

## Foreign Exchange

The determination of forex rates can be broken down into 2 calculations:

1. **Purchasing Power Parity (PPP)** and
2. **Interest Rate Parity (IRP)**

1. PPP suggests that exchange rates will be affected by the different levels of inflation that hold in each country. For example, if the UK has 3% inflation and the US has 1% inflation, then the UK currency will decline against the US dollar. The price of goods will be the same in each country once you have adjusted for inflation.

The calculation is laid out in the text in section 11.2.4, but a more intuitive way of solving these problems can be done as follows:

- Take the spot forex quote, eg. \$1.444/£1,  
One currency is the domestic currency and one currency is the foreign currency. The currency with the single unit in the quote is the domestic currency (ie, £) and the currency on the left of the quote (the non single unit, ie the \$) is the foreign currency.
- Label one currency domestic (DOM) (£) and one currency foreign (FORN) (\$)
- With the PPP you are looking for the expected spot rate at some time in the future. This can be laid out as follows:

$$\text{Expected spot} = \frac{1 + \text{Foreign inflation rate}}{1 + \text{Domestic inflation rate}} * \text{spot rate}$$

$$= \frac{1 + \text{FORN}}{1 + \text{DOM}} * \text{spot}$$

- In this worked example, the spot is \$1.444/£1, US inflation (Foreign) is 1%, UK inflation (Domestic) is 3%. The expected spot rate in one year's time will be:

$$\text{Expected spot} = \frac{1.01}{1.03} * 1.444$$

$$= 0.98058 * 1.444$$

$$= \$1.41596/£1$$

- If you wanted the expected rate in six months:

$$\begin{aligned}
 \text{Expected spot in 6 mths} &= \frac{(1.01)^{0.5}}{(1.03)^{0.5}} * 1.444 \\
 &= \frac{1.0049876}{1.0148892} * 1.444 \\
 &= \$1.42991/£1
 \end{aligned}$$

So the formula becomes:

$$\text{Expected spot} = \frac{(1 + \text{Foreign inflation rate})^n}{(1 + \text{Domestic inflation rate})^n} * \text{spot rate}$$

- Using other currency pairs, eg Russian Rouble and the euro. If inflation is 11% in Russia and 2% in the euro zone, the spot exchange rate is 34.9969 roubles to the euro, what is the expected spot rate in three months time?

First, identify which currency is the foreign and which is the domestic. The euro is the single unit in the quote so it is the domestic currency. Second, write out our formula and drop the inflation numbers in:

$$\begin{aligned}
 \text{Expected spot (3 mths)} &= \frac{1 + \text{foreign}}{1 + \text{domestic}} * \text{spot rate} \\
 &= \frac{(1 + 0.11)^{0.25}}{(1 + 0.02)^{0.25}} * 34.9969 \\
 &= \text{RR35.74459/1euro}
 \end{aligned}$$

The PPP is a long term determinant of exchange rates. Exchange rates do not change quickly to move to what the PPP would predict, so we would say that PPP does not hold in the short term, but is a much better predictor of exchange rates in the longer term.

## 2. Interest Rate Parity.

This is the method for establishing forward exchange rates in the short term. It holds that the interest rate differential between different currencies will determine the forward exchange rate. The forward exchange rate is something that you can actually trade. You can buy the forex forward (you cannot buy the expected spot rate at some point in the future, ie the rate determined by the PPP). The IRP is a very powerful relationship. The interest rates are visible, all the traders can see what the rates are, so the forward rate can be quickly calculated. If the quoted forward is different from that

calculated, then there is an arbitrage opportunity – someone could make a risk free profit. This is extremely rare.

The IRP relationship is very similar to the PPP. It is as follows:

$$\begin{aligned}\text{Forward rate} &= \frac{1 + \text{Foreign interest rate}}{1 + \text{Domestic interest rate}} * \text{spot rate} \\ &= \frac{1 + \text{FORN}}{1 + \text{DOM}} * \text{spot}\end{aligned}$$

So again with this relationship, we need to firstly identify which currency in the quote is the domestic currency and which is the foreign currency, then the numbers drop into the formula, in a similar way to the PPP.

For example, if interest rates in India are 6.5% and in the US they are 4.5% and the spot rate is 40.96 Rupees to a dollar, what is the one year forward rate?

The foreign currency is the Rupee and the domestic is the dollar. Dropping the interest rates into our formula we have;

$$\begin{aligned}\text{One year forward} &= \frac{1 + 0.065}{1 + 0.045} * 40.96 \\ &= \text{Rupees } 41.744/\$1\end{aligned}$$

What is the rate for six months?

The formula will be:

$$\begin{aligned}\text{Forward rate} &= \frac{(1 + \text{Foreign interest rate})^n}{(1 + \text{Domestic interest rate})^n} * \text{spot rate} \\ \text{six month forward} &= \frac{(1.045)^{0.5}}{(1.065)^{0.5}} * 40.96 \\ &= \text{Rupees } 41.350/\$1\end{aligned}$$

The IRP is how forward rates are calculated. Given the spot exchange rate and the two relevant interest rates the forward rate can easily be calculated.

**The key to solving these types of problems is identifying the Domestic (DOM) rate and the Foreign (FORN) rate (single unit = domestic). Once you have done that the missing rate is easy to find. Applying this method will easily solve any forex problem.**

Practice makes perfect, so here are a few more examples to work through:

1. The UK is expected to have an inflation rate of 2% over the next year. In the US inflation is expected to be 3.5% over the same period. If the spot exchange rate is £0.526315/\$ what is the expected spot exchange rate in six months time?

2. Calculate the following rates:

(a) US & Mexican one year interest rates 4% and 7%, spot rate NP11.09/\$. What is six month forward rate?

(b) Euro zone inflation expected to be 2% over next six months, Japanese inflation expected to be 0.5% over same period. Spot rate is 132.4Y/ 1euro. What is the expected six month spot rate?

(c) The Japanese-US spot exchange rate is 0.010101\$/1Yen. The one year interest rate in Japan is 1% and the one year interest rate in the US is 3.5%. What is the three month forward exchange rate?

(d) The expected inflation rate in the UK is 3% in one year's time in Russia over the same period the inflation rate is expected to be 12%. The spot exchange rate is R52.51/£. What is the expected spot exchange rate in one year's time? In six month's time?

## Solutions:

**Q.1**

|                             | <u>inflation rates</u> |
|-----------------------------|------------------------|
| UK                          | 0.02                   |
| US                          | 0.035                  |
| spot x/r                    | 0.526315               |
| dollar is domestic currency |                        |

$$\text{Exp spot rate} = \frac{1 + \text{for}(\text{UK})}{1 + \text{home}(\text{US})} * \text{spot rate}$$

six month rate:

$$0.9927 * \text{spot rt} = \mathbf{0.5225} \quad 1.9139$$

*£ has strengthened  
US has higher inflation rate*

*Using the pound as domestic*

|          |                         |
|----------|-------------------------|
| spot x/r | 1.900003 (= 1/0.526315) |
| =        |                         |
| UK       | 0.02                    |
| US       | 0.035                   |

$$\frac{1 + \text{for}(\text{US})}{1 + \text{home}(\text{UK})} * \text{spot rate}$$

$$1.0073 * \text{spot rt} = \mathbf{1.9139}$$

**Q.2**

|        | <u>interest rates</u> |
|--------|-----------------------|
| (a) US | 0.04                  |
| Mex    | 0.07                  |
| sp x/r | 11.09                 |

$$\text{Fwd rate} = \frac{1 + \text{for}(\text{Mex})}{1 + \text{home}(\text{US})} * \text{spot rate}$$

$$1.0143 * \text{spot rt} = \mathbf{11.2488} \text{ 6 month fwd rate}$$

|          | <u>inflation rates</u> |
|----------|------------------------|
| (b) euro | 0.02 for 6 mths        |
| Japan    | 0.005 for 6 mths       |
| spot x/r | 132.4                  |

$$\text{Exp spot rate} = \frac{1 + \text{for}(\text{Jp})}{1 + \text{home}(\text{euro})} * \text{spot rate}$$

$$0.9853 * \text{spot rt} = \mathbf{130.4529} \text{ exp 6 mth spot rate}$$

*we just use (1 + inflation rates) directly as they are for 6 months*

|          | <u>interest rates</u> |
|----------|-----------------------|
| (c) US   | 0.035                 |
| Japan    | 0.01                  |
| spot x/r | 0.010101              |

$$\text{Fwd rate} = \frac{1 + \text{for}(\text{US})}{1 + \text{home}(\text{Jp})} * \text{spot rate}$$

$$1.0061 * \text{spot rt} = \mathbf{0.01016} \text{ 3 month fwd rate}$$

| <u>Y/\$</u> | <u>Y/\$</u> |
|-------------|-------------|
| 99.0001     | 98.3968     |
| spot        | 3 mth       |

|          | <u>inflation rates</u> |
|----------|------------------------|
| (d) UK   | 0.03                   |
| Russia   | 0.12                   |
| spot x/r | 52.51                  |

$$\text{Exp spot rate} = \frac{1 + \text{for}(\text{Rus})}{1 + \text{home}(\text{UK})} * \text{spot rate}$$

$$1.0874 * \text{spot rt} = \mathbf{57.0983} \text{ exp 1yr spot rate}$$

$$1.0428 * \text{spot rt} = \mathbf{54.7561} \text{ exp 6 mth spot rate}$$