The Foreign Exchange (FOREX) Market

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Abstract

This covers the FOREX market. We start with explaining interest parity and put this into a diagram to allow more analysis. This material assumes you've read and understand the material on exchange rates themselves. This was written for my Open Economy Macroeconomics course at Quinnipiac University.

1 The Law of One Price and Interest Parity

As long as people are free to trade and transaction costs are low, then the prices across markets for the same good should be the same as well. While this can be a bit of a stretch for, say, the car market since it's costly to transport cars or other markets where trade restrictions might apply, these assumptions hold pretty well for trading currencies and for investing globally in the modern world.

The "good" in this case is identical. It's just a return on your investment. You don't have to worry if a German made car is identical to an American made car, etc. A 10% return is a 10% return is a 10% return on your investment.

Also, transaction costs are low these days. While we'll ignore bank and brokerage fees, basically it's a click of a mouse on a computer. That's it. No need to ship a product, worry about time in transportation, breakage while en route, etc.

As a result, the returns across markets should be equal. When they aren't, traders jump in to exploit this return difference - called an "arbitrage opportunity" - and buy into the high return market until the return lowers or the low return rises. One way or another, the returns equal again. In particular, we can use the fact that real returns must be equal and the knowledge that real returns are nominal returns minus expected inflation (i.e., $r = i - \pi^e$ where r is the real return (or interest rate), i is the nominal return (or interest rate), and π^e is the expected rate of inflation over the duration of the investment). Letting a "*" denote "foreign", then starting from domestic real returns needing to be equal to foreign real returns, we can derive an interesting relationship.

$$r = r^* \tag{1.1}$$

$$i - \pi^e = i^* - \pi^{*e}$$

$$i = i^* + \pi^e - \pi^{*e}$$

The first expression just says that real returns must be equal across global markets. If they aren't, then the arbitrage opportunity combined with free trade will equate them again. The intermediate step just uses the definition of a real return (i.e., $r = i - \pi^e$) in each country. Rearranging this gives us the last expression. Using the definition of the nominal exchange rate ($EP^* = P$ where E is the nominal exchange rate, P^* is the foreign price level, and P is the domestic price level) and converting it to percentage changes ($\hat{E} = \pi - \pi^*$ where hats, $\hat{}$, above variables denote percentage change and π represents inflation)

$$i = i^* + \underbrace{\pi^e - \pi^{*e}}_{\hat{E}^e}.$$

This allows us to write what is called (uncovered) "Interest Parity":

$$i = i^* + \hat{E}^e \tag{1.2}$$

To explain this equation intuitively we have to do a little work, but it's important to understand and will be central to all our FOREX analysis.

1.1 Nominal interest rate and expected inflation

Consider the equation for the nominal interest rate (often called the "Fisher equation"), $i = r + \pi^e$. It says that the nominal interest rate equals the real interest rate plus *expected* inflation. Why expected and not actual inflation?

The answer is obvious once you think for a minute about what the nominal interest rate is. Suppose you lend someone some money for 1 year. A year later, you'll get money back plus interest. But what if inflation went way, way up in the mean time? Then while the other person used your money, then when they pay it back each dollar is worth a lot less due to inflation. If you charge them 3% (nominal) interest but inflation doubled, then you actually lost a lot of money in real terms! So it's really important to you, the lender, to charge the correct nominal interest rate on loans and what you expect inflation to be over the life of the loan (i.e., investment) is key.

The borrower has the same interest. In the example above the borrower came out better off, but what if you both agreed on a nominal interest rate of 10%, expecting inflation to be 7%, then the lender expected 3% real return and you were willing to pay 3% real return for using the money. Now suppose inflation drops to zero! Suddenly each dollar you repay is worth a lot more and you are actually paying a 10% return. So it's in the borrower's interest to accurately predict/expect inflation too.

At a very basic level, it's the same globally. You now have two countries and two currencies, so both lenders (investors) and borrowers need to consider inflation in two countries/currencies.

1.2 Global returns and the expected exchange rate

Since you are dealing with two currencies, the exchange is obviously important today and in the future and the inflation rates in both countries is what determines how the exchange rate changes over time. Recall, $\hat{E} = \pi - \pi^*$.

To see why everyone in this market now needs to accurately predict/expect inflation in both countries and/or the expected change in the exchange rate, we consider a simple investment of \$100.

To start, let's suppose everyone decides to ignore the expected change in the exchange rate and see what trouble arises....

Start in a world where the nominal interest rate is 10% in the USA. If you invest the \$100 in the USA, then after 1 year, you'll get back $\$100 \times (1 + .1) = \$110$. You learn that the Europeans have just increased interest rates and now the return (i.e., interest rate) is 15%. So, you decide to invest in Europe and the an extra 5% beyond what you can get in the US at the moment.

1.2.1 CASE 1: Constant exchange rate

In the first case, suppose the USD to Euro exchange rate is 1-to-1, $E = 1$. And suppose it doesn't change over the year. In this case,

1. STEP 1: Convert USD to Euro. You have to convert your USD into Euros in order to invest in Europe. The price of Euros for you is \$1.00 (i.e., $E = 1$) so, $\$100 \times 1/E = \$100 \times 1 = 100$ Euro.
2. STEP 2: Invest in Europe. You now take your money and invest it at the 15% return.
3. STEP 3: After 1 year, collect your Euros. So at the end of the year (or whatever duration you invest), you get your Euros back plus interest: $100 \times (1 + .15) = 115$ Euro.
4. STEP 4: **Convert your Euros back to USD so you can spend them in the USA. In this case, $115Euro \times E = 115Euro \times 1 = \$115$.
5. STEP 5: Calculate your total return. To determine your total return, calculate the percentage change: $\frac{(\$115-\$100)}{\$100} = .15$ so you got a 15% return!

1.2.2 CASE 2: Increasing exchange rate

Now suppose that USD to Euro exchange rate is 1-to-1, $E = 1$ initially but rises to $E = 2$ over the duration of your investment. In this case,

1. STEP 1: Convert USD to Euro. You have to convert your USD into Euros in order to invest in Europe. The price of Euros for you is \$1.00 (i.e., $E = 1$) so, $\$100 \times 1/E = \$100 \times 1 = 100$ Euro.
2. STEP 2: Invest in Europe. You now take your money and invest it at the 15% return.
3. STEP 3: After 1 year, collect your Euros. So at the end of the year (or whatever duration you invest), you get your Euros back plus interest: $100 \times (1 + .15) = 115$ Euro.
4. STEP 4: **Convert your Euros back to USD so you can spend them in the USA. In this case, $115Euro \times E = 115Euro \times 2 = \$230$.
5. STEP 5: Calculate your total return. To determine your total return, calculate the percentage change: $\frac{(\$230-\$100)}{\$100} = 1.30$ so you got a **130% return!**!

Notice that everything was exactly the same as before until step 4! That's when you convert the money back to USD. Why was the return so much higher? Intuitively, an increase in the exchange rate means each USD buys fewer Euros. That is, the US Dollar lost value, or depreciated, while the money was in Euros earning interest. So when you got your money back in Euros, each Euro buys more and more USD. So it doubled the value of each Euro and you got the 15%!

1.2.3 CASE 3: Decreasing exchange rate

Now suppose that USD to Euro exchange rate is 1-to-1, $E = 1$ initially but rises to $E = 1/2$ over the duration of your investment. This means the USD will appreciate while your money is sitting overseas. In this case,

1. STEP 1: Convert USD to Euro. You have to convert your USD into Euros in order to invest in Europe. The price of Euros for you is \$1.00 (i.e., $E = 1$) so, $\$100 \times 1/E = \$100 \times 1 = 100$ Euro.
2. STEP 2: Invest in Europe. You now take your money and invest it at the 15% return.

3. STEP 3: After 1 year, collect your Euros. So at the end of the year (or whatever duration you invest), you get your Euros back plus interest: $100 \times (1 + .15) = 115$ Euro.

4. STEP 4: **Convert your Euros back to USD so you can spend them in the USA. In this case, $115 Euro \times E = 115 Euro \times .5 = \$57.50$.

5. STEP 5: Calculate your total return. To determine your total return, calculate the percentage change: $\frac{(\$57.50-\$100)}{\$100} = -.425$ so you **lost 42.50%!!** Otherwise put, your return was -45.5%.

Notice that everything was exactly the same as before until step 4! That's when you convert the money back to USD. Now each dollar is worth more at the end of the investment but all *your* money is in Euros! So when you convert it back to dollars it loses half it's value.

It should be obvious then, that investors have a serious interest in forecasting and accurately anticipating whether the exchange rate will stay constant, rise or fall over the duration of the investment. That is, they want to determine $\hat{E}^e$ as best they can.

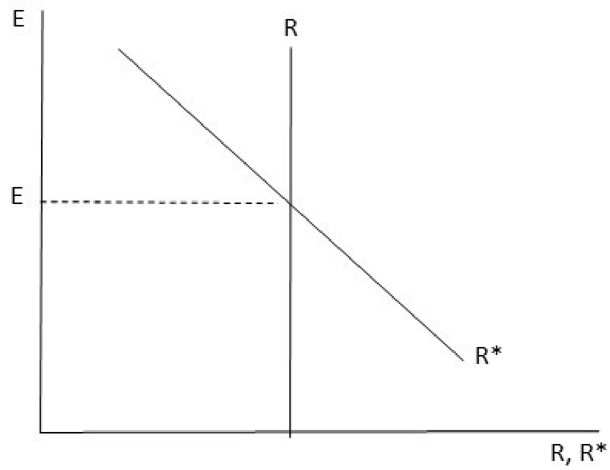
Hence the important of (**??**), $i = i^* + \hat{E}^e$. It's important to compare the return (or interest rate) in each country and the expected change in the exchange rate.

2 The FOREX diagram for analysis

To put this into a diagram for the purpose of analysis, it turns out that all we need is (**??**), $i = i^* + \hat{E}^e$. To make it easier to label our graph, we'll call the domestic returns R and the foreign total return, R^*. So,

$$\underbrace{i}_{R} = \underbrace{i^* + \hat{E}^e}_{R^*}.$$

Our interest here is in determining the nominal exchange rate, E, so our graph will have E on the y-axis and "returns" (i.e., R and R^*) on the x-axis. This diagram and market is called the FOREX market diagram. The final diagram is below and then we explain the shape of each curve.



2.1 Graphing domestic returns

Graphing the domestic returns part is easy. Since $R = i$ and it doesn't depend at all on the nominal exchange rate, E. So, it's just a vertical line.

2.2 Graphing foreign returns

Graphing the foreign returns takes a little thought. The foreign return is $R^* = i^* + \hat{E}^e$ and it is downward sloping in $E - R^*$ space. To see that, expand the expected percentage change term, $\hat{E}^e$,

$$\hat{E}^e = \frac{\Delta E^e}{E} = \frac{E^e}{E} - 1.$$

Since the numerator includes the "expected future exchange rate", E^e, it's only the denominator that contains the current nominal exchange rate, E. As a result, R^* and E are inversely related to each other:

$$R^* = i^* + \frac{E^e}{E} - 1.$$

That is, R^* is downward sloping in $E - R^*$ space.

3 Shifting the curves: basic analysis

Shifting the curves in this diagram is extremely simple. For starters, since $R = i$, anything that increases i shifts this to the right (and lowering the exchange rate, E) and anything that decreases i shifts this to the left (increasing the exchange rate, E). Intuitively, if the return in the US increases (increase i) then people demand more US dollars, pushing up their value which is reflected as a decline in E. If the returns in the US decrease, then people move out of US dollars, selling them and pushing down their value which is reflects as an increase in E.

The R^* curve is only slightly more complicated because it has two components, $R^* = i^* + \hat{E}^e$. So ...

1. Anything increasing the foreign interest rate, i^* shifts the R^* line to the right. Anything decreasing the foreign interest rate shifts the line to the left. The intuition is the same as above but from a foreign perspective. That is, higher i^* means the foreign currency value goes up (and E rises since E is $domestic/foreign$...but their "E" would decline representing an appreciation of their currency) and the opposite for a lower i^*.

2. Anything increasing expectations about the exchange rate will increase exchange rates today by shifting the R^* line to the right. Just think of our numerical example above. If at the beginning (STEP 1) you expect the exchange rate to rise (i.e., your currency to lose value over the year), then at the end of the year you will get the return plus each foreign currency unit will buy more US dollars. So, it's increased the total return you got on investing abroad. In other words, it increased R^*.

There's nothing more to the basic analysis. The trick we'll later see is in shifting expected exchange rates. Since it's based on people's expectations, one can move the R^* left and right and always explain it as "people expected it" and that means it explains everything and thus nothing at all. So we'll have to use shifts in expectations very rarely and with specific meaning and purpose in order to make it a useful concept.