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Under the Hood: Valuation, Issue 1

The understanding of financial instrument valuation has become increasingly important in recent times. International Financial Reporting Standards (in particular IAS39) have changed to create a major new focus on the fair value reporting of derivatives. Many financial instruments that could previously be reported off balance sheet must now be valued and disclosed in financial statements. In some cases, changes in an instrument's value may now impact on the income statement as a gain or loss.

The IFRS and other regulatory changes can have significant implications for your treasury function. This article is the first in a series outlining what you need to know about financial instrument valuation.

When we talk about valuation (also known as mark-to-market) we are referring to the net present value (NPV) of the expected future cash flows of an instrument. This definition has two key components: *present value* and *expected cash flows*. In this article we will explain how a treasury system can help to determine the expected cash flows of a vanilla instrument and then calculate the present value of those flows.

Time is Money

Present value (PV) is a concept based on opportunity cost and the time value of money. The value of a cash flow depends on its timing because a dollar received today is worth more than a dollar received in the future. The compound interest formula shows the relationship between PV and future value (FV):

$FV = PV \times (1+r)^n$ where r = interest rate per period, n = number of periods.

Example 1

We are contracted to pay $1m after one year. Let's also assume the current interest rate is 5.00% for one year. Rearranging and solving the formula for PV gives us:

$$\$1{,}000{,}000 = PV \times (1+0.05)$$

$$\Rightarrow PV = \frac{1{,}000{,}000}{1+0.05} = \$952{,}380.95$$

This is the amount we can start with today and be sure we have exactly $1m to meet our commitment on the required date. As such, we would be indifferent between paying the present value of $952,380.95 today or the future value (FV) of $1,000,000 in one year.

Zero-Rates and Discount Factors

The rate of 5.00% in Example 1 is known as the one-year zero-rate because it pays interest at maturity with no interim coupon payments. A discount factor is the ratio of PV to FV for a given zero-rate and time to maturity. For a cash flow occurring in n years from now, we use an n-year zero rate (z_n) to calculate a discount factor by rearranging the present value formula:

$$\text{Discount factor} = \frac{PV}{FV} = \frac{1}{(1+z_n)^n}$$

Example 2

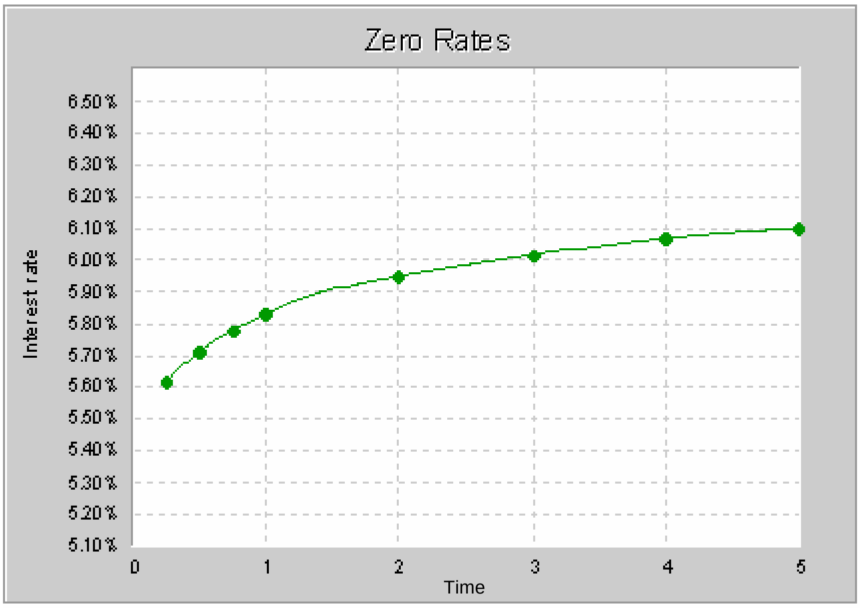
We have a $10m cash flow occurring after two years. Assuming the annualised zero-rate for two years is 6.00% we calculate a discount factor of 0.8900 ($1 / [1 + 0.06]^2$). Rearranging the formula gives us PV = FV × discount factor, allowing us to calculate a present value of $10m × 0.8900 = $8.9m.

Using Zero-Curves

Valuation needs to be based on market rates to obtain a fair value at the current point in time. To start with we need to find zero-rates in the market that match each of our cash flow dates. We can observe interest rates in the money market, futures market and swap market, but usually we come across two problems:

- Some of the market rates will pay coupons and cannot be used directly to value our non-coupon paying cash flows.
- Some of our cash flows will fall between the maturity dates of two market rates.

To overcome the first problem, we need to manipulate the market data to construct a zero-curve by using a technique such as bootstrapping. This process is typically carried out within a treasury system – we input the market rates and the system generates a curve that plots zero rates against the time to maturity. Once this curve has been generated, we can then use an interpolation method to find zero-rates and discount factors for maturity dates falling between the points on the zero-curve. In the next article we will find out more about these techniques.



Valuing Vanilla Instruments

The first step when valuing an instrument is to estimate all the future cash flows. We know the exact cash flow amounts for fixed-rate instruments but may need to forecast the amounts for floating-rate instruments. An interest rate swap is a good example, as it combines both fixed (known) and floating (unknown) legs.

We already know the fixed leg payments for a swap and can discount them using the zero-curve. But the floating leg cash flows are uncertain. A treasury system will use the zero-curve to project forward interest rates and thereby calculate the expected floating cash flows. The swap is then valued by summing the PV of each leg. So just like our very first example, we are discounting individual cash flows by the appropriate discount factors worked out from a zero-curve.

Example 3

Let's say we have a $10m swap paying a fixed rate of 6.25% every quarter for one more year before it matures. Using a treasury system we obtain the 90-day BBSW interest rate forecasts, zero-rates and discount factors for each quarter as presented in Table 1 (assume 90 days in each quarter).

Table 1: Forecast rates, zero-rates and discount factors

Time	90-day BBSW Forecast	Zero Rate	Discount Factor	Floating Receipt	Fixed Payment
Q1	5.65%	5.61%	0.9863	141,250	-156,250
Q2	5.84%	5.71%	0.9719	146,000	-156,250
Q3	5.94%	5.77%	0.9576	148,500	-156,250
Q4	6.03%	5.83%	0.9434	150,750	-156,250
Total				**586,500**	**-625,000**

Using the 90-day BBSW forecasts, we can work out the floating leg amounts we can expect to receive in each quarter. We then multiply each cash flow by the corresponding discount factor to find the PV.

Table 2: Present value calculations

Time	Floating Leg PV	Fixed Leg PV	Total PV
Q1	141,250 × 0.9863 = 139,315	-156,250 × 0.9863 = -154,109	-14,794
Q2	146,000 × 0.9719 = 141,897	-156,250 × 0.9719 = -151,859	-9,962
Q3	148,500 × 0.9576 = 142,204	-156,250 × 0.9576 = -149,625	-7,421
Q4	150,750 × 0.9434 = 142,218	-156,250 × 0.9434 = -147,406	-5,188
Total	**565,634**	**-603,009**	**-37,375**

The PV of the floating leg is the sum of the discounted amounts, in this case being $565,634. Discounting the fixed leg payments gives us a sum of -$603,009 and leads to a NPV of -$37,375 after combining both legs. In other words, the swap is out-of-the-money and we would need to pay our counterparty $37,375 if we wanted to terminate the deal.

Future Topics

In a later article we will discuss options and exotic instruments. Valuing these instruments is different to interest rate swaps because the cash flows are contingent on certain events. With swaps we know when a cash flow will occur and simply need to estimate the amount. With options and exotic instruments, we are unsure if the cash flows will occur because they rely on strike prices, barriers and other conditions.

If you would like us to discuss any particular aspect of valuation or any other risk management topics in a future article then please contact us.

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