

## Under the Hood: Valuation, Issue 3

### FX Valuation

In Issue 1 we introduced present values and explained how future cash flows can be discounted to find the value of a financial instrument. In this issue we will extend that methodology to cash flows that are denominated in a foreign currency.

#### Interest Rate Parity

Consider a foreign exchange transaction where we will sell goods for USD10m in one year from now. On the day of the transaction we will need to pay the USD10m to our bank in exchange for an uncertain amount of AUD.

So what is the fair value of the unknown AUD amount today? To answer this question, we need to know the one-year forward exchange rate. This is the exchange rate we could lock in today so that we can receive a known amount of AUD in return for USD10m after one year.

FX valuation relies on a theory known as *interest rate parity*. It asserts that the cost of borrowing in the domestic currency should be equivalent to borrowing in a foreign currency and locking in the future currency conversions at the present time. In other words, there is a *no-arbitrage* condition relating domestic interest rates, foreign interest rates, the current exchange rate and the future exchange rate.

#### Example 1

Australian one-year interest rate	6.00%
US one-year interest rate	5.40%
Spot exchange rate	0.7400
One-year forward exchange rate	?

Let's say we need to borrow AUD10m for one year. The market rate of interest for this term is 6.00%. At maturity we will need to repay principal and interest of AUD10.6m.

Alternatively we can borrow an equivalent amount of USD7.4m at 5.40% and convert it to AUD10m at the spot exchange rate of 0.7400. At maturity we then need to repay principal and interest of USD7.8m. The calculations for these numbers are shown in the table below.

To lock in the future repayment of USD7.8m, we need to enter a one-year forward exchange contract (FEC), but at what rate?

Example 1 calculations	Alternative 1: Borrow in AUD	Alternative 2: Borrow in USD
Amount Borrowed	AUD 10,000,000	USD 7,400,000 = 10m * 0.74
Amount Repaid in One Year	AUD 10,600,000 = 10m * (1 + 0.06)	USD 7,799,600 = 7.4m * (1 + 0.054)
One-year forward exchange rate = 7,799,600 / 10,600,000 = 0.7358		

#### No Arbitrage Condition

The one-year forward rate in this example must satisfy the *no-arbitrage* condition. This requirements means that the final repayments under both alternatives must be exactly equal when compared as AUD amounts. That is, the USD7.8m amount must convert to AUD10.6m. Solving these amounts for the exchange rate gives us a forward rate of 0.7358.



Example 1 demonstrates the *interest parity condition* which can be expressed as:

$$F \times (1 + r_f) = S \times (1 + r_d)$$

where: F = forward rate  
 S = spot rate (expressed as domestic currency per unit of foreign currency)  
 r<sub>d</sub> = domestic interest rate  
 r<sub>f</sub> = foreign interest rate.

If the interest parity condition does not hold then a riskless profit could be made with zero net investment.

### Valuing a Foreign Exchange Contract

To value an FEC we need to compare the instrument we currently hold with an equivalent instrument quoted in the market at the time of valuation. If the current instrument has a more favourable payoff at maturity then we will have a positive mark-to-market.

#### Example 2

Using the FEC from Example 1, we now move six months into the future. The FEC has another six months until settlement at a rate of 0.7358. At settlement we will sell USD7.8m and buy AUD10.6m. The prevailing rates we observe in the market for this transaction and the interest parity condition are as follows:

Australian six-month interest rate	6.40%
US six-month interest rate	5.30%
Spot exchange rate	0.7700
Six-month forward exchange rate	?

$$\text{Interest parity condition: } F \times \left(1 + \frac{0.064}{2}\right) = 0.77 \times \left(1 + \frac{0.053}{2}\right)$$

Solving for F in the formula above gives a forward rate of 0.7620. This rate is less favourable than our current hedge rate of 0.7358 and so the mark-to-market will be positive. We can lock in the gain by entering a new FEC in the opposite direction to the original but at the prevailing market rate of 0.7620. The resulting flows are as follows:

Closing out the FX position	AUD Flows	USD Flows
Existing FEC to sell USD / buy AUD at 0.7358	+ 10,600,000	- 7,799,600
New FEC in reverse direction to buy USD / sell AUD at 0.7620	- 10,255,118	+ 7,799,600
Net proceeds at maturity date:	+ 374,882	0

We will receive the gain of AUD374,882 when the FEC settles in six months from now. We now need to find the present value of that gain. As we learnt in Issue 1 of *Under the Hood*, the present value is calculated by discounting the future gain at the AUD interest rate of 6.40% for six months. In this case our FEC is worth AUD363,258 today.

$$PV = \frac{374,882}{1 + 0.064/2} = 363,258$$

### FX Pre-Deliveries and Extensions

When we pre-deliver or extend an FEC we are effectively altering the timing of the cash flows of the transaction. This change will have a direct impact on the valuation. A new FEC rate must be calculated such that the market value of the old FEC is equal to the market value of the new FEC. The bank will add or subtract the required amount of forward points so that the mark-to-market valuations are equal.

Typically the bank will also take a few points of margin as a fee for carrying out the pre-delivery or extension. Following the procedure in Example 3 will assist you in approximating the transaction cost being charged by the bank.

#### **Example 3**

Let's assume that on 30 December 2005 we entered a one-year FEC to sell USD10,000,000 at 0.7270. On 30 December 2006 that means we will receive AUD13,755,158.

On 30 June 2006 we decide to pre-deliver the FEC by three months. The new settlement date is 30 September 2006.

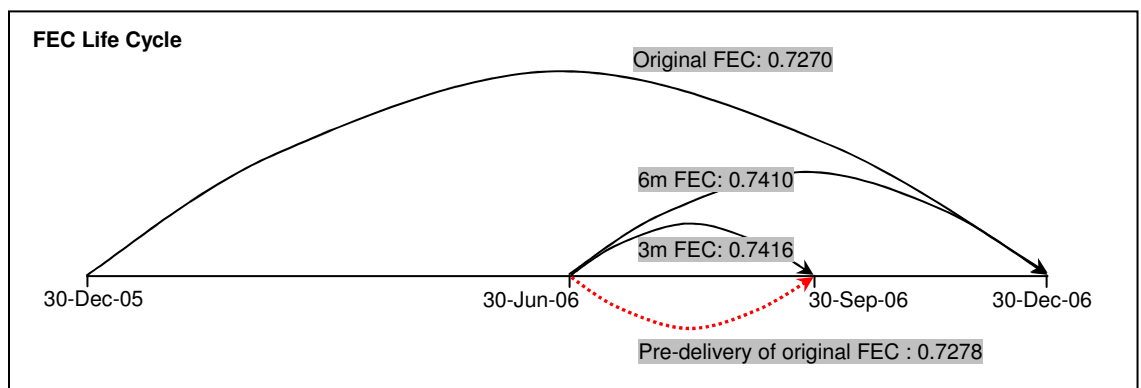
The prevailing market rate of a six-month FEC is 0.7410 on 30 June 2006. Our original FEC rate of 0.7270 is more favourable and so we have a positive mark-to-market. In this case, the mark-to-market value is AUD252,435. When the deal is pre-delivered, the bank will need to select a new rate for the three-month pre-delivery such that it also has a market value of AUD252,435.

In order to calculate the new rate, we start with the prevailing market rate of 0.7416 for a three-month FEC on 30 June 2006. If we sold USD10,000,000 using this contract then we would receive AUD13,484,358 on 30-Sep-2006.

However we also need to receive an additional AUD amount representing the mark-to-market gain on the original FEC. The amount we calculated above was AUD252,435 representing the present value as at 30 June 2006. We need to take the future value of this amount as at 30 September 2006 which is AUD256,133.

Adding the AUD amount of the current three-month FEC and the future value of the mark-to-market gain gives us AUD13,740,491. We will receive this amount in exchange for USD10,000,000 under the pre-delivery. Dividing the USD amount by the AUD amount gives a pre-delivery rate of 0.7278 which is eight points worse than the original FEC rate of 0.7270.

A worksheet outlining the calculations in this example is available on the next page.





**Example 3 Worksheet**

30-Dec-05		
<b>Enter Original FEC</b>		
Prevailing 12 month FEC rate	0.7270	
Sell USD	10,000,000	= Required USD amount
Buy AUD	13,755,158	= 10,000,000 / 0.7270
30-Jun-06		
Prevailing 3 month FEC rate	0.7416	} Inputs provided by a treasury system.
Prevailing 6 month FEC rate	0.7410	
AUD 3 month discount rate	5.86%	
AUD 6 month discount rate	5.90%	
<b>Close Out Original FEC</b>		
6 month FEC rate	0.7410	
Buy USD	10,000,000	
Sell AUD	13,495,277	= 10,000,000 / 0.7410
AUD Gain on original FEC at maturity	259,882	= 13,755,158 - 13,495,277
6 month discount rate	5.90%	
Present value of AUD gain	252,435	= 259,881 / (1 + 0.059 / 2)
<b>Enter Pre-Delivery</b>		
3 month FEC rate	0.7416	
Sell USD	10,000,000	
Buy AUD	13,484,358	= 10,000,000 / 0.7416
Present value of required AUD gain	252,435	
3 month discount rate	5.86%	
Future value of required AUD gain	256,133	= 252,435 * (1 + 0.0586 / 4)
Adjusted Buy AUD amount	13,740,491	= 13,484,358 + 255,974
Adjusted FEC rate	0.7278	= 10,000,000 / 13,740,332

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