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Accounting for Stock Options

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Abstract

Employee stock options differ substantially from traded options. Most expire within 90 days of the termination of employment, and are forfeited if the employee leaves before vesting. The major accounting standards boards are in agreement that options should be expensed, but companies have legitimate complaints about the proposed methods. For example, the proposals create accounting incentives for firms to lay off employees who hold unvested and nearly worthless options. We propose a simple accounting system, based on 90 day option prices, that addresses these legitimate objections. The system produces objective, transparent, and decision-relevant information. Firms are given significant flexibility regarding the amortization of unvested option expense. This flexibility is created, without distorting incentives, by our use of market-based prices whenever an option expense is recognized.

1 Introduction

We propose accounting for vested stock options as 90 day options, extended every quarter. This simple method of financial accounting has several benefits. First, it is an accurate reflection of the actual employee contract. Most employee options must be exercised within 90 days of the termination of employment, regardless of the nominal life of the option. Second, this accounting most closely parallels that for the vast majority of other employee compensation, salary in particular. Third, this system would enable many publicly traded firms to rely on market prices to estimate option expense, as the market prices for 90 day options are generally the most liquid and reliable.

There would be no need, as in other proposals, for firms to estimate the early exercise behavior of employees or the other factors such as future dividends and long-term volatility that are relevant to valuing long-term options. A firm that had traded options with an exercise price of 50 and employee options with an exercise price of 53, say, would only need to rely on an option pricing model to estimate the difference in value of the two securities. Therefore, estimates of value would also be robust to the choice of the underlying contingent claims model.¹

The most obvious argument against this approach is that implicit contracts between the firm and the employee mean that the true value of the firm's liability may differ from that implied by a 90 day option. While surely true for many firms, the argument does not imply that an alternative accounting system will provide better information for decision makers, including executives and security analysts.

Consider a firm with a very simple pay structure that offers only salary and a defined contribution pension benefit proportional to salary. Just as with a firm that offers stock options, the implicit liability of such a firm to its employees may differ from the formal employment-at-will arrangement. For example, if the employee receives a raise of \$2,000 per quarter one might

¹For options that are either far in or far out of the money, the percentage error in value may be large if there are no comparable traded securities, but in absolute terms errors in estimating the value of a 90 day extension will be small. For options with strike prices near the current stock price 90 day extensions will have significant value but the likely percentage difference between say a Black-Scholes price and a market price is likely to be small.

argue that the present value of the firm's future salary obligations has risen by a large multiple of the amount of the raise. Theoretically, one might argue that the firm should expense this future cost when the raise is granted. If, on the other hand, a firm negotiated a contract with an employee that always paid him an amount halfway between his alternative wage and his value to the firm a raise would signal greater future profits from the employment contract, so the increase in future salary liability would be more than offset by an increase in the present value of future employee output.

Nevertheless, continuously accumulated forms of compensation like salary are expensed by accountants as they are explicitly earned. This methodology generates little discussion or controversy, despite the enormity of these items relative to virtually any other expenses. Why? In terms of accounting objectives, expensing the actual salaries paid provides a less noisy, more reliable number to decision makers. It is not sensitive to assumptions about the implicit labor contract, and it is directly comparable across firms. It is not that accountants don't believe in implicit labor contracts, rather that they have concluded that reporting actual salary earned each quarter comes closest to achieving their goals.²

Taking the accountants' approach to salary and applying it to vested pension benefits leads us to viewing an option as a short-term option that is extended by continued employment. The extension is part of future compensation, just as next quarter's salary is part of future compensation. The method provides parallel treatment for two firms that may each have implicit labor contracts with their employees, one of which issues stock options (e.g. Oracle) and one of which does not (say, Stanford University).

Of course many options only vest several years after they are granted. If the employee leaves the firm prior to the vesting date then all the options are forfeited. In this case compensation is discontinuous, as an employee may own nothing if he leaves the day before vesting and a valuable 90 day option to purchase a stock at well below its then-current price if he leaves

²When an explicit long-term contract exists, things are still complicated. For example, in American football it is widely recognized that the reported length and value of a contract is not nearly as relevant as the details of who can terminate the contract early and at what price, since that will determine renegotiation. But even recognizing this, no simple formula for allocating costs across time will apply very generally. For example, a 38 year old football player who received a guaranteed five year contract at a constant wage might reasonably be assumed to provide a disproportionate share of his output during the early part of the contract.

the day after. Other forms of discontinuously accrued compensation, such as unvested pension benefits and annual bonuses paid only to those with the firm at the end of the fiscal year, are often though not always expensed over the entire vesting period.³

The Financial Accounting Standards Board (FASB) and the International Accounting Standards Board (IASB) discuss treating unvested options as though they have the same value as vested options, times a fraction representing the vesting probability of the option. They then propose linearly amortizing their estimated value of the option over the time until vesting. As the probability of vesting is changed over time the firm's income is changed in a given quarter by the increase in the number of options eventually expected to vest, times the grant day value.

Our proposal for unvested options also treats them as equivalent to vested options times a recognition factor, but in our case the vested option equivalents are always 90 day securities. Also, in contrast with the standards boards, we do not require that the recognition factor be justified as an ultimate vesting probability so long as the firm uses a mechanical formula that expenses the number of options that actually vest by the vesting date. We are able to provide this flexibility, which will enable firms to choose amortization schedules that they believe are most consistent with their compensation arrangements, because we use market prices to value any change in recognized options and we require detailed footnotes that would enable an investor to recalculate the option expense under alternative approaches.

To describe why flexibility across firms may be desirable, assume that firm A grants options that vest linearly over the next 16 quarters. Further assume a rule like that proposed by the standards boards, where options vest linearly until the vesting date. For simplicity assume that there is never any attrition. If we treat A's options as one grant then it will expense the same amount each quarter, essentially writing off each option as it vests. If we treat the options as 16 distinct grants, however, then over 57 percent of the total expense would be charged in the first year — all of the options that vest in the first year, more than half the options that vest in the second year, and so on. Which method is “right”? If the linear expensing method is chosen, then none of the options that vest in the final quarter are expensed

³A firm may expense a college tuition benefit in the year paid even though the employee may regard the benefit as something that was earned over time but would be forfeit if he left prior to his children attending college.

until then. But what if another firm, B, issues options that “cliff” vest after four years? What if a firm that issues options vesting after four years cancels the options after two years and replaces them with new, virtually identical options vesting on the same date? The one thing for sure is that the answers to these questions will be highly firm-specific.

Fortunately, if options and option extensions are valued at market prices on the day they are recognized, firms’ incentives to misreport the timing of the expense is greatly reduced. With a “normal” expense such as depreciation a slower schedule implies higher cumulative accounting profits over any time period short of the end of the asset life, and therefore a lower present value of expenses. If options are expensed at market value when recognized, with subsequent extensions also priced at market, then any recognition scheme that leads to all vested options being expensed by the vesting day will create the same risk-adjusted expected present value of expense. For example, if A expensed its options entirely on the grant date, followed by extensions, while B expensed entirely on the vesting date then in expected present value their write-offs would be the same.⁴ A firm that wished to minimize the volatility of the difference between its reported option expense and its estimate of the true expense would have an incentive to choose an expensing schedule that matched its view of its implicit labor contract.

Finally, a market-based system aligns the accounting and economic consequences of layoff and hiring decisions. For example, under current standards board proposals if an employee will produce \$20,000 in real earnings during a period in which he will vest in now-worthless options with a book value of \$50,000 the firm can raise its reported profits by \$30,000 by uneconomically laying the worker off. Thus, these proposals fail the important test of providing accurate, decision-relevant information about the cost of retaining an employee.⁵ In a market-based accounting system as we propose, accounting

⁴Furthermore, while the undiscounted sum of A’s expenses would be lower, A’s earlier expensing of its options would imply greater dilution in the pre-vesting period. Viewing each additional share as having a dilutive “cost” to other shareholders equal to earnings per share, we show that in a benchmark case the expected dilution cost exactly offsets the expected difference in undiscounted expenses among any schedule of expense recognition.

⁵Accountants regard the primary purpose of accounting information to be to provide information useful for decision makers, with the benefit of the disclosure exceeding the costs. A requisite condition for usefulness is that information be understandable. Decision usefulness is broadly determined by relevance and reliability. Like economists, accountants recognize that financial statements represent an implicit model of an enterprise, and therefore must be designed with similar tradeoffs between abstraction and complexity.

and economic net present value are aligned.⁶

At some level it is a mystery as to why the financial accounting for options seems to matter so much. After all, there is no controversy about the corporate tax accounting for options, employed by the Internal Revenue Service, which gives firms a deduction equal to the employee's profit on the day of exercise. This tax accounting has a direct impact on cash flow, as a firm's tax bill will vary from quarter to quarter as a function of the option gains realized. Yet financial accounting, which has no cash flow impact, is clearly of great concern to many executives.⁷

A further mystery concerns the widespread use of options rather than other forms of variable compensation. It is clear that most employees exercise options well before the last possible date, and often as soon as possible. When an employee with an option to buy a non-dividend paying stock at 100 exercises instead of holds at a price of 150, it implies that he prefers to earn the return on 50 dollars of other investments, or to consume a like amount, rather than earn the return on 150 dollars of the firm's stock.⁸ If employees value the returns provided by the stock at such a low level, for whatever reason, then it calls into serious question whether this is an efficient mode of compensation.

The outline of the paper is as follows. In section 2 we discuss how one might implement a proper option accounting system in a world where options were all immediately vested but followed the dominant practice of expiring within 90 days of the termination of employment. In this section we assume that it is possible to have "continuous time accounting" so there is no need

See [2].

⁶Of course, giving firms flexibility means that some will choose expensing methods that do not match their best estimate of economic reality. For example, firms may choose LIFO or FIFO as an inventory method. The IASB initially proposed that firms be allowed to expense options on the assumption that no attrition would occur, the estimate only to be revised as employees departed. Because of the use of market values and the requirement of detailed footnote data, flexibility may give firms room to signal something about their true business while creating limited opportunities for distortion.

⁷Perhaps for some of these executives bonuses and targets may be a function of reported earnings per share, but that response begs the question of why incentive compensation could not be adjusted to compensate for any straightforward accounting charge. See [9] for a discussion of how options might be used to smooth out of pocket labor compensation costs.

⁸Heath, Huddart, and Lang [4] reported that employees in a sample of firms exercised at an average of 2.2 times the exercise price. Presumably in some cases early exercise may have been constrained by the vesting requirement.

to make adjustments for quarterly reporting.

In section 3 we then show how a set of simple approximations enables us to come close to replicating the proper continuous time accounting methodology in a quarterly reporting framework.

In section 4 we consider options that vest over time. Because we use the market to calculate expenses we can give firms a significant amount of flexibility in choosing how they wish to accrue option costs, and we suspect that most would choose specifications that lead to relatively low expense volatility. However, the price of this flexibility is that we would require an elaborate footnote to financial statements that would list the exercise price, vesting date, number of options, and projected vesting percentage for all non-vested classes of options, as well as exercise price and number of shares for vested options.

In section 5 we explain how we would incorporate taxes into our system, and how options would appear on the balance sheet. In section 6 we discuss some alternative proposals. Sections 7 and 8 briefly discuss performance options and summarize our conclusions. An appendix illustrates how our method might be applied to the Intel Corporation for the first quarter of 2003.

We are not wedded to all the details of our system. Rather, our goal is to illustrate that it is possible to develop a simple, reliable, objective accounting system that will provide relevant information. We hope that our work will help accounting standards setters in their thinking about this issue. If there are other proposals or modifications of our proposal that can meet the same objectives in a more satisfactory way, then so much the better.

2 Continuous Time Accounting

In most companies long term options are not really very long term at all. While an option may technically expire after 10 years, the employee only has 90 days to exercise if he either quits or is fired. Therefore, what an employee with a vested option really owns at any given time is a 90 day option. Non-vested options are completely worthless upon termination.

We begin with the case where options immediately vest. In this situation, the employee's compensation is effectively a 90 day option on the day the option is granted. Each additional day that the employee works earns him or her an extension of that option by one day. In this section we discuss

accounting for these vested options, in terms of both expensing and dilution (the number of share-equivalents that the options represent for purposes of determining earnings per share) in a manner that is consistent with the legal reality.

Note that it is entirely possible that implicitly both the firm and the employees believe that the true obligation of the firm to the employees is greater than or less than the legal obligation. However, this is not uniquely true to stock options. For example, a \$1,000 per quarter increase in an employee's salary creates an implicit liability for the firm to pay the higher salary in future quarters as well. A 30 year old worker may be paid less salary than a sixty year old worker, even if he is equally productive, but may have an implicit contract to be paid for his seniority if he remains with the firm.⁹ Thus, an employee's compensation may differ on an economic accrual basis than on a "cash" basis. Yet most would agree that the current accounting method for salary — expensing what is actually paid — is a sensible metric.¹⁰ While other data about the implicit assets and liabilities that the firm's current labor force embodies may be valuable, firms inform shareholders about this information outside of the income statement and balance sheet.

This literal approach escapes the difficult question of estimating the full option life or value on the vesting date. While financial theory tells us that the cost of the option is greatest to the firm if the employee holds the option until the last possible date, most employees do not exercise in this manner and it is their actual behavior that determines the cost to the firm.

2.1 Intuition for Expensing Vested Options

Consider an expiring option, exercisable at a price X , for a stock currently selling at a price S_0 . The option is worth its intrinsic value of $\max\{0, S_0 - X\}$. The value of a one-day extension of the option has two parts. First, if the

⁹This can also work the other way. For example, a university may pay more to externally hired faculty than to internal faculty, all else equal.

¹⁰Note that salary is accrued continuously, as each month the employee works he is owed additional wages. The same is true with vested stock options, whose life is extended an extra month for each month the employee works. This contrasts with compensation that accrues discontinuously, such as annual bonuses to employees who are still with the firm in October, which may be expensed over the full year, or stock options that only vest a year or more after they are granted — to be discussed later.

option is in the money, is the difference between buying the stock today and agreeing to a futures contract to buy the option one day later at the same price of X . This is just the present value of the deferral. Second is the “hindsight value” of being able to defer the decision of whether to exercise by another day. If $sign\{S_0 - X\} \neq sign\{S_1 - X\}$ then the option holder will make a different exercise decision if he has the extra day, and will either make a profit or avert a loss equal to $|S_1 - X|$.

The value of a long term option can be thought of as the value of an option that must be exercised immediately if at all, plus the ex ante value of a series of one day extensions that run until the final expiration date. The value of a 0 day option is of course just its intrinsic value, $\max\{S_0 - X\}$. The present value of any extension from date t to $t + 1$ may be thought of as the present value of deferring the payment of the exercise price from t to $t + 1$, times the (risk-adjusted) probability that the option will be in the money at time t , plus the (risk-adjusted) probability that $sign\{S_t - X\} \neq sign\{S_{t+1} - X\}$ times the present value of the expectation of $|S_{t+1} - X|$, contingent on $sign\{S_t - X\} \neq sign\{S_{t+1} - X\}$. The value at time 0 of an option of life τ is simply the initial intrinsic value plus the sum of the (risk-adjusted) present values of any set of extensions to the option’s life that add up to τ . That is, a five year option could be valued as 1,826 one-day extensions, or 20 quarterly extensions, or even a series of uneven extensions, so long as the last extension brought the total life to five years.

If an employee has an option that must be exercised within 90 days of the termination of employment, and is extended by one day for each extra day worked, then an idealized daily accounting system might work like this: Each day when the employee showed up for work his option would extend for one day. The value of that extension, say from day 90 to day 91, may be broken into two parts. First is the probability¹¹ that the option will be in the money at day 90 times the present value of deferring payment of the exercise price from day 90 to day 91. Second is the probability that $sign\{S_{90} - X\} \neq sign\{S_{91} - X\}$, times the expected value of $|S_{91} - X|$ contingent on this occurring, which may be thought of as the incremental “hindsight value” of an extension.

At this point, the employee owns an option that may be thought of as equivalent to the ownership of some fraction Δ of a share of stock, where Δ

¹¹From hereon, whenever we use the term probability it should be interpreted as risk-adjusted probability, or what is often called “pseudo-probability”.

is the risk-adjusted fraction of the stock's returns that may be attributable to in-the-money states, and a debt to the company to pay the exercise price on the expiration day, times the probability that the option will end in the money.¹² Over the course of the day the employee will thus have capital income on his option equivalent to the owner of Δ shares and an interest expense equivalent to one day's interest times the present value of the exercise price, times the probability that the option will finish in the money. Note that this interest expense matches the income the employee receives from a one day extension of the option, even though one is a labor expense of the firm and the other may be thought of as capital income.

Why the interest terms cancel can best be seen by applying this framework to the evaluation of a hypothetical futures contract between the firm and the employee whereby the employee agrees to purchase a share of stock at the current market price $S_0 = X$ on the day after his employment ends. This may be thought of as a special case of an options contract where it is certain that the stock price will never fall below the exercise price.¹³ In this case there is no hindsight value, as the employee is committed to exercising, and $\Delta = 1$ as the employee effectively owns a share of stock. Each day the employee earns a benefit equal to the interest rate times the exercise price because the original expiration date is deferred a day. But the firm should not report any net cost, as the employee benefit is exactly offset by the interest the firm earns by having the original expiration date drawn a day closer.

This intuition leads to the following approach for daily accounting: On the day of issuance, the firm should take an expense equal to the 90 day Black-Scholes value. On subsequent days, the option value will change because of the change in stock price, the approach of the exercise date because of the passage of time, and the extension of the exercise date due to continued employment. The change in the stock price is most accurately accounted for by diluting earnings per share by Δ shares for each option outstanding, as economically that is the true representation of the employee's equity position. The implicit interest earned by the firm from the passage of time bringing the

¹²We are using "daily" accounting here as a metaphor for a short period of time. The exact recreation of the option from a combination of stocks and bonds would of course entail continuous rather than daily portfolio rebalancing.

¹³As proven in the WorldCom case among others, there is a question of whether a futures contract with an executive, or equivalently a full-recourse loan to buy company stock, is really just an option in disguise. Full payment may be unlikely if the stock does not rise. Rules pertaining to loans to executives could be appropriately applied to futures contracts.

expiration date nearer and the interest savings to the employee from having the option extended by a day can be cancelled out against one another. The incremental “hindsight value” from extending the option an extra day must be expensed. When and if the option is exercised the employee forfeits a 90 day option and the firm has income equal to the difference between the 90 day option value and the intrinsic value. Note that since exercised options tend to be sufficiently far in the money that this last amount will approximate the one quarter interest rate times the exercise price. Should the employee leave the firm, or should the option no longer be extended daily because its nominal 10 year life was ending, then the firm would report daily interest income recognizing the increase in the expected present value of future exercise price revenues.

This method differs from the FASB approach, discussed later, in terms of both expensing and dilution. Applied to the example, the FASB method would entail estimating the date that the employee would pay for the stock. An immediate expense would be taken equal to the difference between the exercise price if paid today and if paid on the projected purchase date. Dilution for in-the-money contracts would vary across time, based on the ratio of the value of the contract if exercised that day to the current stock price, or $(S_t - X)/S_t$ on date t .

2.2 A More Formal Analysis

We will assume no dividends throughout the paper. Write the Black-Scholes formula as:

$$C_t(S_t, X, \tau, \sigma, r) = S_t N(d_{1t}) - X e^{-r(\tau-t)} N(d_{2t}) \quad (1)$$

where C_t is the value of a call and S_t is the stock price at the current time t , τ is the date of maturity, σ is the log of the standard error of returns as a fraction of stock price per unit time¹⁴, and r is the continuous interest rate, assumed constant. Recall that

$$d_{1t} = \frac{\ln(S_t/X) + (r + \frac{\sigma^2}{2})(\tau - t)}{\sigma \sqrt{(\tau - t)}} \quad (2)$$

¹⁴Normally one would not time subscript d_1 and d_2 but it will turn out to be convenient for a discrete time calculation in the next section.

$$d_{2t} = \frac{\ln(S_t/X) + (r - \frac{\sigma^2}{2})(\tau - t)}{\sigma\sqrt{(\tau - t)}} \quad (3)$$

where $N(d)$ is the cumulative normal distribution up to d ,

$$N(d) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^d e^{-\frac{x^2}{2}} dx.$$

The intuitive explanation of the Black-Scholes variables is that $N(d_{1t})$ is the fraction of the present value of the current stock price attributable to the stock's worth in in-the-money outcomes, and also the fraction of any stock price increase that will be reflected in an increase in the option value, i.e. the option's Δ . $N(d_{2t})$ is the risk-adjusted probability that the stock will finish in the money and the exercise price will be paid, and $Xe^{-r(\tau-t)}N(d_{2t})$ is the amount of an implicit loan the employee owes the firm, collateralized by her Δ shares of stock. That is, the economic relation of the option holder to the firm is equivalent to that of someone who owns $N(d_{1t})$ shares of stock and owes the firm a debt of $Xe^{-r(\tau-t)}N(d_{2t})$.

After the initial charge of the 90 day Black-Scholes value, based on (1) the expense of extending the option would be $\partial C_t/\partial\tau$, partly offset by implicit interest income on the outstanding implicit loan. We note

$$\partial C_t/\partial\tau \equiv -\partial C_t/\partial t \equiv -\Theta = rXe^{-r(\tau-t)}N(d_{2t}) + \frac{1}{2}\sigma Xe^{-r(\tau-t)} \frac{N'(d_{2t})}{\sqrt{(\tau-t)}} \quad (4)$$

where the first right-hand-side term in (4) represents the interest benefit of being able to defer repayment a bit longer when the option is extended, and the second right-hand-side term is the hindsight value of being able to postpone the exercise decision by a day. That is, the first expression is equal to the interest rate r times the present value of the exercise price $Xe^{-r(\tau-t)}$ times the risk-adjusted probability that the option will finish in the money and the exercise price will be paid, $N(d_{2t})$. The second expression represents the probability that $\text{sign}\{S_{\tau+d\tau} - X\} \neq \text{sign}\{S_\tau - X\}$, which is $N'(d_{2t})/\sqrt{(\tau-t)}$, times the present value of $|S_{\tau+d\tau}|$ contingent on $\text{sign}\{S_{\tau+d\tau} - X\} \neq \text{sign}\{S_\tau - X\}$, which is $\frac{1}{2}\sigma Xe^{-r(\tau-t)}$.

We further note that the total derivative of the option's value with respect to time if it is not being extended may be written as

$$dC_t/dt = \dot{S}_t N(d_{1t}) - rXe^{-r(\tau-t)}N(d_{2t}) \quad (5)$$

where \dot{S}_t is the time derivative of the stock price. The first of the right hand side terms reflects the fraction of the stock price change accruing to the option holder in his role as an investor in the firm. It is thus appropriately accounted for through earnings dilution, with the option being the equivalent of $N(d_{1t})$ shares of stock. The second term is implicit interest paid, which is interest income to the firm. Note that this interest income exactly offsets the first term of Θ as written in (4), which is the value of the extension of the interest-free loan when the option is extended by continued employment. Netting the two interest terms, the ultimate effect on earnings per share during a period when the option is being extended by continued employment would be the dilution effect of $N(d_{1t})$ shares and the incremental hindsight value of $\frac{1}{2}\sigma X e^{-r(\tau-t)} \frac{N'(d_{2t})}{\sqrt{(\tau-t)}}$.¹⁵

Finally, we must consider the consequences of exercise. At this point the option holder forfeits a claim with a remaining life of τ for the intrinsic value of the option. This provides a gain to the firm of $S_t N(d_{1t}) - X e^{-r(\tau-t)} N(d_{2t}) - \max[0, S - X]$. We would argue that if it is appropriate to charge an expense for the full legal value of the option when issued (e.g. the 90 days the employee would have to exercise were he terminated the next day) then it is appropriate to take into income the full gain from early exercise. That is, empirically we know that employees will often exercise before the last possible moment, as would happen for a zero dividend traded option. If we do not take this into account on the issuing date, a market-based adjustment is required at some date in the future to make the option cost neutral with other forms of compensation which have the same (risk-adjusted present value) expense. Similarly, if the option is no longer extended because of employment termination or the end of the option's 10 year nominal life the firm should report daily accounting income based on the increase in the present value of the expected exercise price to be paid due to the passage of time — though almost by definition the expected exercise price revenues during the last 90 days of the life of an option that expires out of the money are likely to be small.

¹⁵This last term is perhaps more commonly written as $\frac{1}{2}\sigma S \frac{N'(d_{1t})}{\sqrt{(\tau-t)}}$. We use the approach in the text because it better complements our intuitive explanation about the incremental insurance value from having an option extended.

2.3 Robustness of Expenses to Timing of Extensions

One might argue that expenses are really incurred (services are received) on some schedule that does not closely mirror the explicit accrual of income and benefits. For example, if a job involves significant training in firm-specific skills, then the employee's output may be far below his salary early in his career, and above his salary later on. One thing that makes the expensing of salaries on an as-earned basis acceptable is that over the course of the employee's career things presumably even out. The present value of the firm's expense over the employee's entire career will be accurate, even if one might argue that the timing should not have matched the actual cash flows. On the other hand, if firms understate their non-cash costs by \$1000 in one year and overstate them by \$1000 in a future year then the present value of expenses is reduced, and cumulative profits are greater during the entire period from the understatement to the overstatement.

So long as a system uses market prices to value all new options and option extensions, it is robust to timing in the same way as salary. We show this in two ways. First, the (risk-adjusted, expected) present value of labor expenses (the value of the initial option plus extensions, including both the hindsight value and deferral value components) will be insensitive to when the option extensions are booked, so long as they are booked at market prices and end with an option that expires on the exercise date. These expenses will sum to the expected present value of the option on the exercise date, when viewed from the grant date.

Second, the (risk-adjusted, expected) undiscounted sum of labor expenses and capital expenses (the cost of the equity capital owned by option holders, reflected through dilution, less the interest paid by option holders on their loans from the firm) will equal the expected value of the option on the exercise date, when the (risk-adjusted, expected) ratio of accounting earnings to stock price always equals r .

2.3.1 Present Value of Expenses

Consider an option that is granted on date t_0 , with an expiration on date τ_0 . The option is further extended on dates $t_1, t_2, t_3, \dots, t_n$ to new expiration dates $\tau_1, \tau_2, \tau_3, \dots, \tau_n$. We wish to show that the risk-adjusted expected present value of the expenses that the firm will incur if it pays the market price for the initial option and the market price for all extensions will equal the risk-

adjusted expected present value of an option granted at t_0 with an expiration date of τ_n .

Let $E\{C_{t_j}(\tau_j)\}$ be the (risk-adjusted) expected price of a call option that expires on date τ_j when it is evaluated on date t_j . Then the expected discounted cost of an option granted at t_0 with an expiration of τ_0 , plus the discounted expected increase in option value due to each subsequent extension may be written as

$$E \left\{ C_{t_0}(\tau_0) + \sum_{j=1}^n [C_{t_j}(\tau_j) - C_{t_j}(\tau_{j-1})] e^{-rt_j} \right\} \quad (6)$$

$$= E \left\{ \sum_{j=0}^{n-1} [C_{t_j}(\tau_j)e^{-rt_j} - C_{t_{j+1}}(\tau_j)e^{-rt_{j+1}}] + C_{t_n}(\tau_n)e^{-rt_n} \right\} \quad (7)$$

We wish to show that (7) equals the value of an option that is granted at t_0 and expires at τ_n , or $C_{t_0}(\tau_n)$. But $E \{C_{t_j}(\tau_j)e^{-rt_j}\} = E \{C_{t_{j+1}}(\tau_j)e^{-rt_{j+1}}\}$ as the risk-adjusted expected return from holding an option with a given expiration date must equal the interest rate. So (7) reduces to

$$E \{C_{t_n}(\tau_n)e^{-rt_n}\} = C_{t_0}(\tau_n) \quad (8)$$

2.3.2 Undiscounted Effect on Earnings Including Dilution

Timing does of course affect the undiscounted sum of expense deductions. For example, if a firm expensed a share of restricted stock today instead of one year from now in expectation it would have a lower undiscounted expense. Offsetting this, the firm's earnings per share would be diluted by an additional share for an additional year. If accounting income and economic income were equal, then risk-adjusted expected earnings would always equal r times the stock price and similarly the dilutive effect on earnings of existing shareholders less the interest they earn on their loans to option holders would have a risk-adjusted expected value of r times the option price. In this case, the lower undiscounted labor costs of earlier expensing are exactly offset, in expectation, by the higher undiscounted capital costs that arise from earlier recognition.

A bit more generally, if the risk-adjusted expected value of earnings always equalled risk-adjusted economic earnings we would have the same result. That is, the risk-adjusted expected reported earnings over any given period

of time must equal r times the stock price, which may come about through a constant earnings/price ratio of r and earnings that perfectly correlate with the stock, through a constant one-to-one ratio of book value to market value so earnings risk and market risk match perfectly, or any combination.

Mathematically, we note that the undiscounted sum of expenses can be written as (7) but with a zero interest rate:

$$E \left\{ \sum_{j=0}^{n-1} [C_{t_j}(\tau_j) - C_{t_{j+1}}(\tau_j)] + C_{t_n}(\tau_n) \right\} \quad (9)$$

$$= E \left\{ - \sum_{j=0}^{n-1} [e^{r(t_{j+1}-t_j)} - 1] C_j(\tau_j) + C_{t_n}(\tau_n) \right\} \quad (10)$$

Risk-adjusted expected dilution expenses may be written as r times the expected value of the outstanding option at each point in time, or

$$E \left\{ r \sum_{j=0}^{n-1} \int_{t_j}^{t_{j+1}} C_x(t_j) dx + r \int_{t_n}^{\tau_n} C_x(\tau_n) dx \right\} \quad (11)$$

$$= E \left\{ \sum_{j=0}^{n-1} [e^{r(t_{j+1}-t_j)} - 1] C_j(\tau_j) + [e^{r(\tau_n-t_n)} - 1] C_{t_n}(\tau_n) dx \right\} \quad (12)$$

Summing (10) and (12) to find total costs imposed yields

$$\begin{aligned} & E \{ e^{r(\tau_n-t_n)} C_{t_n}(\tau_n) \} \\ &= E \{ C_{\tau_n}(\tau_n) \} \\ &= C_{t_0}(\tau_n) e^{r\tau_n} \end{aligned}$$

so the sum of the undiscounted costs of the option imposed on the earnings attributable to existing shareholders is equal to the expected value of the option on the exercise date. It similarly equals the value of an option expensed on the grant date with an expiration equal to the exercise date, grossed up for the time value of money between the grant date and exercise date.

3 Quarterly Accounting

For financial accounting purposes we propose treating all options that must be exercised within 90 days of termination as having a life that expires a

moment after the end of the quarter. Outstanding options are then extended for continuing employees by a full 90 days at the first moment of the new quarter. New options, which may be issued in the middle of a quarter, are also assumed to expire a moment after the issuing quarter ends, again renewable if the employee is still with the firm at the end of the period. If an employee is terminated before the end of a quarter and still has options outstanding, his options are treated as though renewed for one last quarter at the beginning of the next period. Option expense is based on the cost of the extensions granted on the first day of the quarter, while dilution is based on the status of the options on the last day of the quarter.

The reason for these conventions is that it makes life very simple without creating any serious accounting bias for or against using options as compensation¹⁶. The virtue of assuming that options expire at the end of each quarter is that it makes dilution a simple calculation. If an option is in the money its Δ is 1 and if it is out of the money its Δ is zero. This means that the total dilution in any given quarter is simply the number of shares that are in the money at the end of the period.

The advantage of assuming that the extension occurs at the first moment of the new quarter, and goes from 0 days to 90 days, is twofold. First, the preponderance of traded options are for 90 days, and the valuation of 0 day options is trivial. This will enable public firms to rely upon market data in the estimation of implied volatility. Second, by costing extensions on the first day of the quarter firms and analysts will be able to estimate option expense to a reasonable degree of certainty three months ahead.¹⁷

While we use option volatility based on 90 day option prices, we calculate option expenses by using a zero interest rate in the Black-Scholes formula. The reason we offer the zero-interest approach is that it simplifies the system while producing trivially different results for extensions from using the full Black-Scholes value of the extension and then subtracting out the interest

¹⁶As we will see, this convention does produce a very slight accounting bias in favor of options, but in an environment where it is a struggle to have options accounted for at all it seems like a better idea to propose a system that might understate costs by perhaps less than one percent rather than an equally simple system that could be accused of overcharging.

¹⁷While dilution is not known until the end of the quarter it has the effect of smoothing earnings per share if stock prices and earnings surprises are positively correlated, and it should not be too difficult to explain to shareholders that dilution was increased because their stock went up. We would have no objection in principle to dilution being calculated based on the Δ s of the outstanding options at the beginning of the quarter.

component, as in the proper continuous time system.

Specifically, how does our expensing system work?

We begin with options that are already outstanding and are extended through the quarter. Our argument is that only the portion of the increase in value of an option extension that is due to its hindsight value creates a net expense that should reduce reported income. The implicit interest expense from the extension is exactly offset by implicit interest paid by the option holder. That is, when an option is extended at the beginning of a new quarter its value increases by

$$S_t N(d_{1t}) - X e^{-r(\tau-t)} N(d_{2t}) - \max[S_t - X, 0] \quad (13)$$

compared to immediate expiration. However, against this the firm has offsetting interest income. One way to think of the offsetting income is that its expected value would be

$$E_t \left\{ \int_t^\tau r X e^{-r(\tau-y)} N(d_{2y}) dy \right\} \quad (14)$$

where E_t is the (risk-adjusted) expectation at time t , the beginning of the accounting period, and τ is the date at the end of the period. Noting that

$$E_t \{N(d_{2y})\} = N(d_{2t})$$

always (that is, the expectation of one's future estimate of the probability that the option will end up in the money must be the current estimate), (14) reduces to

$$(1 - e^{-r(\tau-t)}) X N(d_{2t}) \quad (15)$$

Therefore, the option expense net of expected interest income becomes (13) minus (15) or

$$S_t N(d_{1t}(S_t, X, \tau, \sigma, r)) - X N(d_{2t}(S_t, X, \tau, \sigma, r)) - \max[S_t - X, 0] \quad (16)$$

We would allow firms to use either this amount or the slightly different amount calculated by using the volatility implicit in market prices and then valuing the net expense by using that volatility and a zero interest rate in a Black-Scholes calculator. As we show in the next section, this and other differences between the continuous time approach of the previous section and the quarterly approach described here are all quite minor.

3.1 Comparison With Continuous Time Model

In this section we evaluate the various approximations made in moving from a continuous time ideal to a discrete time quarterly accounting system. The purpose is simply to show that the differences between the continuous and discrete systems are very small. The section may be skipped by those uninterested in these details.

3.1.1 Calculating Expenses Using Zero Interest Rate Option Pricing

The reason that (16) is slightly different from the number that would be found by putting a zero interest rate into a Black-Scholes calculator is because of the changes in d_{1t} and d_{2t} implicit in simply using a zero interest rate. If we simply substituted in a zero interest rate we would have

$$\begin{aligned}
 & S_t N(d_{1t}(S_t, X, \tau, \sigma, 0)) \\
 & - X N(d_{2t}(S_t, X, \tau, \sigma, 0)) - \max[S_t - X, 0] \\
 = & S_t N(d_{1t}(S_t, X e^{r(\tau-t)}, \tau, \sigma, r)) \\
 & - X N(d_{2t}(S_t, X e^{r(\tau-t)}, \tau, \sigma, r)) - \max[S_t - X, 0]
 \end{aligned} \tag{17}$$

However, the difference between (17) and (16) is small, so either approach would be reasonable. Another way to view (17) is that for in-the-money options it is equal to the value of a put option with a strike price of X for a stock selling at S .¹⁸ Thus, this formula treats the value of an option extension, ex the interest deferral component, as the difference between a futures contract committing the employee to buy the stock at a price of S at the end of the quarter, and an option to do so.

To elaborate on why there is little difference between (16) and (17), expression (16) is equivalent to the value of an securities contract that requires the purchase of a share of stock on the expiration date whenever the stock sells at a price greater than X (hence the “right” values for $N(d_{1t})$ and $N(d_{2t})$), but with the buyer paying a price of $X e^{r(\tau-t)}$ (and so a present

¹⁸That is, at a zero interest rate the value of a 90 day extension of an in-the-money option versus immediate exercise is equal to the value of being able to put the stock at the exercise price at the end of the quarter. This follows from put-call parity: $C - [S - X e^{-r(\tau-t)}] = P$ where P is the value of a put option, and substituting in a zero interest rate.

value price in beginning-of-quarter dollars of X). Alternatively, (17), calculated as an option at price X when the interest rate is zero, may be equally interpreted as the value of an option exercisable at price $Xe^{r(\tau-t)}$ when the interest rate is r . So (17) will be slightly larger than (16) because (16) is reduced by the losses suffered by the security holder when the stock price on expiration day falls between X and $Xe^{r(\tau-t)}$ and the stock must be bought at price X . But these are small losses times a small probability. As an example of the size of this error, consider a 90 day option with $S_t = 100$, $X = 100$, $r = .04$, and $\sigma = .40$. The probability that the stock will finish between X and $Xe^{r(\tau-t)}$, or roughly 100 and 101, is about 2 percent. On average when this occurs the requirement to buy the stock at 101 will cost about 50 cents, so expenses would be understated by about $.02 \times .50$ or a penny, out of a 90 day option value of about \$8.00. Therefore, either (16) or (17) would be reasonable for determining the quarterly option cost.

3.1.2 Treating Options as though they Expire Every Quarter

Treating options as though they expire at the end of every quarter and are then renewed delays recognition of most costs by a quarter. That is, by the end of each quarter the option is treated as though it has no remaining life when actually it has already been extended another 90 days. However, as shown in section 2.3.1, because we use market prices to evaluate all extensions this deviation does not change the risk-adjusted expected present value of expenses.

3.1.3 Non-adjustment of Expense Upon Exercise

The proposed quarterly system would extend the option by 90 days on the first day of the exercise quarter but would not credit back any amount on the exercise day. Generally when an option is exercised $N(d_{2t}) \approx 1$ as the stock is far enough in the money that the chances of falling out of the money within a quarter are fairly small. Thus the difference is approximately that the continuous time system would provide the firm with a credit to income equal to about one quarter's interest rate times the exercise price while the quarterly system provides no such credit. The difference is even smaller if the option is exercised with less than 90 days of life remaining, as after a termination or near expiration.

Put another way, assuming a one percent per quarter interest rate and a

\$100 exercise price, the continuous time system will involve an extra interest charge of about 50 cents in the first quarter and an offsetting credit of a dollar in the quarter when the option is exercised, but no credit when the option expires worthless.¹⁹ It also provides a credit equal to the “hindsight value” or put value of a 90 day zero-interest option when an option is exercised, but because exercised options tend to be deep in the money relative to a 90 day life this amount will be small.

3.1.4 Extension on First Day of Quarter

Treating all option expense as though it is incurred on the first day of the quarter slightly understates expenses. The understatement is because extensions are “really” purchased each day of the quarter, based on the stock price that day. By “purchasing” all of a quarter’s extensions based on the initial price the firm “pays” the present value of the expected future price. Since the actual future purchases are made an average of 45 days after the beginning of the quarter, the quarterly costs are understated by roughly 45 days’ interest.

3.1.5 Expiration at End of Quarter and Dilution

Finally, by assuming that options expire at the end of the quarter the quarterly system calculates dilution based simply on the number of shares in the money at the end of the quarter, as $\Delta = 1$ for all in-the-money options and $\Delta = 0$ for out of the money options.²⁰ We take this approach merely because it is simpler than basing dilution on the option Δ s at the beginning of the quarters. Either way should come out with the same (risk-adjusted) expected expense in the following sense:

If dilution is based on the Δ at the beginning of the quarter then the option would be counted as diluting shareholder income by $N(d_{1t})$ shares. If, on the other hand, we look at end of quarter results then on average dilution will be only $N(d_{2t})$ shares, which is unambiguously less. But using end of

¹⁹Depending on whether $r \gtrless \frac{1}{2}\sigma^2$ the risk-adjusted expected value of $N(d_{2t})$ may drift up or down, so the expected amount of interest recapture in the continuous system when and if an option is exercised may be greater than or less than the amount of interest expense embodied in the Black-Sholes value on the grant date.

²⁰Technically, options that are exactly at-the-money would have $\Delta = .5$ but we would treat them as out-of-the-money to avoid giving firms an incentive to set exercise prices at a thousandth of a penny above a conceivable closing price.

quarter dilution implies that dilution will apply in the states when the stock does well, and so will apply to a higher average stock price. Note that while $E_t \{N(d_{1\tau})\} = N(d_{2t}) < N(d_{1t})$ if we weight by stock price we observe that $E_t \{S_\tau N(d_{1\tau})\} = S_t e^{r(\tau-t)} N(d_{1t})$ so that the number of dollars of dilution, defined as the expected product of share price and probability of vesting, is the same (in risk-adjusted terms) regardless of whether beginning or end of period valuations are used.

Using beginning of quarter dilution would be an equally valid approach. We offer the end of quarter approach as an alternative because it is consistent and extremely simple. If the Capital Asset Pricing Model held and the ratio of the covariance of earnings with share price relative to the variance of share price exceeded one, then using end of quarter data would tend to lead to greater earnings dilution in dollar terms than using beginning of quarter prices and vice versa.

3.2 Accomodating Current Accounting Rules

Our methodology treats options as financial economists think of them — bundles of equity and contingent loans from issuers. However, traditional accounting practice dating back to well before modern financial theory treats securities as either a form of debt or a form of equity. A warrant expiring in three months, to buy a stock at \$10 a share when the stock is currently trading at \$20, will be treated as half a share of equity for dilution purposes, even though the security really represents almost a full share of stock and a nearly \$10 asset representing the present value of exercise revenues. Treating the warrant as half a share of equity will understate income, as the increase in the present value of the exercise price over time will be ignored, and understate dilution by an offsetting amount.

Assuming that accountants are constrained to treating an option as a pure equity security, equivalent to some fraction of a share of stock and nothing else, how can our system be modified?

Instead of treating an option as a fraction of a share of stock and a loan from the company to the employee, consider it equivalent to a fraction of a share of stock offset by the employee being short an amount of zero coupon preferred stock, which comes due at the end of the quarter. Assume that the accounting for the preferred stock is that its existence, in positive or negative quantity, has no effect on reported income.

Then two changes occur in our accounting: (1) The entire market value

of the 90 day option or option extension must be included as an expense, as the firm earns no interest from the option holder to offset the exercise price deferral value of the option. As with our basic system, whatever amount is written off as an expense would be balanced by an equal entry as paid in capital (ignoring taxes). (2) Dilution at the end of the quarter is now based on the “intrinsic value” of the option, so that (still ignoring taxes) if the stock ends the quarter at a price of S it will create dilution of $(S - X)/S$ shares if in the money. This dilution method is consistent with current accounting practice.

The consistent implementation of these changes would have some virtues. First, the expected present value of option labor expense would still be invariant to the timing of the recognition of options as expenses. Second, this approach would enable pricing to be based on market prices with even fewer adjustments than in our basic system. It is also possible that non-academics will regard a system with these modifications as easier to understand, even though it is a step harder to justify to academics. Third, while these modifications still allow firms to predict option expense with the same accuracy at the beginning of the quarter, they make it easier to predict dilution from quarter to quarter.

The expected undiscounted sum of labor expenses and capital expenses would be the same as in the more accurate model, in the special case where the firm’s reported earnings/price ratio always equalled r ²¹. (This is the case where earnings per share are unaffected by changes in a firm’s debt/equity ratio.) Therefore, while this proposal modification does distort the allocation of expense between earnings and dilution it may represent a reasonable compromise that is perhaps more consistent with long-standing accounting tradition.

3.3 Summary

Our proposal for the treatment of vested options is the following:

At the time the option is issued, value it on a Black-Scholes basis with an expiration at the end of the quarter and an interest rate of zero. Volatility should be based where possible on traded 90 day options. Ongoing options are treated as though they are extended for 90 days at the beginning of each

²¹However, unlike the case of mark-to-market options discussed earlier, this result does not generalize to other cases where on average risk-adjusted reported earnings equal economic earnings, but there is a correlation between stock price and the earnings/price ratio.

quarter, implying an expense equal to roughly the Black-Scholes value with a zero interest rate, less the intrinsic value. When an option is exercised during a quarter no income or expense is recognized. At the end of each quarter dilution is simply the number of options in the money.

Our proposal is meant to provide results that are similar to those in the continuous accounting ideal of the previous section, but through a simple system that can be implemented through quarterly accounting. The differences with the continuous time system are:

(1) Calculation of all option expense using Black-Scholes volatility but a zero interest rate. This leads to an understatement of the cost of an option on its issue date, equal to roughly the one quarter interest rate times half the exercise price of an option issued at-the-money.

(2) Assuming that options expire at the end of each quarter and are then extended by 90 days at the beginning of a new quarter, rather than being extended each day. This leads to a deferral of expense recognition by an average of about half a quarter, and an understatement of the expected present value of option costs by about half a quarter's interest.

(3) No recapture of the forfeited option value on the day of exercise. This roughly balances in risk-adjusted expectation the non-recognition of interest expense in (1), though it differs in some technical respects. Perhaps the most significant differences are that the grant-day interest expense, approximately six percent of the grant-day Black-Scholes expense in a continuous system if $r = .04$ and $\sigma = .4$, is not recaptured until the exercise date, creating a deferral, and the recapture is either roughly double the initial cost or zero depending on whether the option is ever exercised.

(4) Calculation of dilution based on the number of shares in-the-money at the end of the quarter.

(5) If we are constrained to treating options as pure equity for dilution purposes then in (1) above we would use the full market value of the option and in (4) above we would dilute based on the ratio of the intrinsic value of the option, if above zero, to the stock price.

4 Gradual Vesting

The previous section focused on options that were vested on the grant date. However, most options actually vest over time. For example, a company might grant some options with 25 percent vesting after one year and the

remaining 75 percent vesting linearly over the next three years. In contrast to the way one accounts for a monthly salary and other compensation that is accrued continuously such as health benefits for current employees, compensation that is vested discontinuously such as annual bonuses will often be expensed gradually over the period until the payment becomes a commitment, even though technically the bonus may be entirely forfeited if employment is terminated before the vesting date.²²

Gradual vesting seems at first to present all kinds of conceptual difficulties. One approach might be to not recognize an option until it vests, and then treat it as though it were issued on the day of vesting. However, this approach has two problems: it could lead to significant swings in reported earnings that would inversely reflect the underlying business, and it may not reflect the true underlying economic reality. For example, a company's stock might rise from 20 to 50. If an option vested after such a price rise, this would imply an earnings hit to the firm of slightly more than \$30 per option at a time when the company was actually performing well.

As to the economic reality, the "right" way to expense non-vested options may differ from firm to firm. One firm may offer options that vest linearly over four years while another may grant options that only vest at the end of that time. Should options that vest after four years be accounted for differently if the firm simultaneously issues other options that vest after one, two, or three years? Does it matter whether options are a small part of compensation in a firm with relatively stable employment or a large part of compensation in a firm with unstable employment? Once the options are vested they should arguably be viewed in a similar way for all firms, but the recognition of the pre-vesting expense might reasonably differ from firm to firm.

Fortunately, by using an accounting system based on market prices it

²²That said, there are some kinds of benefits that an employee may earn after years of service that, to the best of our knowledge, are still accounted for on a pay-as-you-go basis. For example, the expense associated with a college tuition subsidy for an employee's children may be entirely charged during the years in which it is paid, even if the employee may think of the benefit as having been earned over time. Part of the difference may be a view that while individual employees may think of their benefits being accrued over time, in aggregate the total expense actually paid is the best and "hardest" measure of overall employee compensation. For example, a firm may negotiate a union contract that includes greater pay for more seniority but will not be concerned about the fact that the average worker will be more senior at the time of the next contract negotiation, if the firm's bargaining power to negotiate an overall compensation package is unchanged.

is possible to allow a fair amount of flexibility (though not complete flexibility) to options issuers in their income statement reporting. However, to supplement the income statement aggregates we would require footnotes as described in a later subsection.

The way we would approach gradual vesting is to give companies some latitude in selecting a *mechanical* system for when to account for options as earned. By mechanical, we mean a system that makes adjustments to the number of unvested options treated as already earned based on a well-defined formula that may depend upon time to vesting, realized termination rates, and perhaps other variables.²³

Once an option has been recognized as an accrued employee benefit it would be treated the same way as a vested option, with expensing based on 90 day extensions each quarter. Options that were not yet recognized would create no expense. Firms would choose between recognizing unvested options that were to be expensed within a quarter as though expensed on the first day of the quarter.

The charge in the quarter of recognition would be $S_t N(d_{1t}) - XN(d_{2t})$, assuming a 90 day expiration and calculating d_{1t} and d_{2t} in the manner of either formula (16) or (17). This amount would exceed the intrinsic value unless the option were deeply in the money and the stock paid a large dividend. If the firm reduced the number of options recognized and the options were in-the-money, the firm would report *income* equal to the options' intrinsic value.

The two reasons for requiring a mechanical formula are: (1) to avoid adjusting the number of options based on "stale" prices; a firm could not announce three weeks into the new quarter that it decided to recognize a large number of additional options as earned prior to a run-up in the stock price, and (2) we don't want to allow firms to fiddle with their recognition of options expense in a way that allows continual smoothing of earnings.

The general principle, then, is that the firm could choose a formula based on variables such as current stock price and time to vesting that would determine what fraction of unvested options should be treated as equivalent

²³By basing the formula on time to vesting rather than on a linear schedule, there would be no accounting difference in options held by employees that had the same time until vesting but had been issued on different dates. So for example there would be no accounting consequence of cancelling options issued two years earlier which would not vest for another two years, and replacing them with new options at the same exercise price and the same vesting date.

to vested options at the same exercise price, and what fraction should be treated as not yet having been earned. In this way the firm would always have expensed at least as many options as the employees have legally earned (i.e. the options already vested), but would have the option of expensing on more accelerated schedules that would have about the same expected total cost in terms of effect on discounted earnings and on earnings per share.

Below we describe four possible mechanical rules, though we suspect that as a practical matter accountants might demand a narrower range of choice:

Rule A: Treat all options as though vested on the grant date. In the first quarter this would imply an option expense equal to that if the options really were vested 90 day options. However, each quarter as some terminations occurred some options would be cancelled. The cancellation would have two effects. First, it would reduce the number of options on the books for the next quarter, affecting both dilution and the cost of options being extended another quarter. Second, to the extent that in the money options were cancelled the intrinsic value of those options would be added in to the company's income.²⁴ These adjustments could either be made on the day of forfeiture, using the price that day, or on the first day of the next quarter, using end of period prices. The underlying economic model behind this approach is that the employee implicitly owns the option on the day it is granted, and the company gets a windfall gain whenever an option is forfeited. Effectively, the forfeiture of an already expensed option is negative severance pay. Obviously, this is a very conservative approach to option expense and not entirely realistic, but all our methods will imply essentially the same (risk-adjusted) expected present value of option expense. A company that expected its stock to do well might choose this approach, in part to signal confidence because it would lead to the lowest accounting costs of any method if the stock performed very well.

Note that even though this method projects that all non-vested options will vest it still allocates the cost of the options over the entire life of the option, just as with an option that is vested from the first day. That said, if the options were issued at the money the largest charges would most likely occur in the first quarters of the option's life. Once a stock diverged significantly from the exercise price the ongoing expense would be very low, but

²⁴If it were logistically difficult to calculate the intrinsic value of all forfeited options on the day forfeited, then either a beginning of quarter or end of quarter stock price valuation could be used, so long as the approach was applied consistently.

for the dilution charge attributable to in-the-money options.

Rule B: Treat options as an expense only on the day the options vest. We doubt that many firms would opt for this treatment because of its volatile impact on earnings.²⁵ No expense would be reported until the day an option vested, at which time it would be treated as a new option issued at the current stock price, with an expiration at the end of the quarter, again with an adjustment to eliminate the interest forgiveness portion of the value. For options that were well in the money on vesting day this would imply a large and volatile expense. The underlying economic model consistent with this approach is that either (a) there are no implicit contracts between the firm and the employee, so that employees, either individually or when viewed as a group, will have to take a reduction in salary each period to match the cost of the options that vest in that time, or more weakly (b) any implicit contracts between the employee and the firm are orthogonal to stock option compensation.²⁶ While such a rule was seriously considered by the FASB it was rejected.

Rule C: The firm makes a projection about what fraction of options will vest and treats those options as though they vest on the grant date. To the extent that terminations do not meet expectations the projection is adjusted by a mechanical rule. By the date of vesting the number of options on the books equals the number vested. Rules A and B may be thought of as simply special cases of this rule, with the unrealistic projections that either no or all options will vest. When a firm newly expenses in-the-money options it takes a charge equal to the intrinsic value of the option, plus the value of a 90 day put option at zero interest. That is, the charge would be equal to the option's intrinsic value plus the same ongoing cost as an already expensed option. When the firm newly expenses an out-of-the-money option it takes a charge equal to the value of a 90 day call at zero interest. A reduction in the number of options expected to vest would create reported income equal

²⁵Firms that vest options linearly might choose to expense each option on the day it vests, but they would have the option of using a method that led to earlier recognition.

²⁶That is, the employee's total compensation each period that is based on an implicit contract, but nevertheless the value of any newly vested options is included in the calculation of compensation and thus reduces other forms of pay. For example, the implicit contract between a firm and a CEO might be that if the firm's operations do well then she will receive total compensation of \$5 million, including newly vested options and bonus. So the firm's expenses would be unaffected by the value of the options until the vesting period, at which time the market value of the newly vested options would become part of that period's compensation expense.

to any intrinsic value of the options, and of course the elimination of the ongoing expense of extension. The implicit labor contract model consistent with this approach is that workers are given a set of options and that on net employee termination and retention as well as compensation is orthogonal to whether the options are vested.²⁷

Rule D. Firms could recognize options on their income statement gradually over the time until vesting, with adjustments in projections about the number that will vest being made on a regular and mechanical basis. For example, if all options were expected to vest over 16 quarters then the firm might recognize $(16-X)/16$ of all options not yet forfeited by X quarters before vesting, using the (zero interest) market value of an option on the date it is recognized as its initial expense and then applying treating extensions in the same way as vested options.

Note that even this final approach differs from the FASB in several ways. Obviously there is the matter of the zero interest rate calculation, which leads to lower expected expensing, and the greater dilution caused by our approach. Furthermore, when an option is recognized under our system it is still only expensed 90 days at a time. But the biggest difference is that the FASB uses an expected option value as calculated on the grant date to expense all options, regardless of what happens to the stock price in the time between the grant date and the expense date. The consequence is that if a firm's stock falls then it can raise accounting earnings by laying off workers who hold deep out-of-the-money options and replacing them with identical workers who are then paid the same salary and granted equally worthless options. As opposed to the FASB, we give firms flexibility in choosing the expense date, but require that costs in the expensing quarter be determined using expense date market values. Furthermore, we charge for options each quarter as extensions are earned by employees, again using market prices, rather than by a system that uses grant day prices and attributes all costs to the pre-vesting period.

What is the rationale of this flexible approach?

By giving firms flexibility they have the right to choose an amortization schedule that they believe most closely reflects the economic reality of their own labor situation, so long as they have always expensed at least the options that are legally held by the employees. Firms may choose to amortize on an

²⁷However, as with vested options the underlying assumption is that employees will regard the value of extending the option as compensation.

earlier schedule if they believe that implicitly their workers have earned some of the options that are not yet legally vested.

Furthermore, given adequate footnote disclosure as described in the next section, there is no harm in terms of information provided in allowing firms to accelerate their expensing even if their decision is not based on their view of the most realistic estimate of the schedule of their labor costs. By requiring that all adjustments to the total of expensed options be made at market-based prices, the risk-adjusted present value of costs is the same regardless of whether firms expense options too early or too late. Recall that this is the same positive feature that makes accounting for salary as paid a reasonable long-term approach, even if one believed that expensing salary as earned would not match the timing of the services provided in return.

The flexibility is the equivalent of giving firms the ability to make phantom accounting hedging transactions by allowing it to choose how to hedge its accounting expense by choosing its rule for expensing options. Effectively, a faster expensing schedule is the equivalent to greater hedging of the option accounting expense against a stock price increase. So long as these phantom transactions are on economically fair terms so that there are no gaming opportunities to reduce the expected present value of future expenses, we are not concerned. Note that because gains and losses from transactions in one's own equity do not create accounting income and loss, a firm could not make *real* transactions to directly hedge its accounting liability, adding to the benefit of allowing effective accounting hedging through choice of expensing method.²⁸

If firms wish to make their reported and actual compensation expense match up as closely as possible²⁹, then it will be roughly in their interest to choose an expected vesting rule that closely mirrors the economic reality

²⁸Nor would we be advocates of allowing firms to hedge their accounting liabilities from options by purchasing their own shares or options in those shares. Issuing options transfers risk from the existing shareholders to the employees while buying back equity transfers risk to remaining shareholders. Should the accounting system produce the opposite set of implications, where firms have an incentive to buy options on their own stock to smooth reported earnings?

²⁹Of course firms may choose formulas that correlate expense recognition with increases in stock price, if they think that such increases are correlated with otherwise higher reported earnings and they wished to smooth earnings rather than eliminate the discrepancy between economic and accounting expense. But they would have the option of choosing a formula that they believed mirrored their true costs, and the data available would make it easy for analysts to re-calculate expenses based on alternative expense formulas.

of their implicit labor agreements³⁰. But even if firms choose to account for the expense in other ways there is no significant accounting incentive created to use or not use options as part of compensation. Furthermore, by using only 90 day option prices we make sure that all costs are based on fairly reliable markets, and the parallel treatment with vested options would seem to make the bookkeeping more transparent. Finally, relative to cash wages the economic reality is that options reduce the risk held by existing shareholders, so an economically realistic options accounting system *would not* substantially increase volatility in reported earnings.

4.1 Summary of Treatment of Non-Vested Benefits

We would account for non-vested benefits as though they had the same value as vested benefits, times an “accounting recognition rate”. Firms would have considerable flexibility in choosing their recognition rate schedules, ranging from initially assuming a 100 percent rate and then adjusting downwards for terminations to, for example, assuming a rate that increased linearly over the time to vesting. Rules would have to be mechanical, and perhaps only changable with a long prior notice. The key requirement, though, is that all recognition adjustments be expensed based on market prices on the adjustment day. This implies a charge for any newly expensed option that would reflect its intrinsic value on the day it is recognized.

In the Appendix we illustrate our calculations by applying Rule A to the Intel Corporation’s first quarter report for 2003. We believe that this example indicates that relative to the proposals of the accounting standards boards our method is simpler and more straightforward.

Note that this method would likely produce less volatility in option expense than other methods. If firms chose to make fair initial estimates of the vesting probability option expense would be relatively high in the first quarter after a grant but inevitably lower later on, as the stock drifted from the exercise price. Essentially, our system allows firms to directly “phantom hedge” against changes in the future intrinsic value of their options, requiring them to only bear the risk in the difference between the Black-Scholes zero interest value and the intrinsic value. As firms issue options at a variety of strike prices over time this expense can be estimated ahead with a somewhat

³⁰A natural smoothing occurs as more options are likely to vest, raising expenses, when times are good.

reduced error, because a change in stock price is likely to bring some options closer to the exercise price, raising their expense, even as others are moved farther from the exercise price.³¹ Even this remaining risk can be partly hedged by, for example, adopting conservative recognition policies.³²

While one might debate whether it is worth worrying about the effect of an accounting system on the volatility of reported earnings, as a practical matter it seems likely that a system that produced highly volatile expenses for non-vested options would lead many firms to a system of setting the exercise price at the stock price on the vesting date. Perhaps this change would be a good one, but it should be determined by economic rather than accounting considerations. Furthermore, having a system that *does not* require big writeoffs after a stock has declined, as is necessary under the accounting standards boards' proposals, will reduce political pressure for accounting "relief" after the next market decline.

4.2 Footnote Disclosures

While we are willing to give firms some latitude as to when they recognize unvested options as an expense, we have fairly rigid views on what the appropriate footnote disclosure for options should be. Basically, we want firms to lay out the raw data that will enable analysts to evaluate options in whatever manner they believe appropriate. Specifically, we would require the following tables in the footnotes to financial statements:

For all vested options, a list of the number of options at each exercise price, or if exercise prices are set more than once a month, the number in each small range of exercise prices.

For all non-vested options, a list of the number of granted, non-forfeited options at each exercise price, further broken down by the quarter in which

³¹Of course, any increase in the stock price will proportionately increase the absolute volatility of a stock that follows a lognormal process, and this increase in volatility would proportionately raise the cost associated with an option selling at any given ratio to the strike price.

³²For example, it would be relatively easy for a firm to estimate its option expense at varying stock prices. If, as would commonly be the case, expense would be higher at higher stock prices the firm could hedge by expensing conservatively early on, implying greater expense reductions in future periods when the stock is high and the firm revises downward its vesting rate.

the options vest and the number of the options already recognized on the income statement.

With this information it should be possible for an analyst to determine the sensitivity of option compensation and dilution with respect to changes in the accounting model.

5 Balance Sheet and Income Statement Interaction and Taxes

It is perhaps useful to begin by outlining the FASB approach to dilution under current practice. Because our proposal involves more share dilution, it also involves some projected assets from option exercise. However, in both systems exercise itself should have no impact on reported income and both systems adjust similarly for corporate taxes³³.

The FASB has applied the “Treasury Method” for calculating dilution. Consider a stock that is selling for \$52 and a firm has outstanding an option with an exercise price of \$32 — only in the money options are dilutive. The corporate tax rate is 35 percent. Then the employee’s equity in the option is \$20, but the company will receive a tax deduction worth \$7 if the option is exercised. Therefore, the net cost to the company of the employee being able to buy the stock at the discount price is only \$20-\$7=\$13. The Treasury Method, including taxes, assumes that the option is immediately exercised and that the exercise price and the tax savings are used to repurchase stock. On net, for every 100 options exercised the firm would be able to repurchase 75 shares, because the sum of the exercise price and the tax savings, \$39, is three quarters of the stock price. So this method would calculate a dilution equal to 25 percent of the number of options outstanding, given the 52/32 ratio of stock price to exercise price and the corporate tax rate. Switching to algebra, the formula for dilution of any given issue is

$$D = Q \cdot \frac{(S - X)(1 - T)}{S} \quad (18)$$

where D is the share dilution, Q is the number of options, and T is the corporate tax rate.

³³Firms do not pay payroll taxes on employee stock option income.

Under our proposal, in the money options dilute share for share pre-tax when they are in the money, reflecting their end of quarter valuation which makes Δ equal to 1. Our balance sheet treatment would multiply the number of shares and the exercise price by $(1 - T)$ so we would dilute by 65 shares for every 100 options in the numerical example. We would thus list an asset equal to 65 percent of the exercise price as projected future exercise price revenues (in this case $.65 \cdot 32 = \$20.80$ per option). If, when any in the money option is exercised the company repurchases the portion of the share that was effectively held by the government there will be no change on the balance sheet. In this case, the company would receive \$39 from the exercise price and tax benefit and use \$18.20 to repurchase .35 shares ($.35 \cdot 52 = 18.20$), leaving it with \$20.80. If the company does not repurchase stock then after the exercise it has more dilution and more assets. This is economically accurate, as it no longer has the federal government mitigating the effects of any dilution and it has received a tax deduction worth the market value of the additional shares in return for the extra dilution it will suffer going forward.

On a quarterly expense basis, the option expense that firms report would also be multiplied by one minus the tax rate. These expenses would be offset with an equivalent paid-in capital item, as effectively the employee has contributed wages to purchase the option. Consistent with the balance sheet approach above, we would simply reduce the expense rather than reporting the gross expense and a negative deferred taxes amount.

6 Other Accounting Methods

In this section we discuss several alternative methods of accounting for options.

6.1 Financial Accounting Standards Board

The FASB [3] discusses expensing options linearly between the grant date and the vesting date. Options would be assumed to have an expected life, which might be calculated recognizing that employees may follow an algorithm such as exercising when the ratio of the stock price to exercise price reaches a given level, but as we understand it the expected life rather than the algorithm

would be used to estimate the option's value on the grant date. That is, if the options had three years to vest and a five year expected life then the FASB would have the firm calculate the Black-Scholes or binomial value of a five year option, as of the grant date, and then have that amount expensed linearly over the time to vesting.

If terminations were greater than or less than expectations option expense would be adjusted for the amount of termination. Therefore, reported income could be increased by laying off workers who hold deep out of the money options that were highly valued on the grant date, even if the employee would be economically profitable if retained. Rules about options buybacks and repricing prevent firms from raising their accounting profits through such financial transactions, so real attrition is required. There appears to be no recognition of the fact that more options are likely to vest and exercise is likely to be earlier when the stock goes up. If options are repriced then the value of the new options less the value of the old options must be added to the amount to be expensed over the remaining period. The purpose is to prevent firms from asymmetrically revaluing options when the stock price falls, while not revaluing when the price rises.

Dilution of primary earnings per share would be calculated by the Treasury Method. This method clearly understates the true dilution that would be computed using Δ s. Balancing this, the FASB ignores the implicit interest income firms receive from option holders' effective loans against their levered equity positions. As discussed earlier, this adjustment can be viewed as economically sound in the special case where the earnings/price ratio is always r and the accounting system is constrained to treating options as equity or debt rather than as a hybrid.

The IASB's most recent proposal [7] is similar, using grant day prices and amortizing only over the period until vesting.

6.2 Dilution Only

Many companies have taken the stance the options can be accounted for strictly through dilution, with no need for any other expensing. It is worthwhile to show when this would be true to make it more obvious why it generally isn't.

Consider a futures contract between the employee and the firm with non-dividend stock that vests immediately and must be exercised no later than the termination of employment. The contract specifies that the employee

must buy a share of stock from the firm at the exercise price. Then the contract is equivalent to the firm lending the employee the exercise price to buy the stock, with no interest accruing on the loan so long as the employee continues to work for the company. The employee is effectively like any other shareholder (and has a Δ of 1 always), always owing the exercise price to the firm until the stock is purchased. Therefore, in this special case we can think of the employee always owning a share of stock whose cost to other shareholders is fully captured through dilution and the firm's reported earnings are reduced by the opportunity cost of having lent money to the employee at zero interest rather than having lent in the market, but no further net expense need be recorded.³⁴

There are two important things to note here. First, dilution in this model would be much greater than the dilution that many of these companies have in mind — dilution would equal the total number of options issued. Second, relative to a stock option the futures contract reduces the firm's costs because it does not allow for the possibility that option will expire out of the money, leaving the firm worse off than if its transaction with the employee had been a futures contract. Thus, even full share for share dilution of all options, in or out of the money, understates the firm's expense because it does not recognize the cost of giving the employee the option to cancel the transaction if the stock price is below the exercise price when his employment ends.

A system that accounted for in-the-money options strictly through one-for-one dilution would thus have to impose a charge on earnings equal to the difference between the exercise price and the stock price for any out-of-the-money options, to account for the losses suffered by having provided the employee with an option instead of a futures contract. Alternatively, an expense would have to be taken equal to the value of the put option provided each quarter to the holder of an in-the-money option as well as the value of a call option to an employee who holds an out-of-the-money option. But those changes would return us to the proposal outlined in this paper.

6.3 Hull and White, Kaplan and Palepu

John Hull and Alan White [5] in an early 2003 working paper and Kaplan and Palepu [8] in a late 2003 Harvard Business Review article propose expensing

³⁴Were it not for the possibility of employee default, one could refer to this sort of contract as the Bernie Ebbers model.

unvested options as though the company were supplying its employees with unhedged options in a different firm. Think of Intel awarding its employees options on Microsoft stock, with the analogy precise if Microsoft's and Intel's stocks tracked perfectly.

It is easiest to consider the case of restricted stock, which is like an option with an exercise price of zero, and an "exercise date" equal to the vesting date. Under these systems, the cumulative expense charged to the company would be equal to the number of shares expensed to date, times the stock price. For example, if the plan vested 16 shares after four years and there was to be no attrition, then the expense in the first quarter might be the value, at the end of that quarter, of one share of stock, and the expense in quarter Q , $1 < Q \leq 16$ would be $QS_Q - (Q - 1)S_{Q-1}$, where S_Q is the stock price at the end of quarter Q .

Like ours, this proposal has the advantage of using market prices. It has the disadvantage of treating all the returns the employee earns during the pre-vesting period through the income statement rather than through dilution, as would be the case with other equity holders. That is, under the current, satisfactory, rules were the company to award its employees one share of stock for each of 16 quarters, with no previous promise of any grants, it would recognize an expense equal to the value of one share of stock for each quarter, based on the price at the time of the grant. But after a share was expensed it only affects earnings per share through dilution. By contrast, [5] and [8] record all changes in stock price after an option is expensed but until it is vested as expense or income to the firm.

Because these methods also charge expense cumulatively over time, they lead to an expected present value of labor expenses that are in excess of any notion of the present value of the cost of the grant. It is unclear how these proposals would deal with dilution. Being consistent with the approach of treating unvested options liabilities as short positions in the securities of other firms would require no dilution prior to vesting.

There are, however, good reasons for treating a firm's transactions in its own stock differently from other financial transactions. If Intel issued stock for a nickel a share in the late 1960s and repurchased it today for \$30.00 should it report a loss of \$29.95? By treating options equity differently from other equity this method does poorly on the FASB objective described by Rubinstein [10] as "nearly identical firms should report nearly identical earnings".

7 Performance Options and Other Securities

Some firms provide options that vest early if certain performance targets are met, but only after many years if the targets are not met. For example, options may vest if sales or earnings targets are met or if the average stock price is above a certain level for a given period of time. Sometimes the options will still vest after a long period if the performance targets are not met and the employee nevertheless remains with the firm.

Our system easily accomodates such options. The general system of charging an initial expense equal to the option market value on the day that the option is recognized for income statement purposes, with extensions charged quarterly, would seem to extend immediately to performance options. Again, the firm could recognize unvested options on whatever schedule it wished, subject to the constraint of using market prices to determine the value of newly recognized options, and recognizing all options by the time they become vested.

A firm might assume that it would meet its performance targets and hence expense all of the performance options before the early vesting date. If *ex-post* the targets were not met, then it would have the choice as to whether or not to now reduce the number of options assumed to ultimately vest. Reducing the assumed options to ultimately vest would result in a gain in the income statement. This gain, however, might be quite small since the stock presumably has not done particularly well under the circumstances of failing to meet the performance standards. Reducing the number of out-of-the-money options (which are still treated as 90-day extendable contracts) would usually have only a small impact on reported earnings.

As to options that expire less than 90 days after termination, we would still allow firms to treat them for accounting purposes as if they were extended 90 days at a time. If a firm required employees to exercise within a week of termination we would in principle be willing to allow it to either use the 90 day fiction or to assume that the options were renewed as 7 day options every week. We doubt that many firms would choose the latter course, though. This would require 13 expense calculations within a quarter, and it could be difficult to estimate the reported expense until near the end of the quarter. Furthermore, option costs would become extremely volatile: a 7 day at-the-money option for a \$100 stock with an annual volatility of 40 percent is \$2, while the value of extending an option for one week when the stock is selling at a 110 is only 12 cents.

We do not have a strong position on vested long-term options that do not expire within three months of termination, such as the Halliburton options held by Vice President Richard Cheney. In cases where such options are granted as part of an explicit employment contract there is a valid argument for expensing the entire value of the option over the length of the employment contract, and employing a grant day valuation.

8 Conclusion

Most employee options must be exercised within 90 days of the termination of employment. Such options are 90 day securities that are regularly extended, rather than long term securities. As Black and Scholes showed, at any given time an option holder owns the equivalent of a fraction of a share and an interest-free loan from an employee. The value of having an option extended is that the holder gets the benefit of an extra day's hindsight in deciding whether to exercise, and the interest free loan is extended.

We propose an accounting system for option expense and dilution that is consistent with the realities of employee options. Briefly, we treat options as though they expire just after the end of a quarter and are extended for three months at the very beginning of the next quarter. With these assumptions, which impose roughly the same expected costs as daily accounting, we are able to develop a simple and robust system.

Because our expense formula only depends on the implicit volatility in 90 day options, it is able to rely on market prices. The system only involves a dilution cost for options deep in the money at the end of the quarter and almost no cost at all for deep out of the money options. Companies could predict their option expense on the first day of the quarter to a high degree of certainty. While they could not predict dilution nearly as well, it should not be difficult to explain to shareholders that the reason dilution went up during a quarter was that the stock did well, putting more existing options in the money. Because it is based on market prices our system is fairly robust to the timing of expensing, and therefore to revisions in predictions about vesting, early exercise, and other factors. Most importantly, our system provides decision makers with objective and easily calculated information that aligns the economic and accounting consequences of a firm's employment and compensation practices .

In line with modern financial economics, our system attributes more of the

option expense to dilution and less to income than does the FASB proposal. Doing so requires recognizing that an option is effectively a levered equity investment. If accountants are constrained to treating options as unlevered equity then small changes can accommodate the constraint. If anything these changes might make our system seem even simpler to many, while creating relatively little distortion.

Appendix: Numerical Illustration

We provide an example of how the Bulow-Shoven option accounting system would be implemented for a given set of options and a given firm-chosen expensing rule. Results are provided for both our basic system, which uses zero-interest option values and full dilution for in-the-money options, and for the modified system that uses full option values and Treasury Method dilution. All expense and dilution numbers would have to be multiplied by 1 minus the tax rate to adjust for corporate taxes.

We assume that a firm grants 1,000,000 options on the first day of a quarter. The options vest one year later, on the first day of quarter 5. The riskless interest rate is assumed to be 4 percent per year and volatility is assumed to be 40 percent. The stock pays no dividends. All options have a strike price of 100. The firm chooses a mechanical rule that requires it to recognize 1/2 of all non-forfeited options one year before vesting, with the fraction increasing by 1/8 in each of the next four quarters.

In the example, the firm suffers no pre-vesting attrition in any quarter except the third, when holders of twenty percent of the options leave. In this example we treat attrition in a given quarter as affecting the number of options recognized in the following quarter. This is perhaps the simplest method, and allows firms the greatest predictability in quarterly option costs.

Quarter 1:

Beginning Stock Price: 100

0 interest option value: \$7.91

full option value: \$8.37

intrinsic value: \$0

Recognized shares: $\frac{1}{2} \times 1,000,000 = 500,000$

Change in recognized shares: 500,000

Basic model expense: $500,000 \times \$7.91 = \$3,955,000$

Modified model expense: $500,000 \times \$8.37 = \$4,185,000$

Ending Stock Price: 130

Basic model dilution: 500,000 shares

Modified model dilution: $500,000 \times (30/130) = 115,384$ shares

Quarter 2:

Beginning Stock Price: 130

0 interest option extension value: \$0.98

full option extension value: \$1.86

intrinsic value: \$30.00

Recognized shares: $5/8 \times 1,000,000 = 625,000$

Change in recognized shares: 125,000

Basic model expense: $625,000 \times \$0.98 + 125,000 \times \$30.00 = \$4,362,500$

Modified model expense: $625,000 \times \$1.86 + 125,000 \times \$30.00 = \$4,912,500$

Ending Stock Price: 70

Basic model dilution: 0

Modified model dilution: 0

Quarter 3:

Beginning Stock Price: 70

0 interest option extension value: \$0.24

full option extension value: \$.27

intrinsic value: \$0

Recognized shares: $6/8 \times 1,000,000 = 750,000$

Change in recognized shares = 125,000

Basic model expense: $125,000 \times 0 + 750,000 \times \$0.24 = \$180,000$

Modified model expense: $125,000 \times 0 + 750,000 \times .27 = \$202,500$

Ending stock price: 120

Basic model dilution: 750,000 shares

Modified model dilution: $750,000 \times (20/120) = 125,000$ shares

Quarter 4:

Beginning Stock Price: 120

0 interest option extension value: \$2.11

full option extension value: \$2.89

intrinsic value: \$20.00

Recognized shares: $7/8 \times 1,000,000 \times .80 = 700,000$

Change in recognized shares = -50,000

Basic model expense: $-50,000 \times \$20.00 + 700,000 \times \$2.11 = \$477,000$.

Modified model expense: $125,000 \times 0 + 750,000 \times .27 = \$202,500$

Ending Stock Price: 125

Basic model dilution: 750,000 shares

Modified model dilution: $750,000 \times (25/125) = 150,000$ shares

Quarter 5:

Beginning Stock Price: 125

0 interest option extension value: \$1.45

full option extension value: \$2.29

intrinsic value: \$25.00

Recognized shares: $1,000,000 \times .80 = 800,000$

Change in recognized shares = 100,000

Basic model expense: $100,000 \times \$25.00 + 800,000 \times \$1.45 = \$3,660,000$

Modified model expense: $100,000 \times \$25.00 + 800,000 \times \$2.29 = \$4,332,000$

Ending stock price: 150

Basic model dilution: 800,000 shares

Modified model dilution: $800,000 \times (50/150) = 266,667$ shares

As of the first day of Quarter 5 all options are vested. The number of options outstanding will begin to decline over time due to early exercise or forfeiture. In subsequent quarters there is still an expense due to the extension of the options that remain outstanding at the beginning of the quarter. We illustrate assuming that 75,000 options were exercised in Quarter 5:

Quarter 6:

Beginning Stock Price: 150

Options vested at beginning of previous quarter: 800,000

Options exercised or forfeited: 75,000

Options extended at beginning of new quarter: $800,000 - 75,000 = 725,000$

Zero interest option extension value: \$.18

Full option extension value: \$1.14

Basic model expense: $725,000 \times \$.18 = \$130,500$

Modified model expense: $725,000 \times \$1.14 = \$826,500$

Ending stock price: 160

Basic model dilution: 725,000 shares

Modified model dilution: $725,000 \times (60/160) = 271,875$ shares

For both the basic and modified models quarterly expense would be offset by an equal entry for paid-in capital.

Finally, while the option expense for an individual grant entirely exercisable at one price could fluctuate substantially from quarter to quarter, overall costs may fluctuate substantially less. For example, consider a firm with a million recognized options outstanding at a strike price of 100 and a

million with a strike price of 125. Then if the stock sells at 100 the value of a zero-interest extension of the X=100 options will be \$7.91 while the value of a zero-interest extension of the X=125 options will be \$1.45, for total expenses of \$9.36 million. If the stock is at 125 the next quarter then the value of a zero-interest extension is \$1.45 for X=100 and is \$9.89 for X=125, for a total expense of \$11.34.

Appendix: Intel First Quarter 2003

Using the data from Intel’s 2002 annual 10k report [6] plus its stock price at the end of 2002 (\$16.56) and at the end of the first quarter of 2003 (\$17.22) it is possible to roughly estimate the effect of our method on its first quarter 2003 financial statement. Intel reported outstanding and “exercisable” (presumably vested) options in each of six exercise price ranges as of the end of 2002. Intel also reported an estimated volatility (49 percent) and it pays a dividend of 2 cents per quarter, which we treated as a reduction in the initial stock price. Note that this may make the extension value reported for deep in the money options negative, as the firm saves money by not having to pay a dividend.³⁵ For the Black-Scholes calculations of the value of the extensions we use a zero interest rate, and we assumed that Intel expensed all non-vested options as vested options (Rule A in the text). From this data it is possible to infer the number of shares and the average exercise price of both immediately exercisable and non-exercisable (which we will assume are non-vested) options in each range:

Exercisable (Vested) Options as of 12/28/02

Range of Exercise Price (\$)	Number Vested (millions)	Average Exercise Price (\$)	Extension Value Per Option (\$)	Total Ex. Value (\$millions)
.01 – 16.56	133.5	6.42	-.02	-2.67
16.62 – 20.17	71.8	17.87	1.06	76.29
20.23 – 21.67	3.3	21.04	.37	1.22
21.72 – 25.69	27.6	25.12	.08	2.22
26.06 – 38.81	21.9	34.67	.02	0.35
38.82 – 87.90	15.9	55.32	.00	0.00
Total	274.0			77.40

³⁵Of course the true cost of the extension also includes the loss of interest earned on the strike price because of a deferred exercise, but as noted in the text that expense is accounted for by the non-reporting of interest income on the implicit borrowing of option holders.

Unexercisable (Non-Vested) Options as of 12/28/02

Range of Exercise Price (\$)	Number Non-Vested (millions)	Average Exercise Price (\$)	Extension Value Per Option (\$)	Total Ex. Value (\$ millions)
.01 – 16.56	19.5	13.76	.48	9.44
16.62 – 20.17	54.5	18.94	.76	41.19
20.23 – 21.67	133.3	20.37	.52	68.97
21.72 – 25.69	159.2	24.49	.10	16.32
26.06 – 38.81	116.7	31.68	.06	6.54
38.82 – 87.90	88.2	59.47	.00	0.00
Total	571.4			142.45

Newly Granted (millions)	Avg. Exercise Price (\$)	Expense/Option (\$)	Total Value (\$ millions)
5.7	16.35	1.62	9.21

Note that our method of expensing options results in no charge for the deep out-of-the money options (those with exercise prices ranging from \$38.82 to \$87.90) that were issued mostly in the year 2000. In contrast, under the FASB proposal Intel would have the firm recognizing an expense of almost \$200 million per quarter for options issued that year.³⁶ An employee who held 1,000 options issued by Intel in 2000, valued at the average level, would add \$28,270 to the company's bottom line by quitting the day before rather than the day after vesting in these worthless options. Ironically, the more valuable the option the lower the quarterly amortization under the FASB approach because grant-day option values are likely to be proportional to grant-day exercise prices.

Referring to the tables above, the cost of the existing options for the quarter under our proposal would have been $77.40 + 142.45 = 219.85$ million dollars. Recall that the FASB cost was almost as large for the amortization

³⁶Intel's regular option grant in 2000 was valued under FASB rules at an average \$28.27 per share, amortizable over the five years until vesting. It issued a total of 118 million options, for a total value of \$3.36 billion. Amortized over 16 quarters, this would come to \$210 million per quarter, but forfeitures would probably reduce the total below \$200 million.

of options issued in 2000 alone, and ignoring all other years. Newly granted options would have had a value of 9.21 million. Because forfeited options in the previous quarter were out of the money they provide no offsetting reduction in expense. So total cost of options for the quarter would have been $219.85+9.21=229.06$ million dollars, or about 3.4 cents per share, before corporate taxes. The after-tax cost given a 35 percent tax rate would have been roughly \$149 million or 2.2 cents per share. The only uncertainty about the expense at the beginning of the quarter would have been the value of the newly granted options (which would be proportional to the grant-day stock price) and the value of any forfeitures.

At the end of the quarter 146.8 million options were in the money.³⁷ Again applying a 35 percent corporate tax rate, our method would have implied a dilution of about 96 million shares, against Intel's total outstanding of about 6.65 billion. Thus, dilution would have been approximately 1.5 percent. With Intel's stock price doubling during 2003, there were 632 million options in the money at the end of the third quarter. Adjusting for the tax effect, dilution would have been approximately 411 million shares for the third quarter, or approximately 6.2 percent.

³⁷122.5 million of these were vested. We are assuming that the company had already recognized the expense of the 24.3 million in the money unvested options as consistent with our Rule A..

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