Valuing Employee Stock Options
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This book was written after FASB released its proposed FAS 123 revision in March 2004. As one of the valuation consultants and FASB advisors on the FAS 123 initiative in 2003 and 2004, I would like to illustrate to the finance and accounting world that what FASB has proposed is actually pragmatic and applicable. I am neither for nor against the expensing of employee stock options and would recuse myself from the philosophical and sometimes emotional debate on whether employee stock options should be expensed (that they are a part of an employee’s total compensation, paid in part for the exchange of services, and are an economic opportunity cost to the firm just like restricted stocks or other contingent claims issued by the company) or should not be expensed (that they simply dilute the holdings of existing shareholders, are a cashless expense, and if expensed, provide no additional valuable information to the general investor as to the financial health of the company but rather reduce the company’s profitability and hence the ability to continue issuing more options to its employees). Rather, as an academic and valuation expert, my concern is with creating a universal standard of understanding on how FAS 123 can be uniformly applied to avoid ambiguity, and not whether employee stock options should be expensed. Therefore, let it not be said that the new ruling is abandoned because it is not pragmatic. This book is also my response to FASB board member Katherine Schipper’s direct request to me at the FASB public panel roundtable meeting (Palo Alto, California, June 2004) for assistance in providing more guidance on the overall valuation aspects of FAS 123.

Hopefully the contents of this book will subdue some of the criticisms on how binomial lattices can be used and applied in the real world. The results, tables, graphics, and sample cases illustrated throughout the book were calculated using customized binomial lattice software algorithms I developed to assist FASB in its deliberations, and were based on actual real-life consulting and advisory experience on applying FAS 123. Inexperienced critics will be surprised at some of the findings in the book. For instance, criticisms on the difficulty of finding the highly critical volatility may be unfounded because when real-life scenarios such as vesting, forfeitures, and
suboptimal exercise behavior are added to the model, volatility plays a much smaller and less prominent role. In addition, the book illustrates how Monte Carlo simulation with correlations can be added (to simulate volatility, suboptimal exercise behavior multiple, forfeiture rates, as well as other variables for thousands and even hundreds of thousands of simulation scenarios and trials) to provide a precision of up to $0.01 at a 99.9 percent statistical confidence; coupled with a convergence test of the lattice steps, this provides a highly robust modeling methodology. Future editions of this book will include any and all changes to the FAS 123 requirements since the March 2004 proposal.

Parts One and Four are written specifically for the chief financial officer and finance directors, who are interested in understanding what are the impacts and implications of using a binomial lattice versus a Black-Scholes model. Parts Two and Three are targeted more toward the analysts, consultants, and accountants who require the technical knowledge and example cases to execute the analysis.

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Dr. Johnathan C. Mun is the author of several other well-known books, including *Real Options Analysis: Tools and Techniques* (Wiley, 2002), *Real Options Analysis Course: Business Cases* (Wiley, 2003), *Faith Journey* (Xulon Press, 2003), and *Applied Risk Analysis: Moving Beyond Uncertainty* (Wiley, 2003). He is also the creator of the Real Options Analysis Toolkit software. His books and software have been adopted by major universities in the United States and around the world, and are used widely at a variety of Fortune 500 companies. Dr. Mun has taught seminars and workshops worldwide on the topics of options valuation, risk analysis, simulation, forecasting, financial analysis, and real options analysis. This book is the result of analytical work he did for the Financial Accounting Standards Board in 2003 and 2004, as well as FAS 123 employee stock options valuation advisory and consulting work he has performed at dozens of Fortune 500 firms.

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PART One

Impacts of the New FAS 123 Methodology
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,” 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.

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 recogniz-able 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. 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), 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. 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, 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.
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