Valuation in the context of derivatives litigation

Richard Grove*

Key points

- Litigation involving privately negotiated derivatives has increased dramatically in the wake of the financial markets crisis of recent years.
- Valuation of the derivatives involved is a central issue in much of this litigation.
- Since many privately negotiated derivatives are bespoke transactions, there is not likely to be a price that can be observed from a public trading market for purposes of valuing them.
- As a result, valuation of privately negotiated derivatives often requires the use of an expert familiar with market standard methodology for determining their value.

1. Introduction

The financial crisis of the past few years has spawned an unprecedented number of disputes relating to swaps and other privately negotiated derivatives transactions. Many of these disputes have resulted in litigation which is now progressing through courts and arbitration tribunals around the world. In many, if not all, of these disputes, valuation of the relevant derivatives is a central issue.

Since swaps and other privately negotiated derivatives transactions are often bespoke transactions, their valuation presents a challenge. In contrast to exchange traded futures, which are also considered derivatives and for which a value can readily be determined by reference to the prices at which they trade on the relevant exchange, swaps and other privately negotiated derivatives are, in many instances, unique transactions. Swaps and other privately negotiated derivatives (which are sometimes called over the counter derivatives to distinguish them from exchange traded derivatives and henceforth will be referred to collectively as 'OTC derivatives') are also, as the terminology implies, not publicly traded transactions. This means that there is not often a comparable transaction from which a publicly available price can be observed.

My firm, Rutter Associates, has been called as an independent expert to address valuation issues in many of the disputes relating to OTC derivatives. Some of these disputes present legal issues as to the meaning of the language adopted by the International Swaps and Derivatives Association (ISDA) in its widely used 1992 and 2002 master agreements. However, interpretation of the ISDA language (a legal issue) is usually not the central issue in these disputes. Rather, the main issue in these disputes more often relates to questions of valuation (an issue of economics). Even when valuation is not the central issue, it is almost always an important ancillary issue.

*Richard (Rick) Grove, Partner and Chief Executive Officer, Rutter Associates LLC, New York. Mr Grove wishes to thank Charles Smithson, Bob Selvaggio and Xiaojing Su of Rutter Associates, for their contributions.

doi:10.1093/cmlj/kmr001 Accepted 25 January 2011

This article will focus on the issue of valuation from an economic perspective and not a legal perspective. First, it will look at how valuation issues arise. Then, it will look at the principles that govern valuation exercises generally and the methodology that is used in the valuation of OTC derivatives specifically. Finally, it will address some special issues of interest that are worth noting in these valuation exercises.

2. Contexts in which questions of valuation arise

Close-out value/damages

Almost all OTC derivatives disputes involve the declaration of an early termination date. Under the ISDA master agreements, the declaration of an early termination date entitles the non-defaulting party to calculate the value of the derivative as of the early termination date and thereby determine the amount that should be paid by the defaulting party to the non-defaulting party or vice versa.[1]

The 1992 ISDA Master Agreement allows the parties to select, at the time they enter into the Master Agreement, either of two methodologies for calculating the value of an OTC derivative.[2] The first methodology is called 'Market Quotation' and requires the non-defaulting party to seek quotations from four market-makers for a transaction that would in effect replace the terminated derivative.[3] The non-defaulting party may choose the day and time as of which the quotations will be obtained, but in choosing the day and time, the non-defaulting party is required to act in 'good faith'. If the non-defaulting party receives three or more quotations, the highest and lowest quotations are disregarded and the arithmetic mean of the remaining quotations is deemed to be the value of the derivative in question unless the non-defaulting party is of the 'reasonable belief' that this is not a 'commercially reasonable result'. If too few quotations (ie fewer than three) are obtained to produce a 'Market Quotation' or if the non-defaulting party determines that the result is not 'commercially reasonable', then the non-defaulting party is directed to use the second methodology.[4] The second methodology is called 'Loss' and requires the non-defaulting party to determine its total losses and costs (or gain) in connection with the terminated derivative.[5] The definition of 'Loss' lists several factors that the non-defaulting party may take into account, including 'quotations of relevant rates or prices from one or more leading dealers in the relevant markets.' However, 'Loss' does not provide for a formulaic damage calculation as is the case with the 'Market Quotation' methodology, but rather leaves it to the non-defaulting party to 'reasonably' determine its damages 'in good faith.'

The 2002 ISDA Master Agreement replaces the two alternative methodologies set out in the 1992 ISDA Master Agreement with a single methodology known as the 'Close-out Amount'.[6] 'Close-out Amount' requires the non-defaulting party to determine the

1 1992 ISDA Master Agreement s 6(a) and 6(e)(i) and 2002 ISDA Master Agreement s 6(a) and 6(e)(i).
2 1992 ISDA Master Agreement s 6 (e)(i).
3 1992 ISDA Master Agreement s 14 (definitions of 'Market Quotation' and 'Reference Market-makers').
4 1992 ISDA Master Agreement s 14 (clause (b) of definition of 'Settlement Amount').
5 1992 ISDA Master Agreement s 14 (definition of 'Loss').
6 2002 ISDA Master Agreement s 6(e)(i).

amount of its losses or costs (or gain) that would be incurred in replacing the terminated derivative, or in providing for the non-defaulting party 'the economic equivalent' of the terminated derivative.[7] The non-defaulting party is authorized to include 'costs of funding' and costs related to the termination or re-establishment of any related hedge so long as it does not double count any amount. Similar to the standard of conduct to which a non-defaulting party must adhere in determining 'Loss' under the 1992 Master Agreement, the non-defaulting party determining 'Close-out Amount' under the 2002 Master Agreement must 'act in good faith and use commercially reasonable procedures in order to produce a commercially reasonable result'. In determining 'Close-out Amount', the non-defaulting party is required to use quotations for replacement transactions or relevant market data such as rates, yields, yield curves, volatilities, spreads, correlations and the like, unless such quotations or market data are not 'readily available' or their use would produce a result that is not commercially reasonable, in which case, the non-defaulting party may, but is not required to, use quotations or data from internal sources. The non-defaulting party may use its own pricing or valuation models if such models are used 'in the regular course of business in pricing or valuing' similar transactions between it and unrelated third parties.

Among the three ISDA methodologies, only 'Market Quotation' comes close to being a mechanical determination of value. Even in the case of valuations determined by 'Market Quotation', there is ample room for parties to dispute the result. For example, the defaulting party may argue that the non-defaulting party's choice of the day and time as of which the non-defaulting party sought quotations was not chosen in 'good faith'. For another example, if the non-defaulting party has determined that the results of the 'Market Quotation' determination are not 'commercially reasonable' and the non-defaulting party opts for the 'Loss' fallback, the defaulting party may dispute that conclusion.

If there is ample room for parties to dispute the results of a 'Market Quotation' valuation, there is even greater scope for parties to dispute the results of 'Loss' and 'Close-out Amount' valuations. The 1992 ISDA Master Agreement and the 2002 ISDA Master Agreement leave it to the non-defaulting party to calculate 'Loss' and 'Close-out Amount', respectively. Furthermore, in doing so, the ISDA agreements give an amount of discretion to the non-defaulting party to choose the factors it will consider, and the methodology it will use, in making its determination. However, both ISDA master agreements impose requirements of reasonableness and good faith on the non-defaulting party. These standards provide the defaulting party with a basis upon which it can challenge the determinations of the non-defaulting party.

Valuation as an issue that leads to dispute

While most OTC derivatives disputes involve valuation issues relating to the calculation of damages once liability has been established, in some cases, the dispute itself has its origin in a valuation issue.

7 2002 ISDA Master Agreement s 14 (definition of 'Close-out Amount').

An example of a valuation issue that frequently leads to a dispute between parties to an OTC derivatives transaction can occur in transactions where at least one of the parties has agreed to post collateral to secure the performance of its obligations under the transaction. In these instances, the party posting collateral often posts a fixed 'initial' collateral amount and agrees to post additional 'variation' amounts of collateral if the value of the transaction moves in favour of its counterparty. Since the value of an OTC derivative will vary with the movement in the underlying markets upon which the derivative is based, the value of an OTC derivative normally changes every business day. As a result, the 'variation' amount of collateral is normally recalculated every business day based upon the change in value of the derivative on that day. Depending upon whether the value of the derivative has moved against or in favour of the party posting collateral that party may be required to post additional collateral or may be entitled to a return of some of the collateral it has previously posted. While the party to whom collateral is posted normally has the right to determine the valuation of the derivative and the resulting required collateral amount, the party posting the collateral normally has the right to dispute the valuation and the consequent collateral calculation. In most cases of dispute, the parties are able to reach an amicable agreement. However, in some cases, especially in markets that are moving rapidly as was the case at times during 2007 and 2008, these disputes are not resolved amicably and result in one party or the other declaring an event of default and moving to terminate the derivative. In these cases, not only is valuation necessary to determine damages, but it is also critically important to the establishment of liability.[8]

Valuation as an issue that bears on another issue

Valuation issues can also arise in relation to disputes about the inception of an OTC derivatives transaction. While most OTC derivatives are transacted on the understanding that each party is making its own determination as to the appropriateness of its entering into the transaction, it is not unheard of for a party to allege subsequently that it was not provided with proper disclosure or that the transaction was not suitable for it. Whether such arguments, if proven, are grounds for allowing a party to walk away from a transaction is a legal issue beyond the scope of this article. Suffice it to say for our purposes, that if such an argument is to be considered, issues of valuation might come into play. For example, a party might argue that it was presented by its counterparty with incorrect valuation analyses, which induced it to enter into the transaction. Or a party might argue that, if it had understood that a transaction had a particular value at inception, it would not have entered into the transaction. If any of these arguments is to be entertained, then clearly the appropriate valuation of the derivative at the relevant points in time could have bearing on the outcome of the dispute.

8 It is worth noting that disputes can arise over the value of the collateral that has been posted as well as over the value of the derivative itself. While the most prevalent forms of collateral (cash deposits and government securities) are rarely, if ever, the subject of a valuation dispute, less liquid types of collateral are occasionally permitted and the valuation of such less liquid collateral can give rise to a dispute.

3. Principles of valuation

First choice: observable prices from a liquid and transparent market

Valuation is not a difficult exercise if the asset or position being valued trades with liquidity and frequency in an observable market. For example, the value of a share of a widely traded company, such as British Petroleum, and the value of a widely traded bond, such as the on-the-run 10 year United States Treasury Note, can both be readily determined by reference to the markets in which these instruments trade. This is true with respect to many exchange traded derivatives as well. For example, the Chicago Board of Trade (CBOT) listed future on the 10 year United States Treasury Note trades with sufficient liquidity and transparency that its value at any point during the trading day can be readily determined.

Markets that are liquid and transparent, such as those mentioned in the preceding paragraph, offer not only readily observable current pricing information, but also historical pricing data. So if one is looking to determine the value, as of a particular day in the past, of an instrument, which trades in a liquid and transparent market, data with respect to trades on that day can usually be obtained. In the case of instruments which trade on an exchange, such as the stock of British Petroleum or the CBOT 10 year United States Treasury futures contract, it is usually the exchange on which such instrument trades that stores and makes available this data. In the case of widely traded instruments, which trade in a non-exchange environment, such as the United States 10 year Treasury Note, other data providers often capture and make available historical trading data.

As noted above, OTC derivatives, in contrast to equities, government bonds and exchange-traded derivatives, are often bespoke structures, which are negotiated as private transactions. As a result, there is usually not a publicly observable trade in an OTC derivative from which a valuation of that derivative can be determined without some further computation being required.[9] That is not to say that there may not be a wealth of current and historical data available regarding similar transactions. For example, current and historical data with respect to US dollar interest rate swaps are readily available. However, the swaps for which this data are available will not take into account the bespoke features, such as notional amount, payment dates, etc., of every interest rate swap which one might need to value. The more bespoke the OTC derivative being valued, the less likely it is that one will be able to find current or historical pricing data for that derivative. Moreover, the available pricing data assumes that the contracting parties are

9 One of the current goals of policy-makers in the United States, Europe and elsewhere is to introduce greater price transparency into the OTC derivatives market. For example, the Dodd–Frank legislation, which was passed in the United States in 2010, mandates that certain derivatives that were previously transacted off of exchanges be transacted on exchanges and that other non-exchange traded derivatives be subject to reporting requirements that would include pricing information. The Dodd–Frank legislation leaves it up to the regulatory agencies in the United States to define these requirements. The agencies are currently drafting the relevant rules, which are expected to be promulgated sometime in the middle of 2011. Until these rules are published, the impact of the legislation will not be known for certain. However, these rules are not expected to apply to pre-existing OTC derivatives nor to new OTC derivatives that meet certain criteria. Therefore, it is likely that, for many OTC derivatives, it will continue to be difficult to find a publicly observable trade from which a valuation of that derivative can be determined without some further computation being required.

highly-rated dealers and does not account for the need to consider and price for credit risk when one party to an OTC derivative is of a lower credit quality than the other.

When relevant pricing information for a particular instrument is available from a liquid and transparent market, then this information would normally be the preferred source for valuing that instrument. However, when relevant pricing information is not available, then valuation will depend on more complex methodologies and data sources.

Principles for valuations where prices from a liquid and transparent market are not observable

Three principles should govern the valuation of 'hard-to-value' assets and liabilities:[10]

1. Transparency: the methodology by which such a valuation is performed should be clearly stated and capable of being understood (and audited) by the audience for which the valuation is being performed. The methodology should be able to be described in a step by step outline. There should not be any unexplained 'black box' component to the methodology.
2. Consistency: to the extent possible, the same methodology should be used in similar cases. That is not to say that variations might not be required as a result of differences in the terms of the instrument being valued or the availability of data or for other reasons. However, valuations should be readily reproducible by third parties.
3. Independence: valuations should be conducted using methodologies and principles rooted in market practice and the academic literature. The party conducting the valuation should begin from this point and not refer initially to a desired outcome from which a methodology is then reverse-engineered to produce the desired outcome. Valuations should be verifiable by disinterested third parties.

Basic methodologies for valuations where prices from a liquid and transparent market are not observable

There are three primary methodologies for valuation[11] in cases where prices from a liquid and transparent market are not observable:[12]

1. Relative valuation: the relative valuation methodology estimates the value of an instrument by looking at the price of comparable instruments relative to a common

10 Charles Smithson, 'Valuing 'Hard-to-Value' Assets and Liabilities: Notes on Valuing Structured Credit Products' (2008) 19 J Appl Finance 2.

11 While economists can identify three primary methodologies for valuation in cases where prices from a liquid and transparent market are not observable, the specific facts of a case could argue for a methodology that does not fall within one of the three primary methodologies outlined herein and that a court might accept as appropriate. Such an example can be found in one recent English case in which the court decided not to value a call option at the price at which it might have been sold, but rather to value the option by reference to the value it might have enabled its holder to realize by shorting the asset underlying the option and using the call option to cover the short position should the underlying asset increase in value (*Maple Leaf Macro Volatility Master Fund v Rouvroy* [2009] 2 All ER (Comm) 257). By citing this example, I do not mean to agree or disagree with the valuation approach adopted in this case. I merely present it as an example of how the facts of a case might present an opportunity to put forward a less common valuation methodology.

12 See Smithson (n 1) 2 and Aswath Damodaran, *Investment Valuation:Tools and Techniques for Determining the Value of Any Asset* (John Wiley and Sons, Hoboken 2002) 11.

variable.[13] For example, the credit spread to be assumed in pricing the bonds of an issuer whose debt does not trade with liquidity can be derived from the credit spread implied by the prices of the bonds of similarly rated issuers whose debt does trade with liquidity.

2. Discounted cash flow valuation: the discounted cash flow methodology estimates the value of an instrument by determining the expected future cash flows generated by the instrument over its remaining life and discounting those future cash flows to their present value as of the date of the valuation.[14] This methodology begins with a determination of the contractually specified cash flows. If the instrument includes any optionality such that any of these cash flows is subject to a contingency, then the contingent claim valuation methodology below would be employed. Otherwise, if there are no contingent cash flows and the amount and timing of the contractually specified cash flows can be determined with certainty, an appropriate discount rate is selected and the present value of each contractually specified cash flow is calculated and summed to determine the value. I will go into more detail on the discounted cash flow valuation methodology below.
3. Contingent claim valuation: if the instrument to be valued includes any optionality such that any of the contractually specified cash flows is subject to a contingency, then the future cash flows cannot be determined with certainty. In this case, an option pricing model has to be employed to calculate not only the amounts and timing of the future cash flows, but also the probability that they will occur. In a sense the contingent claim valuation methodology is really a special type of discounted cash flow methodology. Once the probability of the cash flows is determined using an appropriate option pricing model, then the resulting cash flows, as discounted by their probability, are present valued using an appropriate discount rate and summed to determine the value of the instrument in question. I will go into more detail on the contingent claim valuation methodology below.

The 1992 ISDA Master Agreement's 'Market Quotation' methodology is essentially a relative valuation methodology. In the 'Market Quotation' methodology, valuation is determined by reference to quotations for a transaction that is comparable to the transaction being valued, albeit a transaction between different counterparties. The 'Loss' methodology in the 1992 ISDA Master Agreement allows the non-defaulting party to determine valuation by reference to a quotation for a relevant price and, thereby, permits, but does not require the use of relative valuation methodology. The 'Close-out Amount' methodology in the 2002 ISDA Master Agreement requires the non-defaulting party to determine valuation by reference to a market quotation for a replacement transaction unless a market quotation is not 'readily available' and, thereby, establishes a preference for relative valuation methodology. However, the definition of 'Close-out Value' in the

13 Relative valuation is also known as 'Comparable' valuation.

14 Richard A. Brealey, Stewart C. Myers and Franklin Allen, *Principles of Corporate Finance* (8th edn, McGraw-Hill/Irwin, New York 2006) 36.

2002 ISDA Master Agreement permits the use of alternatives to relative valuation methodology if a market quotation is not 'readily available'.

So, relative valuation methodology figures prominently in both the 1992 and 2002 ISDA master agreements. However, in recognition that relative valuation methodology will often not be available, both the 'Loss' methodology in the 1992 ISDA Master Agreement and the 'Close-out Amount' methodology in the 2002 ISDA Master Agreement contemplate alternatives. The discounted cash flow valuation methodology and the contingent claim valuation methodology play important roles in calculating 'Loss' and 'Close-out Amount' in cases where relative valuation methodology is unavailable.

The following table illustrates the extent to which the ISDA master agreements rely upon these three valuation methodologies.

Methodology	1992 ISDA Master Agreement		2002 ISDA Master Agreement
	Market Quotation	Loss	Close-out Amount
Relative valuation	Required	Permitted	Preferred
Discounted cash flow valuation	Fall back to 'Loss' only if quotations are not available	Permitted	Permitted if quotations are not available
Contingent claim valuation	Fall back to 'Loss' only if quotations are not available	Permitted	Permitted if quotations are not available

4. Issues presented by the basic valuation methodologies

Relative value methodology

It is for good reason that the 1992 ISDA Master Agreement gives significant deference to market quotations, both in the 'Market Quotation' option where they form the basis of the valuation determination and in the 'Loss' option where they are a permissible basis for the valuation determination. Likewise, the 2002 ISDA Master Agreement directs the use of market quotations where they can be obtained. The premise underlying this preference for market quotations is that, if available, they are usually the best indicators of market value. Furthermore, if market quotations are available, the determination of the value of an OTC derivative is a pretty simple arithmetic exercise.

Although preferred, market quotations may not always be available. In some market environments, dealers may be reluctant to provide quotations. An example of just such a market environment occurred in the immediate aftermath of the Lehman Brothers bankruptcy in 2008. During the second half of September 2008, dealers needed to focus on mitigating the risk of their positions with Lehman Brothers, dealing with rapidly moving markets and preparing for the possibility that other financial institutions would collapse in Lehman's wake. Not surprisingly, providing quotations for potential new transactions was not high on the list of most dealers' priorities.

Even in more normal market environments, it may be difficult or even impossible to obtain market quotations. Some counterparties of lesser credit standing may not find any dealer willing to quote a price to them, especially for a transaction in which the dealer might be exposed to significant credit risk. Even if credit is not an issue, some transactions may be so customized or so complex, that other dealers may not be capable, or willing, to quote on them.

Even when market quotations can be obtained, there is some risk that the quotation process could have been manipulated. Most market participants pride themselves on their professionalism and would not even consider providing anything other than their true quotation for a given transaction. However, there is some risk that the party seeking quotations could tip off the party making the quotations that an off-market quotation would be acceptable because of the context. If manipulation is suspected, it may be in the interest of one party (or both parties) to the original derivative to check the accuracy of the market quotations using one of the other valuation methodologies (eg discounted cash flow or contingent claim).

While market quotations may be the preferred determinant of the contemporaneous value of an OTC derivative (eg immediately following the declaration of an early termination), market quotations are not generally used for historical valuations of OTC derivatives. For example, it would not be market practice to ask a dealer at a later date to provide a quotation as of a prior date, such as the date on which an OTC derivative was originally transacted. The concern in such an instance is that the dealer would know that it is not being asked to provide a trading price upon which it might be expected to transact. Thus, there is a greater likelihood that any quotation provided would not be a truly market quotation. Furthermore, it is not inconceivable that the benefit of hindsight might skew the dealer's calculation of the quotation.

Thus, although market quotations may often be the preferred method for valuing OTC derivatives, there are many instances where market quotations will not do the job. This is why the ISDA master agreements recognize and permit the use of alternatives that depend fundamentally on different methodologies.

Discounted cash flow methodology

Discounted cash flow methodology is a well known and widely used tool for valuing assets and liabilities.[15] In order to value an asset or a liability, a valuation date is selected. All future cash flows relating to the asset or liability, both positive and negative, subsequent to the valuation date are determined. To account for the time value of money (an amount today, under most circumstances, is worth more than the same amount in the future), an appropriate discount rate is applied to each future cash flow to determine the 'present value' of such cash flow as of the valuation date. The present values of all cash flows are then summed to determine the value of the asset or liability in question as of the valuation date.

15 Ibid 36; James C. Van Horne, *Financial Management and Policy* (4th edn, Prentice-Hall Inc., Englewood Cliffs 1977) 83.

At first blush, using discounted cash flow methodology to value OTC derivatives seems fairly straight forward. However, in most OTC derivatives transactions, at least one set of cash flows is determined by reference to floating market rates fixed at specified points in the future. In the case of a fixed for floating US dollar interest rate swap, for example, cash flows on the 'fixed' leg are determined by reference to a specified fixed rate multiplied by the notional amount of the transaction and are known at the outset, but cash flows on the 'floating' leg, which may be determined pursuant to a series of future US dollar LIBOR[16] settings, cannot be known until each setting occurs. Fortunately, there is a solution to this problem. In order to determine the future cash flows for the floating leg, reference can be made to the forward curve, as of the valuation date, for the relevant floating rate, which in the case of my example is US dollar LIBOR. The actual LIBOR fixings in the future are quite likely to differ from the relevant points on the forward curve. However, as of the valuation date, the forward curve represents the market's view of where LIBOR will be fixed in the future and, therefore, provides an appropriate basis from which to determine the floating leg cash flows that will be factored into the valuation.[17] The forward rates are the 'no arbitrage' rates, which is to say that they are the rates at which market participants are indifferent between a future stream of payments and their present value and, therefore, they are the rates at which market participants can lay off risk.

Using forward curves to determine as of yet unspecified cash flows is a tool that can be used for many types of transactions in addition to the plain vanilla interest rate swap illustrated in the previous paragraph. For example, in a fixed for floating West Texas Intermediate (WTI) crude oil swap, reference can be made to the New York Mercantile Exchange WTI crude oil futures curve to determine the cash flows on the floating leg. Similarly, forward foreign currency exchange rates can be referred to in transactions where cash flows depend on future foreign exchange rates.

It is important to remember that the forward curve data that should be used is the data that existed as of the valuation date. Subsequent market movements must be disregarded if one is to determine the value as of the valuation date. Some parties make the mistake of taking into account market information from dates subsequent to the valuation date. Doing so only serves to show how the value may have changed subsequent to the valuation date. All that is relevant in calculating a value as of the valuation date is information that was known as of the valuation date.

As long as forward curve data exists as of the valuation date, it can be used to determine cash flows that under the contract will be determined in the future. However, in some instances, relevant forward curve data may not exist. For example, the maturity

16 LIBOR is the widely used acronym for the London InterBank Offered Rate, a daily rate set pursuant to rules published by the British Bankers Association (the BBA). LIBOR is produced for ten different currencies and for 15 different maturities for each currency. LIBOR for each currency and maturity is compiled from a panel of quoting banks who submit the rate at which they believe they could borrow funds in the London interbank market by asking for offers and accepting funds at the rates offered. LIBOR is a widely used benchmark in the financial markets.

17 John C. Hull, *Options, Futures, and Other Derivatives* (3rd edn, Prentice-Hall Inc., Upper Saddle River 1997) 123.

of an interest rate swap may extend beyond the length of the publicly available forward curve data for the rate by which the floating leg is determined. In such a case, one may need to determine the relevant forward rates by using econometric techniques to extrapolate the existing forward curve into the future to cover the relevant points.

Once the cash flows have been determined, an appropriate discount rate needs to be selected to present value each of the cash flows. Typically, the discount rate that is used is LIBOR because LIBOR is a measure of the approximate rate at which major swap dealers borrow in the interbank market.[18] For US dollar OTC derivatives cash flows, the LIBOR rate used to discount the cash flows is normally constructed from a curve based on some number of months of eurodollar deposits (eg three months), followed by LIBOR futures out typically to two or three years and the swap curve thereafter.[19] An adjustment needs to be applied to the futures contract so that the rates are all on a consistent basis.[20] This curve results in zero coupon rates that can be determined for each date along the curve. Each cash flow is then discounted at the zero coupon rate that applies to the payment date of that cash flow to generate the present value of that cash flow as of the valuation date. The present values of all of the cash flows are then summed to complete the valuation.

The valuation resulting from the discounting exercise in the preceding paragraph would in effect be a 'mid-market' valuation. No bid–offer spread has been built into the valuation. A 'mid-market' valuation may be the desired goal in many cases. For example, the parties to an OTC derivative may agree to value the derivative at 'mid-market' for purposes of determining the collateral to be posted by one party or the other in respect of that derivative. Likewise, a 'mid-market' valuation may well be appropriate for purposes of assessing the value of an OTC derivative as of the original trade date.

However, the valuation of an OTC derivative by a non-defaulting party following a default by its counterparty should not be at mid-market. In the case of a default, if either the 'Loss' methodology specified by the 1992 ISDA Master Agreement or the 'Close-out Amount' methodology specified by the 2002 ISDA Master Agreement applies, the non-defaulting party may refer to market quotations for a replacement derivative in calculating its damages. Market quotations provided by dealers will not be at 'mid-market' because dealers will insist on both (1) adding, or subtracting, a bid or offer spread to the applicable mid-market rate in order to compensate the dealer for taking on the market risk of the transaction,[21] and (2) adding, or subtracting, a spread to

18 Ibid 121–22.

19 For swaps that are collateralized, some dealers use a discount rate based on the Fed Funds overnight index swap (OIS) curve instead of LIBOR. The OIS curve normally produces a lower discount rate than the LIBOR curve. This lower discount rate may be appropriate given the reduced credit risk resulting from the collateral.

20 Futures prices require a 'convexity adjustment' because futures positions are margined daily while quotes for eurodollar deposits and swaps incorporate no margining.

21 Typically, a dealer will not actually bear the full market risk for the term of the transaction. Instead the dealer will usually hedge part, or all, of the market risk. The bid or offer spread is expected: (a) to cover the cost of the dealer's hedge; and (b) provide the dealer with a profit.

compensate the dealer for the credit exposure that it would be assuming with respect to the non-defaulting party.

In order to take market risk into account in valuing an OTC derivative, the relevant bid or offer spread for market risk can be added to, or subtracted from, the appropriate discount rate that is applied to the leg (or legs) of the trade on which the spread is quoted. Bid and offer spreads are market data which can be obtained, with greater or lesser difficulty depending on the relevant derivative, both for current and historical points in time. Generally, the more liquid the market for an OTC derivative, the more likely it is that bid and offer spreads will be available. In the case of less liquid derivatives, the appropriate bid and offer spread may need to be determined using econometric techniques. For example, in the case of a plain vanilla US dollar interest rate swap of a fixed rate against a floating rate determined by reference to US dollar LIBOR, the bid and offer spread is normally obtainable. In order to value a US dollar interest rate swap, the discount rate used to present value the fixed leg of the swap would be adjusted by the bid or offer spread observable in the market as of the valuation date. It should be noted as well that it may be appropriate to adjust observable bid and offer spreads to account for other factors, including large size (where the transaction being valued exceeds the standard size transaction traded in the market) and illiquidity.

The credit risk to which a dealer is exposed when entering into an OTC derivative with another party is a function of several factors, most notably: (1) the dealer's potential future exposure due to potential market changes that could result in an increase in the mark to market value of the derivative to the dealer; (2) the probability that the other party will default at any given point in time; and (3) the dealer's expected recovery if the other party does indeed default. The interplay of these three factors is typically modeled by means of a simulation technique, such as a Monte Carlo simulation, the use of which will result in an expected credit loss amount from the transaction for which the dealer will require compensation for taking the risk of this loss. Such a simulation exercise requires as inputs (1) the forward curve and the implied volatility for the rate or price underlying the derivative, as of the valuation date, in order to determine the potential future exposure of the dealer and (2) the probability of default of the other party and the expected recovery in the event of such a default, again as of the valuation date. The forward curve and implied volatility are typically obtained from observable market data. The probability of a party's default and the expected recovery in the event of such a default can often be determined by reference to market data such as observable credit default spreads and/or bond spreads for that party. If such market data is not available, then it may be possible to use econometric techniques to estimate the probability of default and expected recovery.

Contingent claim methodology

Many OTC derivatives have option characteristics such that the cash flows of one or more legs of the transaction are not known with certainty at the outset, but rather depend on

the occurrence of subsequent market performance. In valuing an OTC derivative with option characteristics, a simple (single) discounted cash flow methodology cannot be used due to the uncertainty of the cash flows. Instead, an option pricing model is needed.

As noted above, contingent claim valuation methodology is really a special type of discounted cash flow methodology. With the contingent cash flow methodology, an appropriate option pricing model is used to determine the amount and probability of the cash flows. Once the amount and probability of the cash flows have been determined, the resulting cash flows, as discounted by their probability, are present valued using an appropriate discount rate and summed to determine the value of the instrument in question.

There are several possible option pricing models that can be used to determine the amount and the probability of the cash flows of an OTC derivative with option characteristics. The most common choices of option pricing model are a Monte Carlo simulation or a lattice approach. The choice of model will depend on factors such as the nature of the relevant option, the availability of data and the style of the options (eg American, European or other).

Whichever model is chosen, a forward curve for the underlying rate or price as well as the implied volatility of the rate or price, both as of the valuation date, will be required. The forward curve represents the market's central expectation as to the future performance of the rate or price and the implied volatility represents the market's expectation as to the extent to which the actual future performance might vary from the market's central expectation, ie the forward curve. To plot the potential variation of the market's future performance from the yield curve, the shape of the distribution must also be chosen. Common choices for the shape of the distribution include a normal distribution and a lognormal distribution. The choice of distribution will depend on factors such as whether one wants to set a limit on the distribution[22] and the extent to which one intends to perform additional calculations with the resulting data.

It is worth noting two points on the subject of volatility. First, the preferred input is observable traded levels of implied volatility. Implied volatility is a market traded measure of expected future volatility of a relevant rate or price. Implied volatility can be extracted from observed prices at which options trade in the market. In some cases, implied volatility levels themselves may be quoted. In other cases, they may need to be backed out of prices at which the relevant options trade. Implied volatility should not be confused with historical volatility which is a retrospective measure of the volatility of a relevant rate or price. If implied volatility levels are not obtainable from the market, substitutes may be used. These substitutes, whether derived from historical volatility or from other sources, may or may not be good proxies for implied volatility. The quality of the valuation in these cases will depend on the reliability of such substitutes. Thus, it is preferable to use observable trading levels of implied volatility when available. Second,

22 If one is working with a rate or price which, for all practical purposes, ought not to move below zero, one could choose to use a lognormal distribution, which would not permit a value of less than zero.

implied volatility levels are most frequently available for at-the-money options. The implied volatility of in-the-money or out-of-the money options may, and often does, vary from the implied volatility of at-the-money options. If the options to be valued are in-the-money or out-of-the money, care must be taken to obtain the appropriate implied volatility level from the market, if available, or to adjust the implied volatility level observable for at-the-money options in an appropriate way.

Bid and offer spreads exist for implied volatility just as they do for most other market rates and prices. As is the case with discounted cash flow valuation methodology, a 'mid-market' valuation can be obtained by using traded levels of implied volatility. However, if the purpose of a valuation is to calculate the damages to which a non-defaulting party is entitled following the default by its counterparty to an OTC derivative transaction, then it would be appropriate to take the bid implied volatility or offer implied volatility, as applicable, into account. As is the case with discounted cash flow valuation, it may be appropriate to adjust the bid or offer levels of volatility to account for a number of factors, including large size and illiquidity. Similarly, credit risk should be taken into account in contingent claim valuation just as would be the case in discounted cash flow valuation, as explained above.

5. Conclusion

Disputes relating to OTC derivatives have been on the rise. In almost all of these disputes, valuation is an issue which arises in at least one, and sometimes more than one, context in the dispute. If the valuation of OTC derivatives were as simple as looking up a price in a stock table, there would not be much to discuss about valuation, nor would there be much of a need for valuation experts. However, OTC derivatives, by their very nature, are often bespoke transactions for which prices are usually not observable in the market. Thus, valuation requires considerably more effort than simply looking up a price.

The valuation methodologies that can be used in valuing OTC derivatives have their roots in techniques that are well known to economists. In many respects, they follow well trodden paths. However, the complexity of some OTC derivative structures and a lack of data in some instances may require one to make choices when employing the standard valuation techniques. These choices may relate to such issues as the use of econometric techniques to extrapolate forward curves or other market-based data, the choice of an option model, the choice of an assumed distribution in a simulation and many others. The need to make these types of choices and assumptions does not render a valuation impossible or less credible. However, the credibility of the valuation will depend on the basis for the assumptions and the choices made. The more it can be shown that the principles of transparency, consistency and independence have been adhered to in making these choices and assumptions, the greater the credibility of the valuation.