

HOW TO VALUE INDEXED EXECUTIVE STOCK OPTIONS

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Abstract

Some powerful investors, boards of directors and even executives themselves have recently observed that stock options with fixed exercise prices do not properly tie managers' performance to compensation. To mitigate the problem, several corporations are considering the use of employee options whose exercise price varies with major stock indexes. We show how to use the Fischer-Margrabe option pricing model to value this new kind of option for determining the executive's remuneration and for financial reporting.

INTRODUCTION

The rising stock markets of the mid-1990s have made manifest the flaws of fixed exercise stock options as part of executive remuneration. The original intent of issuing these options was to align managers' incentives with the goal of increasing shareholder wealth. However, many sophisticated investors perceive that the rising market tide is rewarding underperforming managers. For example, when the corporation's stock rises by 15 percent during a period when the S&P500 rises by 40 percent, its CEO might still glean millions of dollars by exercising his options.

Some boards of directors are addressing these concerns by discontinuing the practice of issuing executive options with exercise prices near- or at-the-money [Tully, 1998]. For example, one new option format still has an at-the-money exercise price, but cannot be exercised unless the stock price reaches a much higher value before the expiration date. Another format has an at-issue exercise price creating an option far out of the money. If the market as a whole rises significantly, both formats still potentially have the disadvantage of rewarding managers whose stock goes up markedly but less than the broad-based market indexes. Further, in a rising market, high beta stocks should outperform the market. On the other side of the coin, these formats would not reward managers when the stock rises less than the target (or falls less than the target) during a bear market.¹

A more recent innovation is options which have value when the stock price outperforms some market index. Thus, a proposed better format is to write employee stock options with exercise prices indexed to a market, for example, the S&P500 index. At least one corporation, Level 3, is already using this format. This format's advantage to shareholders is that executives must manage so well that the stock price rises faster than the index before their options are in the money. An advantage to executives is that when the stock price falls in a bear market, the option might be in the money if the stock is outperforming the index. However, this format does not deal with the problem of adjusting the option for the underlying stock's beta *vis-a-vis* the index's.

A startling statement in a story presented on CNBC in July 1998 was that some corporations have not yet instituted these index-based option plans because their accountants do not know how to value them. Consequently, it is useful to be familiar with the accounting treatment prescribed by generally accepted accounting principles regarding stock option plans. The accounting treatment of stock options is governed by FASB Statement 123, "Accounting for Stock-Based Compensation." Under the "fair value method" detailed in the statement,² compensation cost is measured at the grant date based on the value of the option. In attempting to measure compensation cost, the accountant must employ an option-pricing model that takes into account the stock price at the date grant, the exercise price, the expected life of the option, the expected volatility of the underlying stock, the expected dividends on the stock, and the risk-free interest rate over the expected life of the option. FASB Statement 123 specifically mentions the Black-Scholes and the binomial option pricing models as acceptable methods for

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determining compensation cost. According to the statement, once the fair value of the option has been estimated at the grant date, it is not subsequently adjusted for changes in the factors determining the value of the option.

Once the fair value of the option (i.e., the compensation cost) has been determined using an appropriate option pricing model, it must be allocated to service periods. In other words, the compensation cost must be expensed over the periods in which the compensation cost is incurred. In accomplishing this, the total compensation cost recognized is based on the number of options the company grants that eventually vest. Generally, a stock-based compensation award becomes vested when the employee's rights to the award are no longer contingent on additional services or performance conditions. If the number of shares expected to vest and actual forfeitures differ, the company has two alternatives. First, it can recognize the compensation cost of an estimate of the number of options expected to vest with subsequent revisions for actual forfeitures. Second, it can recognize the compensation cost based on total options issued and subsequently adjust the cost for actual forfeitures. In general, the company should recognize stock-based compensation costs over the period(s) in which the related employee services are performed, which is frequently the same as the vesting period. The cost should be accounted for as a charge to an account called "compensation cost" and a corresponding credit to an equity account ("paid-in capital").

In application, astute accountants use the Black-Scholes option pricing model to find the fair value of the stock option; however, the Black-Scholes does not apply to the index-based-exercise-price option. Consequently, the purpose of this article is to show that employment of the Fischer-Margrabe Option Pricing Model to value the index-based option is state-of-the-art. Second, we will demonstrate how an actual corporation could apply the model with data reliable to meet the needs of financial analysts, boards of directors and accountants.

VALUATION

The Fischer-Margrabe option pricing was developed by the two researchers contemporaneously, but independently, as an extension to the Black-Scholes option pricing model. Although the respective titles of Fischer [1978] and Margrabe [1978] mention specific option pricing applications, they both observe that it applies to many options whose exercise prices are uncertain. It has direct application to an employee stock option to buy the employer's common stock on a specified date at a price determined by that stock's value relative to a stated market index. The fact that the option cannot be sold in a market before its expiration is not relevant to the model's valuation.³

Margrabe and Fischer show that the value of an option to exchange one asset for another depends on the standard deviations of the two assets and the correlation between them. The application of their formula to the executive index option is:

$$C(S, X, T) = SN(d_1) - XN(d_2) \quad (1)$$

where:

$$d_1 = \frac{\ln(S/X) + V^2 T}{V\sqrt{T}} \quad (2)$$

$$d_2 = d_1 - V\sqrt{T} \quad (3)$$

$$V^2 = V_S^2 - 2\rho_{SX} V_S V_X + V_X^2 \quad (4)$$

and:

- $N(\cdot)$ = the cumulative standard normal density function,
- S = the current market price of the corporation's stock,
- X = the current value of the index-exercise price,
- T = the years until the option's expiration,
- V_S = the instantaneous standard deviation of the stock,
- V_X = the instantaneous standard deviation of the index price,
- V = the instantaneous proportional standard deviation of the change in the ratio of the stock price and the exercise price, and
- ρ_{SX} = the instantaneous correlation coefficient between the stock price and the exercise price.

Consider the following hypothetical example. Suppose that America Online (AOL), the internet service provider, decides to provide its executives with a stock option plan. The executives receive a call option on July 31, 1998 with an exercise price tied to the S&P500 index. On this date, AOL's price is approximately 10 percent of the S&P500 index; thus, AOL's board of directors decides that the exercise price will be 10 percent of the index. At expiration in one year, the executives have the option of exercise or forfeiture—AOL contemplates no renegotiation nor extension of the plan. Since AOL pays no dividend, the option is a European call option.

We derive all needed data for valuation of our hypothetical options from published sources and the Black-Scholes model. By definition, $T = 1.0$. The *Wall Street Journal*, 7/31/98, gives the AOL stock price to be $S = \$117.5625$, the S&P500 index level to be 1142.95 (that is, $X = 1142.95/10 = 114.30$) and the one-year Treasury bill yield to be 5.07 percent. On this day, a call option on AOL with an exercise price of \$130, expiring 10/16/98, had a price (premium) of \$9.25. Solving the Black-Scholes model via a spreadsheet program, we find that the call's price implies an instantaneous standard deviation, $V_S = 0.5206$. A call option on the S&P500 index with an exercise price of 1200, also expiring 10/16/98, sold for \$19.25. Thus, by similar technique, we find $V_X = 0.2476$.⁴ We find the correlation between AOL stock and the S&P500/10 for the previous year based on their respective daily prices. The Pearson correlation coefficient is $\rho_{SX} = 0.9421$.

Using these data, Equation (4) yields $V^2 = 0.08946$. Equations (2) and (3) yield $d_1 = 0.3933$ and $d_2 = 0.0942$, respectively. Equation (1), then, is:

$$\begin{aligned} C(S, X, T) &= SN(d_1) - XN(d_2) \\ &= 117.5625N(.3933) - 114.295N(.0942) \\ &= 117.5625(.652951) - 114.295(.537525) \\ &= 15.33 \end{aligned}$$

Thus, AOL's hypothetical employee stock option is worth \$15.33.

We found that if an analyst naively treats the exercise price as fixed, the Black-Scholes would value this option (incorrectly) at \$27.94. Clearly, accountants are correct to be concerned about the accuracy of the Black-Scholes model to value index-based options; nevertheless, the solution via the Fischer-Margrabe model is theoretically reliable and uses objective data. It should meet the requirements of FASB 123.

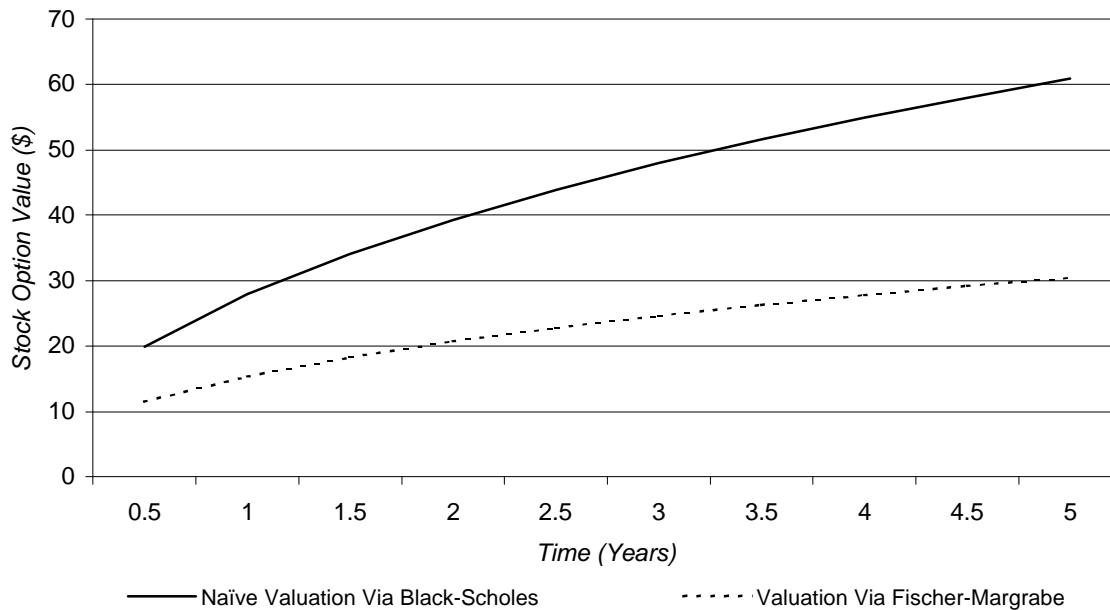
VALUATION SENSITIVITY TO OPTION LIFE

With the proposed index-based option structure, the board of directors or other compensation determining body only has direct control over one input variable, the expiration date. Exhibit 1 shows the sensitivity of the hypothetical AOL executive index-based option to the time to expiration. Similarly, the exhibit shows the sensitivity of an AOL fixed exercise price executive option (at the same price) to expiration time. A comparison shows that the former type of option results in a lower value and, hence, compensation cost. This is especially true for longer-life options. Thus, the mispricing resulting from improper use of the Black-Scholes model to value the indexed-exercise-price option is increasing in the time remaining to maturity. Since executive stock options often vest several years after the grant date, an accurate valuation via the Fischer-Margrabe option pricing model is necessary in order not to grossly understate the granting company's earnings over the vesting period.

CONCLUSION

Executive options with exercise prices tied to an index have incentive advantages over the prevalent fixed exercise price option. As more corporations adopt the new option, they can use, as we demonstrate, the Fischer-Margrabe option pricing model to value for both management compensation decisions and accounting for financial reporting. Indexed options result in a lower level of compensation costs to be charged against future earnings than equivalent fixed-exercise-price options, especially for options with long vesting periods.

EXHIBIT 1
Sensitivity of Indexes-Exercise-Price and Fixed-Exercise-Price
Stock Option Values to Time Maturity



ENDNOTES

1. Whether options encourage managers to take unwarranted risks with corporate resources or to overcome their innate over-conservatism is a point of much debate.
2. Companies can elect to measure compensation cost using the “intrinsic value based method” of accounting prescribed by Accounting Principles Board Opinion No. 25, the statement preceding FASB Statement 123. However, entities electing to remain with the accounting in Opinion 25 must make pro forma disclosures of net income and, if presented, earnings per share, as if the fair value based method defined in FASB Statements 123 had been applied. Consequently, only the fair value method is discussed here.
3. The model requires some modification if the firm is likely to pay common dividends before expiration.
4. If no traded call exists for the corporation’s stock or for the chosen index, one could obtain stock or index prices over the last year, calculate continuously compounded returns by taking logarithms, and calculate the standard deviation of the continuously compounded return. This approach is frequently used but yields accurate results only to the extent that the historical standard deviation is indicative of its future standard deviation.

REFERENCES

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