An introduction to the foreign exchange market
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The market in foreign exchange is an excellent example of a liquid, transparent and immediate global financial market. Rates in the foreign exchange (FX) markets move at an extremely rapid pace and in fact, it is a very different discipline to bond trading or money markets trading. There is a considerable literature on the FX markets, as it of course a separate subject in its own right. Some banks organise their forward desk as part of the money markets and not the foreign exchange desk, so it is useful for money market traders and salespersons to have an understanding of this subject.

The price quotation for currencies generally follows the ISO convention, which is also used by the SWIFT and Reuters dealing systems, and is the three-letter code used to identify a currency, such as USD for US dollar and GBP for sterling. The rate convention is to quote everything in terms of one unit of the US dollar, so that the dollar and Swiss franc rate is quoted as USD/CHF, and is the number of Swiss francs to one US dollar. The exception is for sterling, which is quoted as GBP/USD and is the number of US dollars to the pound. The rate for euros has been quoted both ways round, for example EUR/USD although some banks, for example RBS Financial Markets in the UK quotes euros to the pound, that is GBP/EUR.

Spot exchange rates

A *spot* FX trade is an outright purchase or sale of one currency against another currency, with delivery two working days after the trade date. Non-working days so not count, so a trade on a Friday is settled on the following Tuesday. There are some exceptions to this, for example traded of US dollar against Canadian dollar are settled the next working day; note that in some currencies, generally in the middle east, markets are closed on Friday but open on Saturday. A settlement date that falls on a public holiday in the country of one of the two currencies is delayed for settlement by that day. An FX transaction is possible between any two currencies, however to reduce the number of quotes that need to be made the market generally quotes only against the US dollar or occasionally sterling or euro, so that the exchange rate between two non-dollar currencies is calculated from the rate for each currency against the dollar. The resulting exchange rate is known as the *cross-rate*. Cross-rates themselves are also traded between banks in addition to dollar-based rates. This is usually because the relationship between two rates is closer than that of either against the dollar, for example the Swiss franc moves more closely in line with the euro than against the dollar, so in practice one observes that the dollar / Swiss franc rate is more a function of the euro / franc rate.

The spot FX quote is a two-way bid-offer price, just as in the bond and money markets, and indicates the rate at which a bank is prepared to buy the base currency against the variable currency; this is the "bid" for the variable currency, so is the lower rate. The other side of the quote is the rate at which the bank is prepared to sell the base currency

against the variable currency. For example a quote of 1.6245 - 1.6255 for GBP/USD means that the bank is prepared to buy sterling for $1.6245, and to sell sterling for $1.6255. The convention in the FX market is uniform across countries, unlike the money markets. Although the money market convention for bid-offer quotes is for example, 5½% - 5¼%, meaning that the "bid" for paper - the rate at which the bank will lend funds, say in the CD market - is the higher rate and always on the left, this convention is reversed in certain countries. In the FX markets the convention is always the same one just described.

The difference between the two side in a quote is the bank's dealing spread. Rates are quoted to $1/100^{th}$ of a cent, known as a *pip*. In the quote above, the spread is 10 pips, however this amount is a function of the size of the quote number, so that the rate for USD/JPY at say, 110.10 - 110.20, indicates a spread of 0.10 yen. Generally only the pips in the two rates are quoted, so that for example the quote above would be simply "45-55". The "big figure" is not quoted.

Example 1
Exchange cross-rates

Consider the following two spot rates:
EUR/USD   1.0566-1.0571
AUD/USD   0.7034-0.7039

The EUR/USD dealer buys euros and sells dollars at 1.0566 (the left side), while the AUD/USD dealer sells Australian dollars and buys US dollars at 0.7039 (the right side). To calculate the rate at which the bank buys euros and sells Australian dollars, we need:

1.0566 / 0.7039 = 1.4997 is the rate at which the bank buys euros and sells Australian dollars. In the same way the rate at which the bank sells euros and buys Australian dollars is given by 1.0571 / 0.7034 or 1.5028.

Therefore the spot EUR/AUD rate is 1.4997 - 1.5028.

The derivation of cross-rates can be depicted in the following way. If we assume two exchange rates XXX/YYY and XXX/ZZZ, the cross-rates are:

YYY/ZZZ = XXX/ZZZ ÷ XXX/YYY
ZZZ/YYY = XXX/YYY ÷ XXX/ZZZ

Given two exchange rates YYY/XXX and XXX/ZZZ, the cross-rates are:

YYY/ZZZ = YYY/XXX × XXX/ZZZ
ZZZ/YYY = 1 ÷ (YYY/XXX × XXX/ZZZ)

Forward exchange rates

Forward outright

The spot exchange rate is the rate for immediate delivery (notwithstanding that actual delivery is two days forward). A *forward contract* or simply *forward* is an outright purchase or sale of one currency in exchange for another currency for settlement on a specified date at some point in the future. The exchange rate is quoted in the same way as the spot rate, with the bank buying the base currency on the bide side and selling it on the offered side. In some emerging markets no liquid forward market exists so forwards are settled in cash against the spot rate on the maturity date. These *non-deliverable forwards* are considered at the end of this section.

Although some commentators have stated that the forward rate may be seen as the market's view of where the spot rate will be on the maturity date of the forward transaction, this is incorrect. A forward rate is calculated on the current interest rates of the two currencies involved, and the principle of no-arbitrage pricing ensures that there is no profit to be gained from simultaneous (and opposite) dealing in spot and forward. Consider the following strategy:

- borrow US dollars for six months starting from the spot value date;
- sell dollars and buy sterling for value spot;
- deposit the long sterling position for six months from the spot value date;
- sell forward today the sterling principal and interest which mature in six months time into dollars.

The market will adjust the forward price so that the two initial transactions if carried out simultaneously will generate a zero profit / loss. The forward rates quoted in the trade will be calculated on the six months deposit rates for dollars and sterling; in general the calculation of a forward rate is given as (1).

$$Fwd = Spot \times \frac{\left(1 + \text{variable currency deposit rate} \times \frac{days}{B}\right)}{\left(1 + \text{base currency deposit rate} \times \frac{days}{B}\right)} \qquad (1)\text{ril}$$

The year day-count base B will be either 365 or 360 depending on the convention for the currency in question.

Example 2
Forward rate

90-day GBP deposit rate: 5.75%
90-day USD deposit rate: 6.15%
Spot GBP/USD rate: 1.6315 (mid-rate)

The forward rate is given by:

$$1.6315 \times \frac{\left(1 + 0.0575 \times \frac{90}{365}\right)}{\left(1 + 0.0615 \times \frac{90}{360}\right)} = 1.6296$$

Therefore to deal forward the GBP/USD mid-rate is 1.6296, so in effect £1 buys $1.6296 in three months time as opposed to $1.6315 today. Under different circumstances sterling may be worth more in the future than at the spot date.

Forward swaps

The calculation given above illustrates how a forward rate is calculated and quoted in theory. In practice as spot rates change rapidly, often many times even in one minute, it would be tedious to keep re-calculating the forward rate so often. Therefore banks quote a forward spread over the spot rate, which can then be added or subtracted to the spot rate as it changes. This spread is known as the *swap points*. An approximate value for the number of swap points is given by 30.20 below.

$$\text{Forward swap} \approx \text{spot} \times \text{deposit rate differential} \times \frac{days}{B} \qquad (2)$$

The approximation is not accurate enough for forwards maturing more than 30 days from now, in which case another equation must be used. This is given as (2).It is also possible to calculate an approximate deposit rate differential from the swap points by re-arranging 30.20.

$$\text{Forward swap} = \text{spot} \times \frac{\left(\text{variable currency depo rate} \times \frac{days}{B} - \text{base currency depo rate} \times \frac{days}{B}\right)}{\left(1 + \text{base currency depo rate} \times \frac{days}{B}\right)}$$

(3)

The swap points are quoted as two-way prices in the same way as spot rates. In practice a middle spot price is used and then the forward swap spread around the spot quote. The difference between the interest rates of the two currencies will determine the magnitude of the swap points and whether they are added or subtracted from the spot rate. When the swap points are positive and the forwards trader applies a bid-offer spread to quote a two-way price, the left-hand side of the quote is smaller than the right-hand side as usual. When the swap points are negative, the trader must quote a "more negative" number on the left and a "more positive" number on the right-hand side. The "minus" sign is not shown however, so that the left-hand side may appear to be the larger number. Basically when the swap price appears larger on the right, it means that it is negative and must be subtracted from the spot rate and not added.

Forwards traders are in fact interest rate traders rather than foreign exchange traders; although they will be left positions that arise from customer orders, in general they will manage their book based on their view of short-term deposit rates in the currencies they are trading. In general a forward trader expecting the interest rate differential to move in favour of the base currency, for example, a rise in base currency rates or a fall in the variable currency rate, will "buy and sell" the base currency. This is equivalent to borrowing the base currency and depositing in the variable currency. The relationship between interest rates and forward swaps means that banks can take advantage of different opportunities in different markets. Assume that a bank requires funding in one currency but is able to borrow in another currency at a relatively cheaper rate. It may wish to borrow in the second currency and use a forward contract to convert the

borrowing to the first currency. It will do this if the all-in cost of borrowing is less than the cost of borrowing directly in the first currency.

Forward cross-rates

A forward cross-rate is calculated in the same way as spot cross-rates. The formulas given for spot cross-rates can be adapted to forward rates.

Forward-forwards

A forward-forward swap is a deal between two forward dates rather than from the spot date to a forward date; this is the same terminology and meaning as in the bond markets, where a forward or a forward-forward rate is the zero-coupon interest rate between two points both beginning in the future. In the foreign exchange market, an example would be a contract to sell sterling three months forward and buy it back in six months time. Here, the swap is for the three-month period between the three-month date and the six-month date. The reason a bank or corporate might do this is to hedge a forward exposure or because of a particular view it has on forward rates, in effect deposit rates.

Example 4
Forward-forward contract

GBP/USD spot rate: 1.6315-20
3-month swap: 45-41
6-month swap: 135-125

If a bank wished to sell GBP three month forward and buy them back six months forward, this is identical to undertaking one swap to buy GBP spot and sell GBP three months forward, and another to sell GBP spot and buy it six months forward. Swaps are always quoted as the quoting bank buying the base currency forward on the bid side, and selling the base currency forward on the offered side; the counterparty bank van "buy and sell" GBP "spot against three months" at a swap price of -45, with settlement rates of spot and (spot - 0.0045). It can "sell and buy" GBP "spot against six months" at the swap price of -125 with settlement rates of spot and (spot - 0.0125). It can therefore do both simultaneously, which implies a difference between the two forward prices of (-125) - (-45) = -90 points. Conversely the bank can "buy and sell" GBP "three months against six months" at a swap price of (-135) - (-41) or -94 points. The two-way price is therefore 94-90 (we ignore the negative signs).