Currency Forward Model

An FX Forward is a deal where one currency is exchanged for another currency at future date at a pre-determined exchange rate. The pre-determined FX rate is determined at deal inception and is referred to as the forward exchange rate.

FX forwards are off-balance sheet instruments because when they are initiated there is no premium; the forward exchange rate when a deal first commences guarantees that there is no premium.

FX marking-to-market relies on FX forward re-valuation. Forward exchange rates used in FX forward re-valuation are determined using forward points. For example, the 1-year forward USD-CAD exchange rate is determined by adding the 1-year USD-CAD forward point to the spot USD-CAD exchange rate.

Forward points are values quoted by dealers. These values may be positive or negative because of different interest rates for different currencies. In principle, forward points are given by using the standard formula that relates the spot FX rate to the forward FX rate and subtracting spot FX rate.

Trading agency provides the most comprehensive list of forward point quotes. The listing of forward points covers FX forward contracts maturing in one, two and seven days, and one, two, three, six, nine and twelve months.

Any intermediate forward points are linearly interpolated rather than obtaining a forward point quote directly from a dealer. It should be noted that since there are bid and offer spot FX rates, there are also bid and offer forward points.

The following convention should be noted: if, for example, the spot date is January 26, 1999, the date for an FX forward point at one month is February 26, 1999; and if, for example, the spot date is January 31, 1999, the date for an FX forward point at one month is February 28, 1999.

Given spot rate X_s , spot date T_s and forward date T, the FX forward rate can be represented as

$$\begin{cases} X_f = X_s \dfrac{D_b(T_s, T)}{D_q(T_s, T)} & if \;\; T \geq T_s \\ X_f = X_s \dfrac{D_q(T, T_s)}{D_b(T, T_s)} & if \;\; T < T_s \end{cases}$$

where

X_s the spot FX rate quoted as base/quote

t the valuation date

T_s the spot date (several days after the valuation date)

T the forward date

$D_b(T_s, T)$ the discount factor of base currency from spot date to forward date

$D_q(T_s, T)$ the discount factor of quote currency from spot date to forward date

The present value of an FX forward contract is given by

$$PV(t) = N_b D_b(t, T) X_0 - N_q D_q(t, T)$$

where

t the valuation date

T the payment date

X_s the spot FX rate quoted base/quote

$D_b(t, T)$ the discount factor of base currency from valuation date to forward date

$D_q(t, T)$ the discount factor of quote currency from valuation date to forward date

N_b the notional principal amount for base currency

N_q the notional principal amount for quote currency

You can find more details at
https://finpricing.com/lib/EqCppi.html