Exchange Rates

ABSOLUTE PURCHASING POWER PARITY

The basic idea behind absolute purchasing power parity is that a commodity costs the same regardless of what currency is used to purchase it or where it is selling. This is a straightforward concept. If a beer costs £2 in London, and the exchange rate is £.60 per dollar, then a beer costs £2 × $/£.60 = $3.33 in New York.

If PPP did not hold, arbitrage would be possible (in principle) if apples were moved from one country to another. For example, suppose apples are selling in New York for $4 per bushel, whereas in London the price is £2.40 per bushel. Absolute PPP implies that:

$$P_{UK} = S_0 \times P_{US}$$
$$£2.40 = S_0 \times \$4$$
$$S_0 = £2.40 / \$4 = £.60$$

That is, the implied spot exchange rate is £.60 per dollar. Equivalently, a pound is worth $1 / £.60 = $1.67.

Suppose that, instead, the actual exchange rate is £.50. Starting with $4, a trader could buy a bushel of apples in New York, ship it to London, and sell it there for £2.40. Our trader could then convert the £2.40 into dollars at the prevailing exchange rate, S_0 = £.50, yielding a total of £2.40 / .50 = $4.80. The round-trip gain would be 80 cents.

RELATIVE PURCHASING POWER PARITY

As a practical matter, a relative version of purchasing power parity has evolved. Relative purchasing power parity does not tell us what determines the absolute level of the exchange rate. Instead, it tells what determines the *change* in the exchange rate over time.

Suppose the British pound–U.S. dollar exchange rate is currently S_0 = £.50. Further suppose that the inflation rate in Britain is predicted to be 10 percent over the coming year, and (for the moment) the inflation rate in the United States is predicted to be zero. What do you think the exchange rate will be in a year?

If you think about it, you see that a dollar currently costs .50 pounds in Britain. With 10 percent inflation, we expect prices in Britain to generally rise by 10 percent. So we expect that the price of a dollar will go up by 10 percent, and the exchange rate should rise to £.50 × 1.1 = £.55.

If the inflation rate in the United States is not zero, then we need to worry about the *relative* inflation rates in the two countries. For example, suppose the U.S. inflation rate is predicted to be 4 percent. Relative to prices in the United States, prices in Britain are rising at a rate of 10% – 4% = 6% per year. So we expect the price of the dollar to rise by 6 percent, and the predicted exchange rate is £.50 × 1.06 = £.53.

In general, relative PPP says that the change in the exchange rate is determined by the difference in the inflation rates of the two countries. To be more specific, we will use the following notation:

S_0 = Current (time 0) spot exchange rate (foreign currency per dollar)

$E(S_t)$ = Expected exchange rate in t periods
h_{US} = Inflation rate in the United States
h_{FC} = Foreign country inflation rate

Based on our preceding discussion, relative PPP says that the expected percentage change in the exchange rate over the next year, $[E(S_1) - S_0] / S_0$, is:

$$[E(S_1) - S_0] / S_0 = h_{FC} - h_{US}$$

In words, relative PPP simply says that the expected percentage change in the exchange rate is equal to the difference in inflation rates. If we rearrange this slightly, we get:

$$E(S_1) = S_0 \times [1 + (h_{FC} - h_{US})]$$

In general, relative PPP says that the expected exchange rate at some time in the future, $E(S_t)$, is:

$$E(S_t) = S_0 \times [1 + (h_{FC} - h_{US})]^t$$

INTEREST RATE PARITY
To avoid arbitrage opportunities, then there must be some relationship between spot exchange rates, forward exchange rates, and relative interest rates. In general, this relationship is:

$$F_1 / S_0 = (1 + R_{FC}) / (1 + R_{US})$$

Very loosely, what IRP says is that any difference in interest rates between two countries for some period is just offset by the change in the relative value of the currencies, thereby eliminating any arbitrage possibilities. Notice that we could also write:

$$F_1 = S_0 \times [1 + (R_{FC} - R_{US})]$$

In general, if we have t periods instead of just one, the IRP approximation is written as:

$$F_t = S_0 \times [1 + (R_{FC} - R_{US})]^t$$

FORWARD RATES AND FUTURE SPOT RATES
In addition to PPP and IRP, we need to discuss one more basic relationship. What is the connection between the forward rate and the expected future spot rate? The unbiased forward rates (UFR) condition says that the forward rate, F_1, is equal to the *expected* future spot rate, $E(S_1)$:

$$F_1 = E(S_1)$$

With *t* periods, UFR would be written as:

$$F_t = E(S_t)$$

UNCOVERED INTEREST RATE PARITY
To start, it is useful to collect our international financial market relationships in one place:

PPP: $E(S_1) = S_0 \times [1 + (h_{FC} - h_{US})]$
IRP: $F_1 = S_0 \times [1 + (R_{FC} - R_{US})]$
UFR: $F_1 = E(S_1)$

We begin by combining UFR and IRP. Because we know that $F_1 = E(S_1)$ from the UFR condition, we can substitute $E(S_1)$ for F_1 in IRP. The result is:

UIP: $E(S_1) = S_0 \times [1 + (R_{FC} - R_{US})]$

This important relationship is called uncovered interest parity (UIP. With *t* periods, UIP becomes:

$$E(S_t) = S_0 \times [1 + (R_{FC} - R_{US})]^t$$

THE INTERNATIONAL FISHER EFFECT
Next, we compare PPP and UIP. Both of them have $E(S_1)$ on the left-hand side, so their right-hand sides must be equal. We thus have that:

$$S_0 \times [1 + (h_{FC} - h_{US})] = S_0 \times [1 + (R_{FC} - R_{US})]^t$$
$$h_{FC} - h_{US} = R_{FC} - R_{US}$$

This tells us that the difference in returns between the United States and a foreign country is just equal to the difference in inflation rates. Rearranging this slightly gives us the international Fisher effect (IFE):

$$R_{US} - h_{US} = R_{FC} - h_{FC}$$

The IFE says that *real* rates are equal across countries.