KEY POINTS

- The value of a swap is determined by calculating the value of each future cash flow in today's terms (the present value).
- Three types of cash flows might occur: fixed, variable or contingent.
- The valuation can be conducted at the inception of the transaction which can determine its *hidden* or *implicit* cost.
- It can also be conducted at any time during its life (mark-to-market (MTM)) which provides an indication of the loss or profit on unwinding (breaking) the transaction.

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Valuing swaps: what exactly are "hidden costs" and "mark-to-market"?

Calculating the value of an interest rate swap, or any financial security, has always been extremely important not just for market participants, but also in litigation. Several aspects of the analysis – such as mark-to-market (MTM) and hidden costs – have been highlighted in cases. This article explains the valuation method and its importance to litigation.

The idea of "mark-to-market" (MTM) of financial derivatives such as swaps has always been critical for banks and regulators, and now it is important in litigation. Walker J in *Dexia Crediop SpA v Comune di Prato* [2015] EWHC 1746 (Comm) said (at para 36): "Issues arise in the present case as to whether the MTM of the swaps had any, and if so what, relevance to their validity to enforceability".[1] He goes on: "MTM is generally understood in its simplest form to mean the present value of the expected cash-flows, calculated according to a series of generally accepted conventions". Walker J alludes to complexities in the calculation (at para 40). How is MTM calculated and what complexities are important to consider?

A RECAP OF INTEREST RATE SWAPS

Whilst the question of MTM is important for all derivatives and indeed, more generally, all securities, I shall discuss the principles of MTM in relation to interest rate swaps (also referred to as IRSs, or simply swaps), the instrument in question in *Prato*.

A swap is an agreement between two parties where one party pays a fixed rate of interest on a periodic basis (interest period) calculated against a notional amount and the other party pays an amount linked to a variable interest rate, historically typically LIBOR or now one of its replacements such as SONIA (for British pounds) and SOFR (for US dollars)[2] during each interest period. To illustrate the mechanics of a swap, a transaction denominated in euros and with a EURIBOR variable rate (akin to the old LIBOR) will be used.

Party A (usually a borrower such as Prato; also known as the Fixed Rate Payer) agrees to pay a fixed rate of interest of 5.25% to Party B (usually a bank such as Dexia; also known as the Floating Rate Payer or the Variable Rate Payer). Party B agrees to pay a variable rate (also known as the floating rate) of interest of 3-month EURIBOR to Party A every quarter. The calculation of the interest amount is based on a notional value of €100m. This notional value is never actually paid or received by either party; it is merely used to calculate the fixed and variable interest amounts. In practice the net amount of interest is payable by one party to the other. The payments continue for, say, two years, the tenor of the transaction.

The method of calculation of each interest amount, the action to take should a payment date fall on a holiday etc, are defined in a swap confirmation exchanged between the parties and more general terms are defined in the ISDA[3] agreement, if one has been entered into. These details are important because it allows for the calculation of the exact amounts payable by Party A and B on each interest payment date.

The fixed rate payable by Party A for two years is known as the two-year swap rate.

A liquid market exists in interest rate swaps, typically up to 30 years and sometimes longer (dependant on the currency). Each maturity will have a different swap rate and together they form a swap curve. The swap rates themselves change like the price of any other traded asset such as equities (see Table 1 below).

The value of the swap can be calculated once the *expected cash-flows* payable by parties A and B are known over its life.

EXPECTED CASH-FLOWS

The calculation of the amount payable by Party A (the fixed rate) is relatively straightforward. First the number of days between the last interest payment date and the next one is calculated which then determines the fraction of the year represented by the particular interest period. For ease of calculation, I shall assume that each quarter period is 0.25 years.[4] The interest payable by Party A is then calculated to be €1,312,500 (5.25% x 0.25 x €100,000,000) each quarter.

Suppose the 3-month EURIBOR at the start of the first interest period is 4%, then Party B has to pay €1,000,000 (4% x 0.25 x €100,000,000). In practice, Party A pays Party B the net amount of €312,500 on the interest payment date (€1,312,500 minus €1,000,000).

A difficulty arises with future interest periods because the EURIBORs are not yet known; the required EURIBOR for the next interest period is the one published at the start of that period. However, the future *expected* EURIBORs (or any

TABLE 1: SWAP RATES

SWAP TENOR (YEARS)	SWAP RATE ON (7 FEBRUARY 2023)	SWAP RATE ON (6 JANUARY 2022)
1	3.217%	- 0.319%
5	2.794%	0.471%
10	2.785%	0.645%
30	2.416%	0.643%

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other variable rate) can be calculated at any time from the then swap curve. It is important to note that the calculations of the future EURIBORs do not represent predictions of what they will be; they are simply calculated using the current swap curve on the calculation date.

To illustrate how this is done, suppose the 3-month EURIBOR is 4% and the 6-month EURIBOR is 4.25% on the valuation date. These are the actual market rates for borrowing euros from a market counterparty for three months and six months, respectively. To calculate the expected payments made by Party B (the floating rate payer) in the second quarter, we need the 3-month EURIBOR in three months' time. This figure will not be published for three months, but the expected value can be calculated from the current 3-month and 6-month rates. Borrowing euros for six months (at the 6-month EURIBOR of 4.25%) must be the same in terms of the total interest paid as borrowing for three months now (at the 3-month EURIBOR of 4%) and then for a further three months at the 3-month EURIBOR starting in three months (this is the rate we are after). Following the logic through gives the 3-month EURIBOR in three months' time of 4.46%. In this fashion all the expected future 3-month EURIBORs can be calculated on the valuation date using only the then swap curve.

Once the future expected EURIBORs have been computed, the net cash-flows between the two parties can be calculated, as shown in Table 2.

PRESENT VALUE

The total net amount paid by Party A to Party B in this example is €335,000 (the sum of figures in the fourth column). This is not the complete story because each of these payments occur at varying dates in the future over the life of the 2-year swap. To be comparable, the value of each of the future payments must be adjusted to reflect the difference in value between a payment today and a payment in the future; that is how the present value of the future cash flows is calculated. €1,000,000 is worth more than €1,000,000 in three months' time. This is because €1,000,000 today can be deposited at the 3-month EURIBOR (4%) to get €1,010,000. The extra €10,000 represents the interest received after three months (€1,000,000 x 4% x 0.25). It follows that €1,010,000 in three months is equivalent to €1,000,000 today; in other words, the present value of €1,010,000 is €1,000,000. The interest rate used to calculate the present value of each of the future cash flows is derived from the then swap curve. The present value of future cash flows in the 2-year swap is calculated as shown in Table 3.

TABLE 2: NET CASH-FLOW CALCULATIONS

INTEREST PERIOD	FIXED RATE PAYER (PARTY A)	FLOATING RATE PAYER (PARTY B)	NET FUTURE PAYMENT BY PARTY A
1 (0.25 years)	€1,312,500 (5.25%)	€1,000,000 (4%)	€312,500
2 (0.50 years)	€1,312,500 (5.25%)	€1,115,000 (4.46%)	€197,500
3 (0.75 years)	€1,312,500 (5.25%)	€1,187,500 (4.75%)	€125,000
4 (1.00 year)	€1,312,500 (5.25%)	€1,250,000 (5%)	€62,500
5 (1.25 years)	€1,312,500 (5.25%)	€1,300,000 (5.2%)	€12,500
6 (1.50 years)	€1,312,500 (5.25%)	€1,375,000 (5.5%)	(€62,500)
7 (1.75 years)	€1,312,500 (5.25%)	€1,437,500 (5.75%)	(€125,000)
8 (2.00 years)	€1,312,500 (5.25%)	€1,500,000 (6%)	(€187,500)
TOTAL	**€10,500,000**	**€10,165,000**	**€335,000**

TABLE 3: PRESENT VALUE OF FUTURE CASH FLOWS IN THE 2-YEAR SWAP

INTEREST PERIOD	NET FUTURE PAYMENT BY PARTY A	PRESENT VALUE OF NET FUTURE PAYMENT BY PARTY A
1 (0.25 years)	€312,500	€308,660
2 (0.50 years)	€197,500	€192,676
3 (0.75 years)	€125,000	€120,448
4 (1.00 year)	€62,500	€59,484
5 (1.25 years)	€12,500	€11,751
6 (1.50 years)	(€62,500)	(€58,031)
7 (1.75 years)	(€125,000)	(€114,636)
8 (2.00 years)	(€187,500)	(€169,841)
TOTAL	**€335,000**	**€350,510**

The Net Present Value (NPV; the sum of each of the present values) of all the expected future cash flows is €350,510 (the sum of the third column). This is the total amount Party A will have to pay to Party B over the life of the swap (two years) in terms of today's value. The calculation of the NPV of a swap is critical: in summary, it is the net present value of the expected future cash flows using only the then swap curve.

MARK-TO-MARKET

The NPV of a swap is its value. Unfortunately, there are more issues to consider.

The first question that arises is which swap curve is to be used in the calculation (to calculate the future expected EURIBORs, and the rates used to calculate the present values)? For example, if an investor wished to trade shares in a listed stock, there would be two prices to consider; namely, the market bid price (say, €100): the price at which the investor can sell shares, and the market offer price (say, €102): the price at which the investor can buy shares. The investor would be quoted a price of €100-102. The swap market trades in a similar fashion with a bid and an offer rate. The 2-year swap rate might be quoted as 5.02%-5.07%. In other words, a party has to pay 5.07% if it wished to pay the fixed rate – Party B will pay a 5.07% fixed rate to the market counterparty to enter into a 2-year swap or receive 5.02% if it wished

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to receive the fixed rate (and pay the variable rate.) So, there are two market swap curves at any time – the market bid and market offer swap curves. A third important curve is the mid-rate. This is simply the mid-point between the bid rate and the offer rate (5.045% in this example).

The second question is how the bank (Party B) gets paid for facilitating the swap between the market and Party A. Afterall, Party A is not charged an upfront cash fee. The bank does this by charging Party A a fixed rate which is higher than the market offer swap rate. The difference between the fixed rate paid by Party A to Party B and the fixed rate paid by Party B to the market counterparty (or the rate it would have paid had it hedged its position perfectly, even though it may not actually do this) is then Party B's revenue. Using the examples above then, Party A pays 5.25% to Party B and Party B pays 5.07% to the market counterparty. The difference of 0.18% (18 basis points or bps) is Party B's revenue. In the example of the swap, the NPV of the swap using the offered swap rate (5.07%) is zero (the NPV of a swap using the market swap curve is always zero), however at the traded swap rate (5.25%) the NPV is €350,510 in Party B's favour. In other words, Party B, if it wished to, can hedge the position perfectly in the market and benefit from the net present value of future cash flows from Party A without taking any risk. This is described as the *hidden* or *implicit* cost of the transaction (see s A4.4 and para 18 of the judgment) – it benefits Party B and is often unknown to Party A.

Like any traded asset, the market swap rates change with time and, as the swap rates change, so do the estimates of future EURIBORs and the rates used to compute the present value of the future cash flows, and therefore, the NPV of the swap. Valuing the swap (calculating the NPV) after trading using the then swap curve is known as marking-to-market and the MTM is simply the NPV. It is indicative of the cost of unwinding the swap at that time. The MTM is often calculated using the mid-market swap curve. However, if Party A were to actually close the swap, that is to unwind or break it, the break cost is likely to be calculated using the bid swap curve, thus increasing the break cost. If the swap curve that is used to calculate the break cost is lower than the bid swap curve, then the difference in the NPV calculated using these two rate curves represents a further *hidden* profit for Party B. Of course, it may well be justifiable to use a lower rate if the size of the swap is much greater than the normal size traded in the market. Typically, whether the bid-, offer-, or mid-market swap curve is used depends on the use to which the MTM is put. It is usual to use the mid-market swap curve for monitoring the value of the swap day-to-day. The bid-swap curve (or offer if Party A has entered into a swap where it receives the fixed rate) should be used when considering unwinding the transaction.

An additional element to pricing a swap is what is known as the *counterparty credit exposure* (see para 62 of the judgment). Suppose interest rates move down after the swap is traded. In such a circumstance the MTM of the swap will be in Party B's favour: Party A would have to pay Party B a break cost to unwind the swap. Party B then has a credit exposure to Party A. Party B will not receive the future cash flows from Party A were it to default. Party B would normally charge for this additional risk to which it is exposed by adding a further amount to the swap rate if Party A is the fixed rate payer (or reducing the swap rate if Party A is the receiver of the fixed rate).

COMPLEXITIES

The above analysis applies to cash flows that are known or can be calculated and which will definitely be made. What if a cash flow is contingent? For example, in a product known as an interest rate cap or simply a cap, a payment is made at the end of a quarter only if the variable rate exceeds a pre-determined level (a similar product called a *floor* is one where a payment is made only if the variable rate falls below the pre-determined level). Or take a Cancellable Swap where one of the parties has the right to cancel the transaction prior to its maturity date (similarly in an *extendable swap* one of the parties has the right to increase the tenor). If it were to do this, the cash flows due after the date of cancellation will not occur. There are other examples of such contingent products with varying degrees of complexity. They all share the characteristic that some or all of the cash flows are contingent. There are well-established methods to calculate the NPV (or MTM) of such products ("generally accepted conventions"). A discussion of the methodology is beyond the scope of this article.

CONCLUSION

The value of an interest rate swap is determined by calculating the present value of all the cash flows due to be paid and received over the term of the contract. Broadly, there are three types of such cash flows. First, where the cash flow is fixed and known, the calculation is relatively straightforward. Second, cash flows dependent on a variable rate such as EURIBOR cannot be known for the entirety of the contract since the relevant variable rates are only set in the future and not known on the valuation date. Nevertheless, these can be estimated using market swap rates and these estimates can then be used to calculate the required present values. Third, where the cash flows are contingent such as in, for example, interest rate caps and cancellable agreements, though calculating their values is more intricate, there are market standard methods for doing so.

The value of a transacted swap can be determined at the inception of the trade and is the *hidden* or *implicit* cost of the swap.

The swap can also be valued at any time during its life and such a valuation is referred to as its MTM – it is an indication of the cost or profit of the swap were it to be unwound or cancelled. ■

1 See also, Foxton J in *Banca Intesa Sanpaolo v Comune di Venezia* [2022] EWHC 1656 (28 June).

2 See Hanif Virji, 'LIBOR transition: demystifying the interest calculations in the LMA exposure draft', (2021) 4 JIBFL 264 (April) for a discussion on the mechanics of interest calculations using LIBOR's replacements. See Hanif Virji *et al*, 'Facing the end of LIBOR: the financial and legal implications', (2019) 11 JIBFL 715 (December) for a discussion of the demise of LIBOR and its replacement.

3 International Swaps and Derivatives Association. *Prato* describes the standard terms as follows (at para 3): "From 1985 onwards ISDA has produced standard terms, including definitions, for use in the swaps market. ISDA is an association of market participants …" .

4 In practice, there are adjustments to the fraction of the year represented by each interest period because of weekends, other holidays and market conventions. As an example, the interest period from 1 January 2023 to 31 March 2023 has 89 days which is 0.2472 years, if a year is taken to be 360 days – or 0.2438, if it is taken to be 365 days.