



Pricing Derivative Contracts

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One of the perennial problems faced by investors, and one that has excited financial engineers, academics and regulators alike, is the problem of pricing derivative contracts. In order to get a fair value, in contrast to equity shares and fixed income bonds, it takes much more than merely applying a known market price to a holding. Theoretically, the price of both bonds and shares can be mathematically derived as the present value of all future income streams. However, in the case of shares this is less certain and often mitigated by the arbitraging actions of a huge and highly liquid market. In the case of derivatives, however, this market is often far less liquid and deriving a price requires complex modelling of the uncertain cash-flows that govern the relationship between the derivative contract and the underlying asset.



Pricing's academic roots

In order to analyse and price options and other derivative products, an analyst must model the relationship between the behaviour of the underlying securities and the price of the derivative contract. One of the most important variables in this relationship is volatility i.e. the range in which the price of the underlying security has varied over a given period of time. However, it was not until the 1970's that the full force of academia came to bear on this issue when two American academics called Fisher Black and Myron Scholes devised a model that allowed them to value a vanilla option. They came up with a solution (essentially a partial differential equation) that could calculate

this volatility to accurately price options. They defined volatility as the annual (normally distributed) standard deviation of a security's price. Thus using security prices, strike prices, expected interest rates, time to expiry and the all-important volatility, they were able to compute option prices using a formula that is still widely used today. Since then, a bewildering roll-call of the great and good have added to this work so that in today's financial parlance, each derivative class has one (or several) mathematical models attached to it.

From theory to application

In today's brave new world where mainstream asset managers, and not just the investment banks and hedge funds, are beginning to use derivatives in significant volumes, this academic groundwork can create its own issues. Asset managers are not traditionally staffed with 'quants' (financial engineers) or rafts of Phds. In order to run these models, they must either buy in scarce talent or buy in software and / or data that does this for them.

There are therefore several paths managers can take depending on volumes, resources, and the types of derivative traded:






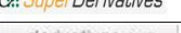
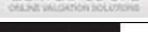






Mark-to-market – where a contract is sufficiently liquid, investors have a readily available 'arbitrage-free price' (the market price); so called because the trading volumes have ensured that arbitrage opportunities no longer exist. Such price transparency can only occur when the derivative is actively traded on an exchange.

Mark-to-model – where a market price is not available, participants use a defined formula to calculate the price, or use other modelling processes such as Monte-Carlo simulation or reverse engineering. There are, however, some inherent issues with using this option. Primarily (for the buy-side at least), it is one of finding the requisite skill and experience to run the models. Such resources are in high demand at the current time – there is also therefore a significant cost implication here. Another issue that should not be overlooked is the appropriateness and limitations of the model itself. A mathematical model can never, despite its seeming complexity, match the machinations of human minds and their attendant emotions. A case in point is the academic Robert Merton who (it is said) spent most of the evening of the ceremony at which he was to be awarded the Nobel Prize for Economics weeping in a back room as the company he worked for (and whose models he had constructed) was in the throes of losing billions of dollars. That firm was Long Term Capital Management, and he had just contributed to causing a trillion dollar hole in the market. Models often do not take account of the ‘fat-tails’ engendered by political events, catastrophes, or (in this case) new correlations in previously uncorrelated markets. Models should therefore constantly be back-tested in order to ensure their veracity in a defined and managed process.

Third party supplied software – there are now many software suppliers breaking into the software market that have the many industry models embedded in their products to allow users to calculate their own prices. Asset management firms must ensure that they impart due diligence on any software selection decisions in order to be certain that they are getting both the asset and model coverage appropriate to them, that the solution can be easily integrated into their current infrastructure and that (in this still nascent market) the proposed solution is both future-proofed and scalable. This is one area where many companies fall over.

Third party supplied data – as the industry has matured, so has the supply of data from third party suppliers. These suppliers tend to use a hybrid model of collecting contributing data from dealers and running their own models. The major players in this arena are Markit, Derivatives Fitch and CMA. Increasingly, many of the larger front office systems are already offering off-the-shelf interfaces to these suppliers much as they already do for the more traditional suppliers of pricing data.

Examples of third party options are shown in the diagram below:

Vendor	Coverage	Source	Delivery
	ABS, CDS, Convertible Bonds	Contributor	Portal
	Credit Derivatives	Contributor	Online / FTP
	Credit Derivatives	Contributor	Online / FTP
	Credit Derivatives	Contributor	Application (QuoteVision)
	Options	Models	Real Time Pricing (App) Revaluation Svc (online)
	Options, Swaps	Models	Online
	Convertibles (Monis) Cross Asset (Reech)	Models	Excel Add-in ASP
	Credit, Equity derivatives	Models	Excel add-in
	Cross Asset (historical data)	Models	Application / ASP
	Credit, Interest, Swaps, Bond	Models	Independent Val Svc via FTP
	Cross Asset	Models	Application
	Cross Asset Valuations	3 rd party	Online
	Cross Asset Valuations	3 rd party	Online

Independence, verification and control

One of the big drives in the industry, being pushed both by regulators and the Alternative Investment Management Association, is independent pricing and verification. Valuation methodologies should therefore be reasonable and consistently applied, and where possible prices sourced from (several) independent resources. Thus in order to service market demands, many of the large custodian banks have recently been announcing security services that now include Over The Counter (OTC) derivative pricing that sit alongside other OTC services such as collateral management.



Investors are also increasingly asking for written valuation policies that should be reviewed on a regular basis. The challenge for the buy-side is therefore to ensure that the processes and infrastructures are in place to achieve this. In order to do this, firms should be looking to implement an enterprise-wide valuation policy that should cover the following items:

- Establish a governance and control structure that would include a valuation committee and an independent pricing function
- Detail each valuation methodology on an asset-by-asset basis together with the processes for revision and review of those methodologies
- Establish procedures for checking the validity of prices from all sources (with independent verification where possible) and for the back-testing of any models used
- Ensure that the role and the responsibilities of the valuation committee is well-defined and clearly communicated

Conclusion

As the buy-side moves deeper into derivatives territory, and as they invest in systems, suppliers and architectures to support this move, the correct pricing and valuation of their trades is a key challenge. New regulations coming into play (in particular MiFID) will require that this process is both transparent and appropriate and the difficulties in achieving this should not be underestimated. Success can only therefore be achieved by addressing all of the issues in a unified and structured fashion. Implementing a governance structure is therefore key to this process; as is the (early) involvement of the relevant regulatory authorities in order to ensure that all parties, whether they are fund managers, dealers, operations staff, clients or counter-parties are all satisfied and bought-in to the process. Perhaps most importantly of all, firms will have to ensure that there is independent verification of derivative prices. Both the story of Long Term Capital Management and more recently the Amaranth debacle stemmed in part from issues around pricing and the use of these within their risk models and they should therefore serve as cautionary tales for new participants in the market.



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