and its trading partners, weighted by the respective trade shares of each partner.

Conclusion and Summary

In this paper you learned about the exchange rate, that is, the value of one currency in terms of another currency. Exchange rates are essential for economic transactions across national borders and are the principal component of the foreign exchange market. In this chapter you also learned about the history of exchange rate regimes going from the

pegged exchange rates, used during the gold standard era, to the mostly flexible exchange rates which is what we have today.

We also discussed the main theories of exchange rate determination and in the process we familiarized ourselves with important concepts of the foreign exchange market such as the difference between the spot exchange rate and the forward exchange rate. We were also able to discuss different theories related to these concepts such as covered and uncovered interest rate parity and purchasing power parity.

As we mentioned above, the specific factors that determine the value of a currency in terms of another currency remain the source of much debate. However, as we did in this chapter by looking at different theories of exchange rate determination we can get a feel for the functioning of the exchange rate market and we can relate the value of a country's currency with other important variables from that country such as imports, exports, interest rates, income and money supply. The next time that you travel abroad, purchase a foreign good, or get involved in any type of international transaction take a minute to analyze how the theories discussed in this chapter apply to your transaction. You may even come up with new ideas to formulate better theories of exchange rate determination.

Further Readings

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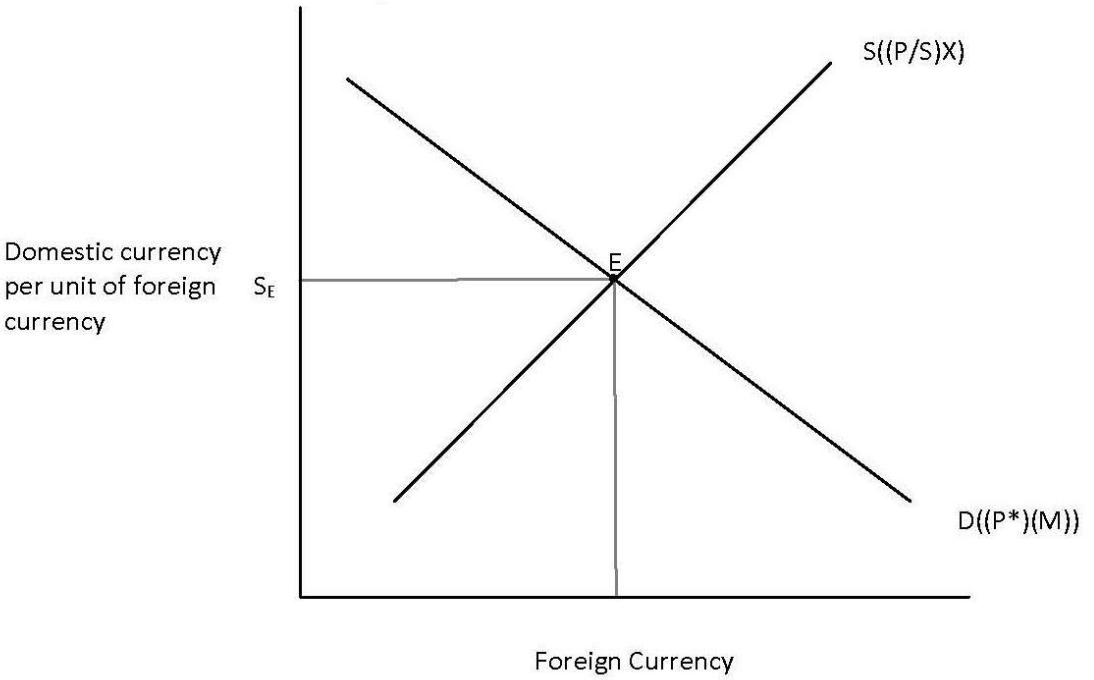
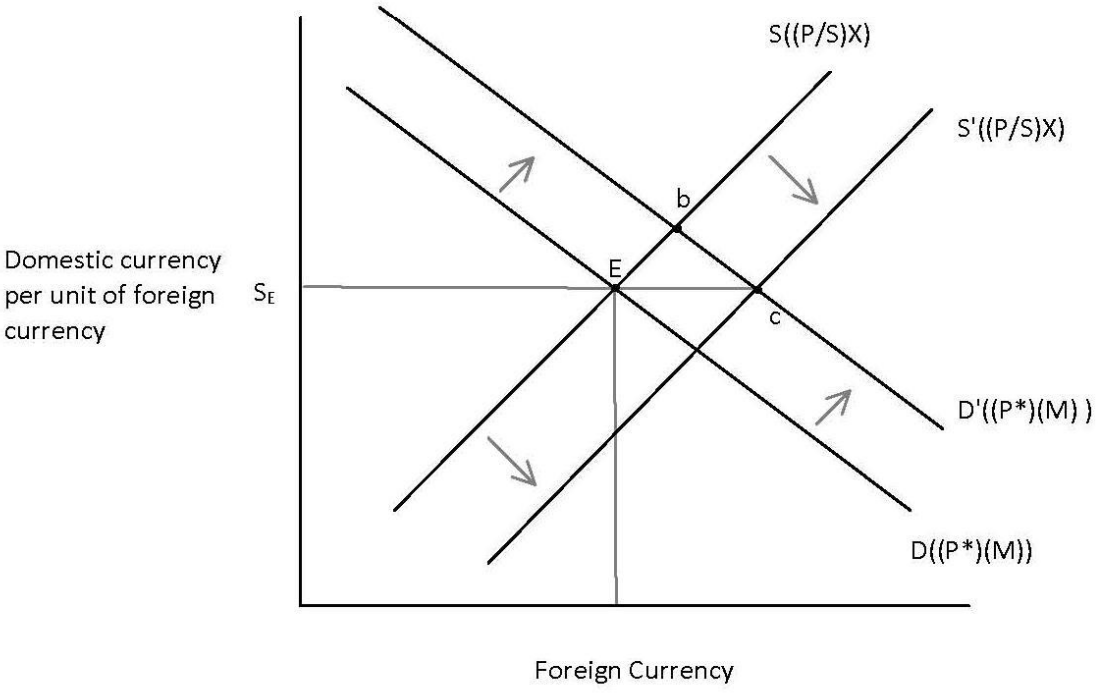
Table 1: Summary Predictions of the Monetary Approach to the Exchange Rate

	Increase in the:		
	Relative Money Supply ($m_t - m_t^*$)	Relative Income ($y_t - y_t^*$)	Relative Interest Rate ($i_t - i_t^*$)
Impact on the domestic currency	Depreciation	Appreciation	Depreciation



(a) Foreign exchange rate market equilibrium.



(b) Increase in demand for foreign exchange.

Figure 1: A simple model of exchange rate determination.