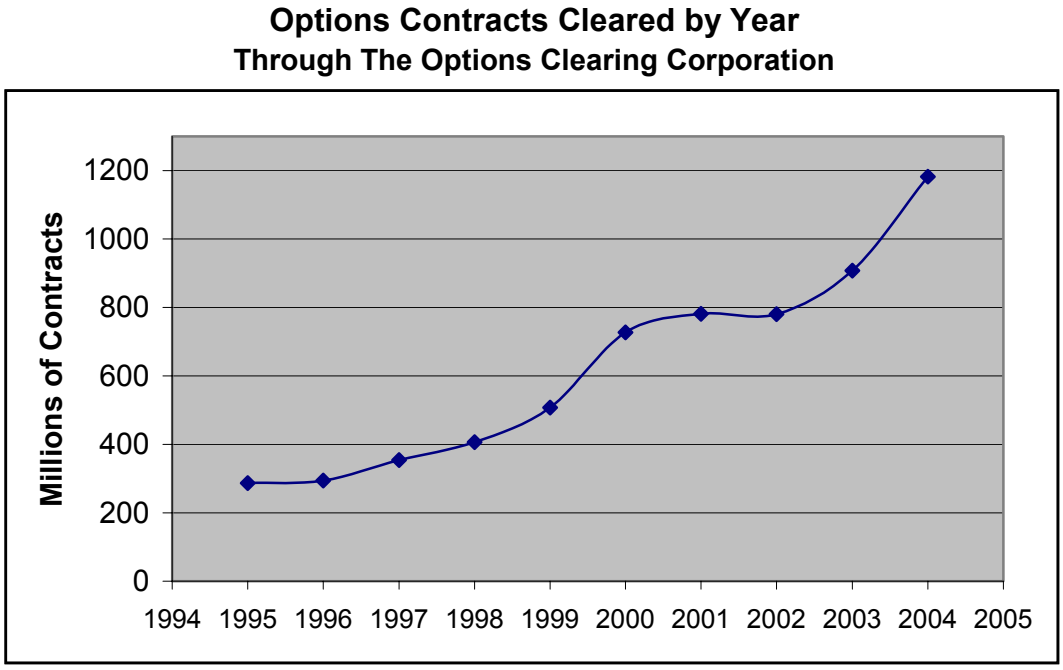
# An Options Primer

By Bruce B. Thomas

A manifold increase in options usage over the last ten years offers solid evidence that investors and corporations are finally cognizant of the financial benefits that options can provide. In tandem with this extraordinary growth, corporate officers, regulators, accountants, and consultants have worked to educate themselves so that they can properly assess the value and risk of options.

While much of the interest and concern during the last few years has centered on the proper use of and accounting for employee stock options, companies are finding many ways to take advantage of the leverage that options provide for both investment and risk management. It is now more important than ever for management accountants to develop an appreciation for option usage and valuation. This article overviews this subject.




## Options

Option contracts give the holder a right to buy or sell property at a specified price, called the strike or exercise price, within a given period of time for an agreed upon sum. The payment that is exchanged for this right is called the option premium. Options are considered derivatives because they derive their value from the price of some underlying asset. If the option holder does not exercise his right within the given period of time, the option expires worthless. Having the right, but not the obligation, to buy or sell property at some pre-specified price is valuable, which is why option buyers are willing to pay a premium for it.

Options that grant a right to sell something are called "puts." Options that grant a right to buy something are known as "calls." Options can be classified based on the exercise rights they contain, too. American style options give the holder the right to exercise an option at any point prior to expiration, while European-style options only permit exercise at expiration. The Bermudian option is effectively a hybrid approach since it allows exercise at certain pre-determined points during an option's life.

**The Value of an Option**

An option's value can be thought of as having two primary components, an intrinsic value and a time value. The intrinsic value is the value that an investor would get if she immediately exercised the option. If an option has a positive intrinsic value, meaning that the exercise price is less than the current price of the asset, it is said to be "in-the-money." Thus, deep in-the-money options refer to options that have strike prices substantially below the underlying asset price, and deep out-of-the-money options refer to options that have strike prices substantially above the underlying asset price.

The time value of an option results from how likely and in what direction the intrinsic value of the option is expected to change over the life of option. This value is a function of the underlying asset's propensity to change in value and the remaining life of an option. While the intrinsic value may rise or fall over the life of an option, the time value always diminishes over that period and approaches zero toward the end of the options life.

Although many options expire without value, most options that are in-the-money are bought or sold, rather than exercised. This is because exercising an option early forfeits the remaining time value of the option and destroys its financial leverage.

**Financial Leverage**

Options are beneficial because they allow the holder to exert financial leverage by buying just the portion of the underlying property that the holder believes is desirable. The following example demonstrates this point.

A speculator believes that a particular stock will rise to $60 within the next three months from its current price of $50 and has a choice of buying the underlying stock or options on the stock. Assuming that the speculator has $5,000 to invest and a three-month option to buy one share at a strike price of $50 cost $3.58, the speculator can buy either 100 shares of the stock or purchase 1,396 options to buy the stock. The options are significantly cheaper than the stock because they are only valuable if the stock price increases above $50 per share during the next three months.

The table below compares these two alternatives. If the speculator is correct and the stock price increases to $60, she will make $1,000 if she purchases the stock. She will make $8,966 if she purchases the options. Thus, the options enable the speculator to buy more of the portion of the stock that she finds valuable. For this reason, it can be much more efficient for a speculator to buy options than to buy the underlying stock.

**Example : Using Options to Create Leverage**

| Stock Investment | | Option Investment | |
|---|---|---|---|
| Initial Investment | $ 5,000.00 | Initial Investment | $ 5,000.00 |
| Cost Per Share | $ 50.00 | Cost Per Option | $ 3.58 |
| Number of Shares Purchased | 100 | Number of Options Purchased | 1,397 |
| New Value Per Share | $60.00 | New Value Per Option | $ 10.00 |
| Number of Shares Owned | 100 | Number of Options Owned | 1,397 |
| New Value of Stock Investment | $6,000.00 | New Value of Option Investment | $ 13,966.48 |
| Less Cost of Stock | $ (5,000.00) | Less Cost of Options | $ (5,000.00) |
| Increase in Value | $ 1,000.00 | Increase in Value | $ 8,966.48 |

## Option Usage

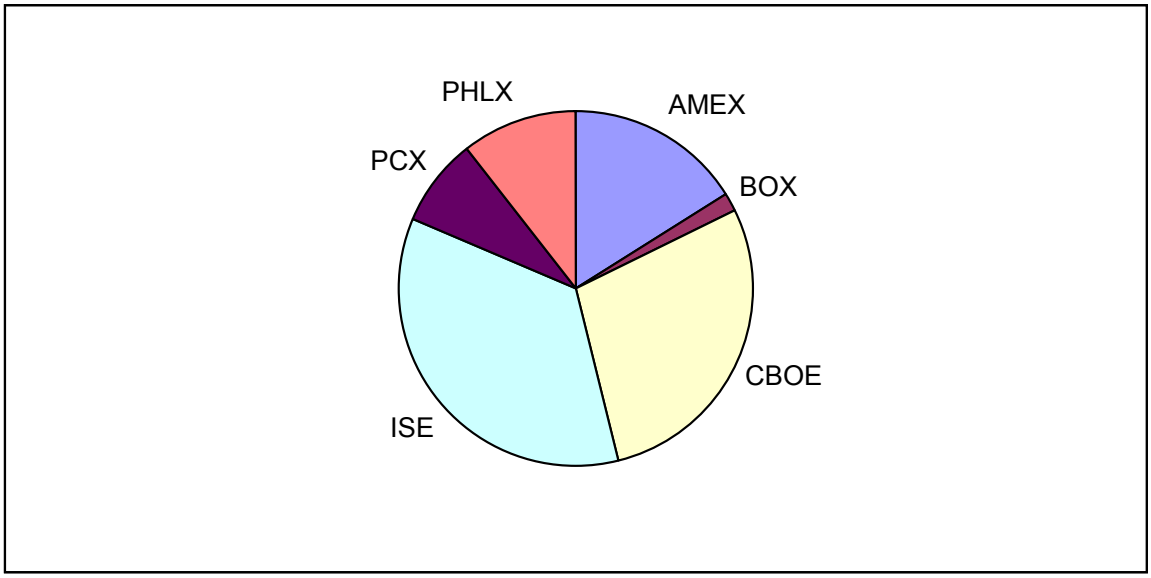
Exchanges facilitate the trading of options on stock, commodities, currencies, and debt instruments. An exchange can be a physical location or an electronic mechanism where trading takes place. Although options can be traded directly between two individuals or companies, this rarely happens in practice. This is because exchanges assist in the price discovery process and provide a valuable role in minimizing credit risk.

Options are used in many different ways. Speculators use options to bet on the price of some underlying property over some specified period of time. Assuming a speculator believes that the underlying property's price will decrease, she may purchase a put option, giving her the right to sell that property to the option seller at a pre-specified price. Conversely, if she believes that the price will increase, she may desire to purchase a call option.

Companies and individuals may be willing to sell options on assets that they own to increase their returns on those assets. For example, an investor who feels that a particular stock he owns is unlikely to decrease in value and has significant long-term growth potential may be willing to sell a put option on that stock so that he can earn an option premium. Similarly, he may desire to sell a call on a stock that he owns but feels is unlikely to increase in price over the option term.

Many investors also use options to hedge or offset the risk of some component of their portfolios. For example, a stockholder who is concerned that stock prices may fall dramatically might buy put options and sell call options to limit the potential loss of value. Similarly, manufacturers may desire to hedge price increases or decreases associated with their raw material inventories.

**2004 Option Volume by Exchange**
(In Millions of Contracts as Reported by the Options Clearing Corporation)




| | Equity | Index | Foreign Currency | Total | % of OCC Option Volume |
|---|---|---|---|---|---|
| **The American Stock Exchange (AMEX)** | 195.4 | 7.3 | - | 202.7 | 16.0% |
| **Boston Options Exchange (BOX)** | 20.7 | - | - | 20.7 | 1.6% |
| **Chicago Board Options Exchange (CBOE)** | 275.6 | 85.5 | - | 361.1 | 28.5% |
| **The International Securities Exchange (ISE)** | 360.8 | 83.4 | - | 444.2 | 35.1% |
| **The Pacific Exchange (PCX)** | 103.3 | - | - | 103.3 | 8.2% |
| **Philadelphia Stock and Options Exchange (PHLX)** | 127.9 | 5.3 | 0.2 | 133.4 | 10.5% |
| **Total Volume** | 1,083.7 | 181.5 | 0.2 | 1,265.4 | 100.0% |

## Incentive Stock Options

Another type of option in widespread use is the incentive stock option. These options are granted to corporate managers and employees as a means of motivating them to achieve certain financial and operational objectives. Incentive stock options are usually granted at a strike price that is at or above the price of the underlying stock on the grant date. These options often vest over a period of future employment such as three or four years and have terms as long as ten years. By contrast, most options that are traded on exchanges have expiration dates less than one year into the future.

There has been significant controversy in recent years over the use of incentive stock options. While part of the debate is focused on the suspicion that corporate executives are too highly compensated, there is also a concern that executives may have the ability to manipulate the value of their options. These concerns are fuelled by disputes over option valuation and the proper way to account for this compensation. From an accounting perspective, the issues are about how best to show the dilutive effects of such options, whether to show them as an expense, and how to measure that expense.

**FASB 123(R)**

For more than 30 years companies have used the "intrinsic value method" of valuing stock compensation.[1] Using this approach, companies only recognized compensation expense if the options they granted to their employees had intrinsic value. If companies issued options to their employees so that the exercise price was at or above the current price of the stock on the grant date, no compensation expense was shown.

While this was an imperfect solution, it was adequate in an era when few employees were granted stock options. As option grants to employees became routine and substantial, the main flaw of this approach became more important and difficult to ignore. Even without intrinsic value, options contain some element of time value. Since this value is being given to employees as compensation, why should it not be recognized as an expense in the company's books and records?

The Financial Accounting Standards Board issued Statements of Financial Standards No. 123(R) to address this question and requires public companies to measure the cost of employee stock options using a "fair value" approach.[2] A market price is the best guide to fair value and should be used if it is available, but in the absence of such a valuation, the FASB requires the use of an option pricing model to estimate the fair value of the option grants.

However, FAS 123(R) is still controversial. Many arguments have been put forth as to why no expense should be recognized. Some argue that showing such an expense would adversely affect certain types of businesses that are accustomed to granting copious amounts of options in lieu of larger cash compensation. Others make the argument that accounting has traditionally concerned itself with how the entity used its resources and not about the ownership of its stock.

Even if one agrees with the logic of ascribing a fair value to option grants and including that value as an expense in a company's books and records, FAS 123(R) is still problematic because it requires companies to use option pricing models in the absence of a true market price. By mandating that an expense be recorded before it is reasonably measurable and estimable and not changing the estimate of this expense over time, this accounting treatment also goes against the logic of other accounting standards.

Putting all of these issues aside, one must still wrestle with issues surrounding option valuation models. Which model should one use and what is the best way to use it? Do any of the option pricing models produce meaningful valuations for long-duration option contracts where there is no liquid market?

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[1] The Accounting Principles Board mandated this method in 1972 when it issued APB 25, "Accounting for Stock Issued to Employees."

[2] The FASB issued Statement no. 123(R), Share-Based Payment, in December 2004. Most public companies must implement this new standard as of the start of reporting periods beginning after June 15, 2005.

**Option Pricing Models**
A number of mathematical models have been developed to determine the theoretical value of an option. The first of these models to achieve widespread acceptance was the Black and Scholes Option Pricing Model which was introduced in 1973.

As it was originally formulated, this model was predicated upon the assumptions that: the underlying stock pays no dividends; European exercise terms are used; interest rates are known and constant; no commissions are charged; markets are efficient; and returns are lognormally distributed. Since its development, modifications have been made to the Black and Scholes model to enable it to handle stocks where dividend payments are made.

One theoretical problem with the Black and Scholes model, is that it significantly understates the value of away from the money American Exercise options. One can see this problem most clearly by examining how this model values deep-in-the-money options, because the intrinsic value will be greater than the model value, which does not make any sense. This undervaluation increases as the time to expiration increases. Generally, this problem is not a major issue, because most options trade near the money and do not have long expiration periods.

Problems such as this one have provided the impetus for the creation of newer option valuation models. These models include Binomial Trees, Trinomial Trees, the Jump Diffusion Model, the Barone-Adesi and Whaley model, and the Bjerksund and Stensland model. The Binomial Model, for example, breaks down the time to the expiration of an option into discrete intervals. At each interval, the stock is assumed to increase or decrease by a certain amount based on its volatility and time to expiration. In effect, this produces a tree of potential stock prices over the life of the option with each branch representing a possible path that the stock price could take during the remaining life of the option. Probabilities are then applied to each path to produce the expected value of the option.

One advantage that the Black and Scholes Model has over other option valuation models is that it is much faster than some of the newer models that require iterative calculations. Calculation speed is essential in a market where option prices can change very quickly.

While they employ different techniques, each of these models requires essentially the same inputs to create an option's theoretical value. These inputs are: the current stock price, the exercise price, the time to expiration, the risk-free interest rate, the dividend rate, and the volatility of the underlying stock. Despite all the improvements, each of these models can be challenged on the basis that the assumptions that they are predicated upon do not hold true in the real world.

**Uncertain Option Values**
Regardless of which option pricing model is used, there is still significant uncertainty about what the value of an option is. This uncertainty is resident before the contract is entered into and extends until the date the contract expires. As the time value of an option dissipates, the theoretical value and the market value converge on the intrinsic

value. The difference between the theoretical value and the market value is as much the fault of the models as of the option markets.

Actual option prices vary from the theoretical values of the option pricing models for a number of reasons. First, the models do not generally recognize transaction costs. Second, most option traders are wary of markets that are illiquid and will charge more for entering such markets. A lack of market liquidity impedes price discovery and allows for significant pricing imperfections on options that do not trade very much such as options on smaller companies, options with expiration dates greater than one year, and deep in or out-of-the-money contracts.

**August 2005 AIG Puts**
(As of May 20th, 2005)

| Strike Price | Ticker | Last Trade | Theoretical Value | Implied Volatility |
|---|---|---|---|---|
| $ 25.00 | .AIGTE | $ - | $ - | 63% |
| $ 35.00 | .AIGTG | $ 0.25 | $ - | 47% |
| $ 45.00 | .AIGTI | $ 0.70 | $ 0.18 | 36% |
| $ 55.00 | .AIGTK | $ 3.60 | $ 3.09 | 29% |
| $ 65.00 | .AIGTM | $ 11.20 | $ 10.95 | 33% |
| $ 75.00 | .AIGTO | $ 21.90 | $ 20.66 | 50% |
| $ 85.00 | .AIGTQ | $ 27.30 | $ 30.57 | 63% |
| $ 95.00 | .AIGTS | $ 38.50 | $ 40.49 | 75% |

Source: PCQuote.com

However there are significant differences between the model values and the market values, even when the options are heavily traded. The table above illustrates this point; it shows a snapshot of some of the puts on American International Group's stock (AIG) as of the market close on May 20th, 2005. With a market capitalization of approximately $140 billion, AIG is one of the largest companies in the world. Also this data was captured when the expiration date of this option series was only three months away. Despite these features, one notices some relatively large differences between the theoretical value and the last trade value. Even at a strike price of $55, which is the closest to the closing stock price of $53.76, the last trade is approximately 17% higher than the theoretical value.[3]

Proponents of option pricing models naturally assume that such differences are caused by market participants using different assumptions about the inputs to those models, but most of the inputs are not in dispute. The current stock price, the exercise price, and the time to expiration are facts. Also, the risk-free interest rate and the dividend rate do not generally change enough over short-periods of time to cause big changes in option values. Thus, the parameter most in dispute is the volatility of the underlying stock.

**Volatility**

The most important input to an option pricing model is the future volatility of the underlying asset. All of the other inputs are either known, are reasonably well known, or

[3] $3.60-3.09 = .51 / 3.09 = .165 or 17%.

do not usually have a tremendous impact on option valuation anyway. Option valuation, in a theoretical sense, is derived from the volatility of the underlying asset since this is the means by which the models account for significant changes in the value of the underlying asset.

Since future volatility is not knowable, options market participants typically look to the past and try to develop an estimate of what volatility is "normally." However, even this is problematic. Historical volatility can vary significantly based on how the calculation is performed and how many days of market activity are used to derive this number. Of course, this number is only useful if history repeats itself, and most options buyers and sellers do not believe that it will.

Even if one could predict the volatility of a stock over some future period of time, it would not help determine the value of the option at the expiration date. Stocks can exhibit extraordinary amounts of price volatility only to end up where they were at the start of the period. Alternatively, stocks can increase or decline substantially while exhibiting only modest amounts of volatility.

Option valuation is akin to developing an expected value on a single outcome that has a wide range of possibilities. The expected value, for any particular option at the start of the option period, is likely to be very different than the expiration value, even if one knew precisely the future volatility of the underlying asset. Therefore, actual volatility is meaningful only in an abstract, theoretical way to explain option valuation across an entire portfolio.

**Implied Volatility**

One can take the current market value of an option and the other less contentious model inputs described above and substitute volatilities into an option model until it produces a theoretical value that is equal to the market value of that option. This number is called "implied volatility."

In essence, implied volatility provides a way for market participants to reconcile actual option prices with the theoretical values derived from the models they use. Historical volatility and implied volatility may diverge because market participants think the price of the stock may change more or less than the historical volatility would imply over the future life of the option.

For those participants who believe that their chosen option pricing model adequately describes the value of an option, implied volatility may be useful for reconciling the model with the market. However, the fact that different implied volatility numbers are required for each different strike price on the same option shows that one should not place much confidence in this interpretation. Moreover, this number is not very meaningful for deep in or out-of-the- money options, where extraordinary amounts of volatility are required to change the option value by relatively small amounts of money.

**Conclusion**

If all of the assumptions on which the option pricing models are predicated were true, there would be no difference between the models and the market. But the world we live in is much more complicated, and it is important to appreciate the limitations of option models. If there are substantial differences between the values produced by option pricing models and the market on relatively short-term options on the largest companies, it is reasonable to question the accuracy of these models for long-duration options and for options on smaller companies.

The truth is that option market participants do not place much faith in the accuracy of the values produced by option pricing models but use them as a guide for identifying market anomalies that warrant further investigation. The real value of option pricing models is that they help us understand how useful and efficient options can be.

While option calculations are relatively complicated and difficult to understand, option models, personal computers, and copious amounts of information on the internet are leveling the playing field and making it easier than ever before for one to become an informed option user. Greater knowledge about options has resulted in more option usage and more liquidity in the options markets. This is good for everyone.