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Continuing education

How Markets Price FX Forwards

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Forwards have long been the workhorse of forex markets, but not everyone appreciates their pricing subtleties.

Foreign exchange markets can be divided into spot markets and forward markets respectively. Foreign exchange dealers routinely quote forward foreign exchange rates, but the means by which this is accomplished are often not accurately appreciated.

A forward pricing example

Consider the case of a Japanese car manufacturer which exports to the US and consequently has substantial foreign exchange exposures, being long dollar-denominated receivables. In particular, say a receivable of USD10 million is expected in three months and the car manufacturer's treasurer approaches the company's bank seeking a forward foreign exchange contract in order to "fix" the three-month forward exchange rate and avoid exchange rate risk.

Assuming a spot exchange rate of USD/JPY 114.50, the bank immediately quotes a three month forward of USD/JPY 113.06. How does the bank quote the three-month forward rate?

Nuts and bolts. The underlying transactions which enable the bank to quote a forward rate are as follows (see Figure 1):

(1) SPOT: sell USD10 mil at a spot rate of USD/JPY 114.50 and receive JPY 1,129.1913 mil.

(2) SWAP: what in Figure 1 appears to be a 90-day USD borrowing at 5.60% pa, taken together with the 90 day JPY investment at 0.50% pa, is referred to as a 90-day USD/JPY "spot against forward swap.".

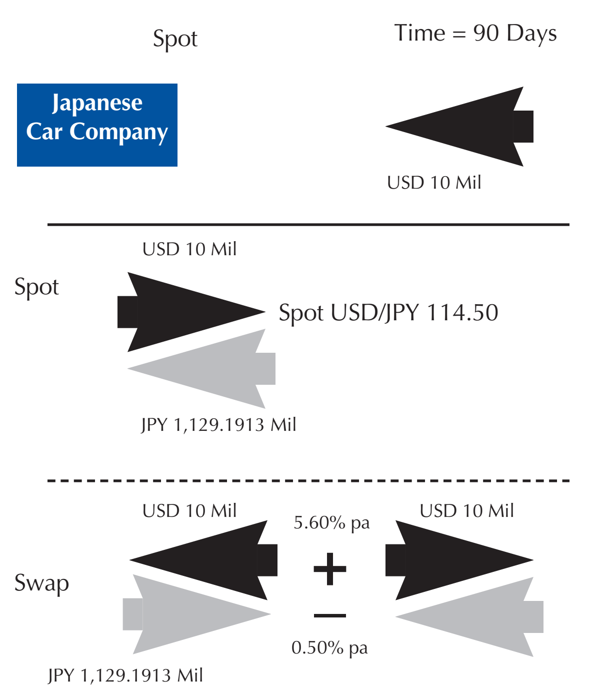
In practice, the swap entails two distinct "legs" (both undertaken with the same counterparty), namely:

(i) at spot: buy USD10 mil and sell JPY1,129.1913 mil and

(ii) 90 days after spot: sell (or swap) USD10 mil and buy an amount of JPY to be determined by the 90-day "forward points" (or "swap points").

It is the combination of the spot transaction (undertaken by specialist spot dealers) and the swap (undertaken by the swap dealers, who deal "forwards") that allows the price-making bank to determine the forward exchange rate.

Figure 1: Determining a Forward FX Rate



Interest differential is key. Notice that the swap described above entails an interest rate differential between the USD and the JPY of: (5.60 - 0.50) = 5.10% pa. It is this interest rate differential which now needs to be translated mathematically to a precise number of "forward points" for, in this case, the 90-day forward time period. This calculation is made by initially defining an exchange rate quotation:

UNIT/CURRENCY (spot rate)

where:

- UNIT = first quoted currency
- CURRENCY = second quoted currency (to the right of the "/")
- spot rate = a varying numerical market determined rate
- and noting that the "/" means "equal to" not "divide by."

For a dealer to then make a forward USD/JPY quote, there must be two interest rates for the particular time period. In general, the dealer will seek the interest rate on the UNIT of the quote (here, the USD interest rate) and the interest rate on the CURRENCY of the quote (here, the JPY interest rate).

The equation for forward points, POINTS, is then given by:

$$\text{POINTS} = \frac{\text{SPOT} \times (\pm \text{IUNIT} \mp \text{ICUR}) \times (\text{DAYS}/360)}{1 + [(\text{DAYS}/360) \times \text{IUNIT}]}$$

where:

- SPOT = spot exchange rate
- IUNIT = interest rate on UNIT of quote (entered as decimal)
- ICUR = interest rate on CURRENCY of quote (entered as decimal)
- DAYS = days in forward period
- and assuming a 360 day year (rather than a 365 day year).

For example, assuming the following:

- SPOT = 114.50
- IUNIT = 5.60% pa (the USD interest rate)
- ICUR = 0.50% pa (the JPY interest rate)
- DAYS = 90

then the 90 day forward USD/JPY points are:

$$\text{POINTS} = \frac{114.50 \times (\pm 0.056 \mp 0.0050) \times (90/360)}{1 + [(90/360) \times 0.056]}$$

$$= 144 \text{ points}$$

This is the equivalent of 1.44 JPY, after rounding the calculated number after the second decimal place and then ignoring the decimal point.

Outright rate. The calculated forward points would be deducted from the spot rate of USD/JPY 114.50, because US

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interest rates are higher than Japanese rates. Hence the 90-day outright forward rate would be:

USD/JPY (114.50 - 1.44) = USD/JPY 113.06

Arbitrage over expectations

What if another dealer is quoting a different number of forward points (e.g., 140 points) for the same forward date at the same time? Clearly, an arbitrage opportunity would exist. The dealer who had just formally calculated the 90-day forward points would buy USD 90 days forward at the "high" number of points (i.e., 144) deducted from the spot rate and simultaneously sell USD 90 days forward at the "low" number of points (i.e., 140) deducted from the spot rate, making a risk-free (or arbitrage) profit. In effect, the two money markets (the US and Japanese) have been arbitraged against the FX market.

Such arbitrage is why interest rate differentials have the most compelling influence on forward foreign exchange rate determination—and not expectations of future spot moves (a common misperception).

Any dealer who ever quotes a forward price which differs markedly from that dictated by the interest rate differential merely presents other dealers with a risk-free profit opportunity. This is why it would be sheer folly for a bank to quote forward prices that simply reflected its expectations of the future spot rate.

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