CHAPTER 1

Implications of the New FAS 123 Requirements

A BRIEF INTRODUCTION

In what the *Wall Street Journal* calls "among the most far-reaching steps that the Financial Accounting Standards Board (FASB) has made in its 30 year history,"[1] on March 31, 2004, FASB released a Proposed Statement of Financial Accounting Standards (FAS) on Share-based Payment amending the old FAS Statements 123 and 95 issued in October 1995.[2]

The original 1995 statements required that all share-based payment arrangements with parties other than employees be accounted for in value. The revised 2004 statement retains the principle established in FAS 123 (1995) that a public entity should measure the cost of employee services received in exchange for awards of equity instruments based on the fair value of the instruments at the grant date. In addition, the FASB has reaffirmed the conclusion in the 2004 proposed Statement 123 revision that employee services received in exchange for equity instruments give rise to recognizable compensation cost as the services are used in the issuing entity's operations. Based on that conclusion, this proposed Statement requires that such compensation cost be recognized in the financial statements.

The FASB states in its proposal that it wants to maximize the convergence of U.S. and international accounting standards for *employee stock options* (ESOs), and as such, the proposed 2004 FAS 123 revisions are consistent with the International Accounting Standards Board's *share-based payment* (IFRS 2, issued February 19, 2004). At the date of writing, the proposed Statement will be effective for new awards and portions of existing awards that have not yet vested at the beginning of the first fiscal year starting from December 15, 2004, with a possible delay in effective date to allow corporations to better prepare for the transition. In anticipation of the Standard, many companies such as GE and Coca-Cola have already voluntarily expensed their ESOs at the time of writing. This need for more transparency is in line with the 2002 Sarbanes-Oxley Act, which requires that public companies develop and comply with accepted standards of financial and managerial prudence.

One of the areas of concern is the fair-market valuation of these ESOs. The binomial lattice is the preferred method in the proposed FAS 123 requirements, and critics argue that companies do not necessarily have the resources in-house or the data availability to perform complex valuations that not only are consistent with these new requirements but will pass an audit as well.

The goal of this book is to provide you with a better understanding of the valuation applications of a customized binomial lattice through a systematic and objective assessment of the methodology. This book is concerned only with the valuation of ESOs, and not the management of these options.[3] The analyses performed in this book use my own proprietary customized binomial lattice computer algorithms and my software, the Real Options Analysis Toolkit, and Decisioneering, Inc.'s Crystal Ball Monte Carlo simulation software. This book was written based on my advisory work with FASB in 2003 and 2004, graduate research work in the area of options analysis, actual FAS 123 consulting projects with several Fortune 500 firms, and options software development experience, as well as my prior three books.

This book is divided into four parts. In Part One, the impacts of the 2004 FAS 123 are reviewed. In Chapter 1, the implications of the new FAS 123 requirements with respect to the valuation of ESOs are introduced. Chapter 2 reviews the FAS 123 requirements in more detail, focusing on the methodological requirements. Chapter 3 illustrates the impacts to the valuation results of using a customized binomial lattice versus a traditional *Black-Scholes model* (BSM),[4] as well as where the variation lies. (The traditional BSM described throughout this book is the original model with naïve assumptions without any modifications to include more exotic inputs, which can be very mathematically complex.) The chapter also reviews the selection and justification of the customized binomial lattice, as well as the effects of incorporating vesting, employee suboptimal exercise behavior, forfeiture rates, changing risk-free rates, changing dividends, and changing volatilities over time. Chapter 4 reviews some of the other modifications to value such as nonmarketability, expected life analysis, and dilution. Chapter 5 provides an introduction to using Monte Carlo simulation coupled with binomial lattices to obtain a robust and statistically valid set of option valuation results. Chapter 6 illustrates an example of how the option valuation's fair-market value can be allocated and expensed over the vesting period of the option.

In Part Two, the technical background required to run the BSM and customized binomial lattices are provided. Chapter 7 provides a brief technical background of the BSM and binomial lattice. Chapter 8 provides more detailed technical background on the use of a simple binomial lattice, complete with step-by-step valuation examples. The customized binomial lattice algorithms are briefly explained. Chapter 8's appendix explores in more detail the uses of binomial, trinomial, and multinomial lattices. Chapter 9 deals with how to obtain the model inputs, and their financial, statistical, and analytical justifications.

Chapter 10 in Part Three shows an example ESO fair-market valuation that is based on several real-life cases.[5] Chapter 10's appendix provides a "Getting Started Guide" in using the demo software in the accompanying CD-ROM.

Finally, Part Four provides multiple options valuation results that will prove valuable from the perspective of the analyst all the way to the chief financial officer when it comes to valuing the impact of using the binomial lattice versus BSM. These tables provide a first-pass rough estimate of the fair-market value of the option using a customized binomial lattice, providing management with valuable insights into the possible expenses before having to delve into more detailed, complex, and protracted analyses. In the face of implementing a challenging and potentially complex valuation system, firms need to first obtain a benchmark to understand if these more sophisticated models will provide comparable, lower, or higher values than the BSM.

AN EXECUTIVE SUMMARY OF THE FAS 123 VALUATION IMPLICATIONS

This book broaches the subject of fair-market valuation through an analytical assessment of the three mainstream approaches used in option pricing, and provides guidance on using them, coupled with the mathematical background, sample case study, and demo software to help the reader get started with ESO valuation. The first approach is a set of closed-form models,[6] including the BSM for option pricing and the American option approximation pricing models. The second approach is the use of Monte Carlo path-dependent simulation, including its applications in option pricing as well as its use in simulating the option model's uncertain and probabilistic inputs. The third and final approach is the use of lattices and the customized binomial lattices applied throughout this book. These three sets of methodologies are reviewed based on several criteria, including method applicability, underlying assumptions, robustness of analytical results, and ease of use.[7]

Based on the results illustrated throughout the book, it can be concluded that the BSM, albeit theoretically correct and elegant, is insufficient and inappropriately applied when it comes to quantifying the fair-market value of an ESO. This is because the BSM is applicable only to European options without dividends, where the holder of the option can exercise the option only on its maturity date and the underlying stock does not pay any dividends. However, in reality, most ESOs are American-type options with dividends, where the option holder can execute the option at any time up to (after the vesting period and except blackout dates) and including the maturity date while the underlying stock pays dividends. A stock's price drops by approximately the amount of the dividend on the ex-dividend date, which means that the value of an American stock option (with its ability for early exercise) is greater than that of a European-type option. However, for fairness of comparison, the Generalized Black-Scholes model (GBM) is used—the GBM allows for the inclusion of dividends albeit it is applicable only for valuing European options. The terms BSM and GBM will be used interchangeably throughout this book, which describes the original models developed by Black and Scholes without any modifications (the correct model will be used whenever appropriate).

In addition, under real-world conditions, ESOs have blackout dates and a time to vesting before the employee can execute the option, which is also contingent on the firm and/or the individual employee attaining a specific performance level (e.g., profitability, growth rate, or stock price hitting a minimum barrier before the options become live), and subject to forfeitures when the employee leaves the firm or is terminated prematurely before reaching the vested period. Also, certain options follow a tranching or graduated scale, where a certain percentage of the stock option grants becomes exercisable every year, and if the firm underperforms, it may be required to repurchase the options at a specific termination price. Just as important, the GBM assumes that all employees execute their options optimally—that is, the model assumes that every employee is intelligent enough to execute the option whenever it becomes optimal to do so. In reality, employees tend to execute their stock options prematurely and often suboptimally. The GBM or BSM do not adequately account for this suboptimal early exercise behavior and subsequently overvalue the option (sometimes significantly). The firm may undergo some corporate restructuring (e.g., divestitures, or mergers and acquisitions that may require a stock swap that changes the volatility of the underlying stock) and hence its underlying stock's volatility may change over time. In addition, risk-free rates change over time (both U.S. Treasury spot rates and forward rates fluctuate) and will impact the value of the option. The same applies to dividend policy, where dividend payout ratios can change over the life of an ESO. In addition, ESOs cannot be executed during blackout periods (typically weeks before and afer earnings announcements), and the ESOs in general are nonmarketable and nontransferable (cannot be freely bought or sold in an open market). Finally, options that are granted may sometimes be forfeited by employees when they leave or are terminated during the vesting period (alternatively, employees have a limited time, typically 30 to 90 days, to exercise the portion of the options that have vested, after they leave the firm). All these real-life scenarios make the GBM and BSM insufficient and inappropriate when used to place a fair-market value on the option grant. In summary, firms can implement a variety of provisions that affect the fair value of the options whereas the above list is only a few examples.

Generally speaking, the BSM and GBM typically *overstate* the fair-market value of ESOs where there is suboptimal early exercise behavior coupled with vesting requirements and where employee forfeitures occur, or when the risk-free rates, dividends, and volatilities change over the life of the option. In fact, firms using the BSM and GBM to value and expense ESOs may be significantly overstating their true expense, typically incurring hundreds of thousands to tens of millions of dollars in excess expenses per year.[8]

The analyses in this book illustrate that under very specific conditions (European options with and without dividends) the binomial lattice and Monte Carlo simulation approaches yield identical values to the GBM, indicating that the two former approaches are robust and exact at the limit. When American options with dividends are analyzed, the traditional BSM and GBM undervalue the options, whereas binomial lattices and American options approximation models are more exact. However, when specific real-life business conditions are modeled (i.e., forfeiture rates, probability that the employee leaves or is terminated, time-vesting, blackout dates, tranching, employee suboptimal exercise behavior, changing risk-free rates, and so forth), the American approximation models or Monte Carlo simulation by themselves are also insufficient to capture all of the real-life nuances. Only when the binomial lattice (which is highly flexible in its modeling capabilities) is used will the true fair-market value of the stock option be captured—Monte Carlo simulation can be applied to further simulate the uncertain inputs that go into the binomial lattices. That is, the binomial lattice is used to calculate the American stock option with dividend while the inputs into the binomial lattice can be simulated to capture the uncertainty and probabilistic effects of the real-life conditions mentioned. Basic binomial lattices are extremely easy to use and apply as compared with the other methods. However, in the case of FAS 123, more complex customized binomial lattices are required, but their analytics are based on the simple binomial lattice. In addition, a comparison of other lattices (trinomials and multinomials) indicates that the binomial lattice is still the preferred method (all lattices provide similar results at the limit, while binomial lattices are the easiest and most convenient to compute).

Binomial lattices can be customized to account for exotic events such as stock price barriers (a barrier option exists when the stock option becomes either in-the-money or out-of-the-money only when it hits a stock price barrier), vesting tranches (a specific percent of the options granted becomes vested or exercisable each year), changing volatilities, dividends, and risk-free rates over time (changing business and economic conditions or corporate restructuring), employee suboptimal exercise behaviors (early execution by employees who require liquidity or are risk-averse), forfeitures (employees leaving or terminated during and after the vesting period), and so forth—the same conditions where the BSM and GBM fail miserably. Monte Carlo simulation then can be applied to simulate the probabilities of forfeitures and employee suboptimal behavior, and these simulated values can be used as the inputs into the binomial lattices. *Without the use of binomial lattices, firms may be significantly* overvaluing *ESOs and could potentially end up overexpensing millions of dollars per year.*

In using the highly flexible binomial lattices with Monte Carlo simulation, firms can now create exotic ESOs with different flavors such as performance-based options (i.e., a percentage of ESOs that come into-the-money if the firm hits a particular earnings level, and this percentage may increase based on some graded scale) and value them accordingly.

This book provides a comprehensive review of all the necessary steps and methodologies required to value ESOs. No matter which direction the final requirements lean toward, the methodologies described here can be mixed and matched accordingly.

SUMMARY AND KEY POINTS

- It has been over 30 years since Fischer Black and Myron Scholes derived their option pricing model and significant advancements have been made; therefore, do not restrict stock option pricing to one specific model (the BSM) where a plethora of other models and applications can be explored.
- The three mainstream approaches to valuing stock options are closed-form models (e.g., BSM, GBM, and American option approximation models), Monte Carlo simulation, and binomial lattices.

- The BSM and GBM will typically *overstate* the fair value of ESOs where there is suboptimal early exercise behavior coupled with vesting requirements and option forfeitures. *In fact, firms using the BSM and GBM to value and expense ESOs may be significantly overstating their true expense.*
- The BSM requires many underlying assumptions before it works, and as such, has significant limitations, including being applicable only for European options without dividends. In addition, American option approximation models are very complex and difficult to create in a spreadsheet.[9] The BSM *cannot* account for American options, options based on stocks that pay dividends (the GBM can, however, account for dividends in a European option), forfeitures, underperformance, stock price barriers, vesting periods, blackout dates, changing business environments and volatilities, suboptimal early exercise, and a slew of other conditions.
- Monte Carlo simulation when used alone is another option valuation approach, but is restricted only to European options. Simulation can be used in two different ways: solving the option's fair-market value through path simulations of stock prices, or in conjunction with other approaches (e.g., binomial lattices and closed-form models) to capture multiple sources of uncertainty in the model.[10]
- Binomial lattices are flexible and easy to implement. They are capable of valuing American-type stock options with dividends but require computational power. Software applications should be used to facilitate this computation. Binomial lattices can be used to calculate American options paying dividends and can be easily adapted to solve options with stock price barriers and used in conjunction with Monte Carlo simulation to account for the uncertain input assumptions (e.g., probabilities of forfeiture, suboptimal exercise behavior, vesting, blackout periods, underperformance, and so forth).
- Based on the analyses throughout the book, it is recommended that the use of a model that assumes an ESO is European style, when in fact the option is an exotic American style option with vesting, should not be permitted as this substantially overstates compensation expense. Many factors (e.g., vesting, suboptimal exercise behavior, performance-based options, blackout dates, and forfeitures) influence the fair value of ESOs, and a binomial lattice approach to valuation that considers these factors should be used. Option valuations using BSM, GBM, or other closed-form models should not be permitted when the requirements for those models are not met. Binomial lattice valuation models should be used instead.