ACCOUNTING FOR EMPLOYEE STOCK OPTIONS

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ABSTRACT

In this paper we argue that employee stock options should be expensed on the grant date and then marked to market on subsequent reporting dates. We present a robust procedure for valuing executive stock options. It explicitly considers the vesting period, the possibility that employees will leave the company during the life of the option, the inability of employees to trade their options, and dilution issues.

ACCOUNTING FOR EMPLOYEE STOCK OPTIONS

The accounting treatment of employee stock options has received a great deal of attention in recent years. The Financial Accounting Standards Board (1995) in FASB 123 establishes a fair-value-based method of accounting for employee stock options in which options are expensed at the time they are granted. The standard encourages companies to adopt the method, but does not require them to do. Companies that do not adopt the method are required to disclose the pro forma effects of doing so.

In the aftermath of Enron, WorldCom, and other extreme cases of managerial behavior, there are renewed attempts throughout the world to require companies to expense employee stock options. The International Accounting Standards Board (2002) has published an exposure draft, ED 2, proposing that all share-based payments be expensed. Some national accounting standards boards are also moving towards standards that would require expensing.

In this paper we first review the accounting issues. We then propose a valuation procedure for employee stock options which is robust and captures the key properties of these securities. For the sake of definiteness we consider what might be termed plain vanilla employee stock options.[1] These have the following properties

1. The options are call options issued by the employer company on its own stock.
2. There is a vesting period of during which the options cannot be exercised.
3. When employees leave their jobs (voluntarily or involuntarily) during the vesting period they forfeit unvested options.
4. When employees leave (voluntarily or involuntarily) after the vesting period they forfeit options that are out of the money and they have to exercise vested options that are in the money immediately.
5. Employees are not permitted to sell their employee stock options. They must exercise the options and sell the underlying shares in order to realize a cash benefit or diversify their portfolios.

[1] Our approach can be adapted to apply to other employee stock option plans.

6. When options are exercised, the company issues new Treasury stock.

Accounting Issues

One issue in expensing stock options concerns the timing of the recognition of the expense. Should the expense be recognized at the time the options are granted, at the time they vest, or at the time they are exercised? FASB 123 favors recognizing the expense on the grant date. The company can choose to make an estimate of the options that will not vest and reduce the amount of the expense accordingly. Alternatively, it can calculate the expense on the assumption that all options will vest and later reverse the expense for those that do not.

In ED 2 the International Accounting Standards Board proposes that the value of the options be calculated on the grant date. If there is no vesting period, the expense is recognized immediately. If there is a vesting period, the expense is recognized year by year during the vesting period as the employees provide service for the company.

FASB 123 regards employee stock options as akin to compensation that is almost certain to be received by the employee. IASB's ED 2 regards them as payment for services performed for the company by the employee during the vesting period. In our view FASB 123's interpretation of the nature of employee stock options is closer to reality. The grant date is the point in time when the company creates a contingent claim against its assets. Few employees regard employee stock options as payment for services provided during the vesting period. It also worth noting that, although the company usually has the option of changing an employee's regular compensation during the vesting period, it does not have the option of adjusting the terms of employee stock options during this period. In our view the vesting period in employee stock options is like the lockout period that is a feature of many over-the-counter derivatives contracts. No investment bank would seriously consider waiting until the end of a lock out period before marking to market a derivative.[2]

[2] The vesting period can be viewed as providing another dimension to the contingency in an employee stock option. The employee's ultimate payoff is contingent on how well the stock performs and on remaining employed. The same principles should be used in dealing with all contingencies.

Expensing executive stock options at the time they are exercised has some advocates. It totally avoids uncertainties as to the valuation of the option because the value of the option at the time it is exercised is unambiguously its intrinsic value; that is, it is the excess of the stock price at the time of exercise over the strike price. Supporters of the idea of expensing stock options on the exercise date also argue that the realized cost of the executive stock options to the company is best measured as the intrinsic value of the options at the time they are exercised. If the options are never exercised there is no cost.

Many of the debates concerning executive stock options center on whether they are liabilities of the company or equity claims against the company. The reality is that they are neither. Traditionally accountants have classified claims against a company as debt or equity. With the advent of derivatives markets the nature of the claims that can been outstanding against a company have become considerably more complex. A good case can be made for adding another category, Contingent Claims, to the Liabilities and Net Worth side of the balance sheet. The Contingent Claims category would include warrants, convertible debt, and executive stock options.

One area where we disagree with both FASB 123 and IASB's ED 2 concerns what happens after the grant date. In our view contingent claims should be revalued (i.e., marked to market) on the grant date and at each subsequent reporting date. Consider a company with a December year-end that issues at-the-money executive stock options in March that are worth $100 million. Suppose that by the year-end its stock price has dropped by 50% and the options are almost worthless. Is it meaningful to ask the company to recognize a $100 million expense when it reports its results in December?

Employee stock options should be valued and expensed on the grant date. This involves a charge to income and an increase in the Contingent Claims account.[3] At subsequent reporting dates they should be revalued. If the value has gone up there is an additional charge to the income statement and an increase in the Contingent Claims account. If the value has gone down there is a reversal of previous charges to the income statement and a reduction in the Contingent Claims account.

[3] As suggested by FASB 123 the amount expensed can be reduced by an estimate of the number of options that will not vest.

There is one crucial advantage of this procedure. The cumulative amount expensed for a stock option over its whole life, regardless of the precise way it is valued, will always be a) zero if it is never exercised, or b) the intrinsic value at the time of exercise if it is exercised. Two different accountants using different option pricing models or different volatility estimates may differ on how employee stock option expenses are allocated to accounting periods, but they will not differ on the cumulative expense charged. Many accounting practitioners are likely to be far more comfortable with the idea of expensing an employee stock option if they know that there will be no ambiguity about the cumulative expense over the whole life of the option.

Another key advantage of marking to market executive stock options is that it reflects the risk sharing between the company's shareholders and its employees. This is a key feature of employee stock options. Consider the following two strategies available to a company:

1. Buy options on its own stock from an investment bank and distribute them to its employees
2. Grant the employees the usual type of executive stock options

Suppose that the terms of the options are the same in both cases. The key difference between the strategies is that risks are shared between the company's shareholders and the employees in the second strategy, but not in the first. If the company does badly the options will be worthless. In the case of the second strategy the cost to the company's shareholders and the benefit to the employees is zero ─ and this is just as well because the company's shareholders are not in a position to afford a payoff on the options. If the company does well, the options will prove to be valuable. In the case of the second strategy the cost to the company's shareholders and the benefit to the employees will be significant, but the company's shareholders are in a position to afford costs of the option payoffs.

Clearly the options issued under the first of the two strategies should be expensed on the grant date and should not be marked to market subsequently. The cost of the options to the company's shareholders is known on the grant date and is independent of how well the company does. The options issued under the second of the two strategies should be

marked to market. By doing so the risk sharing will be recognized in the way the options are accounted for.

Valuation Approach

From a derivatives valuation perspective, the most difficult feature of a plain vanilla employee stock option is its non-marketability. An employee is not allowed to sell an employee stock option. If the employee wants to realize cash or diversify his or her portfolio, the employee must exercise the option and sell the underlying stock.

One result in the pricing of derivatives is that an American call option on a non-dividend-paying stock should never be exercised early. The holder of the option will always be better off if he or she sells the option rather than exercising it before maturity. Consider an employee stock option issued by a company that pays no dividends. If it could be freely traded, it too would never be exercised prior to maturity. In practice, because they cannot be traded freely, executive stock options are frequently exercised early. As Huddart and Lang (1996) point out, employees commonly sacrifice half the value of options by exercising early. This means that the cost of the options to the company is reduced by half.

We model the early exercise behavior of employees by assuming that exercise takes place whenever a) an option has vested and b) the stock price reaches a certain multiple M of the strike price.[4] The value of M may be different for different groups of employees. When historical data on the early exercise behavior of employees is available, M can be estimated as the average ratio of the stock price to the strike price when employees have made voluntarily early exercise decisions and these decisions are not made immediately after the end of the vesting period. Companies that do not have any of their own historical data available can base their estimates of M on published statistics. Luckily the value of an option is not unduly sensitive to M. Later in the paper we will review the published statistics and present some information on the sensitivity of option valuations to M.

[4] Huddard (1994) suggests that this early exercise behavior captures employee risk aversion.

Our procedure for valuing executive stock options is analogous to the procedure used by investment banks to value mortgage-backed securities. The value of a mortgage-backed security is dependent on the prepayment behavior of the holders of the mortgages in the underlying pool. The level of interest rates is one factor determining this prepayment behavior, but not the only factor. An investment bank models prepayment behavior to determine the true value of the mortgage-backed security. For a similar reason we model early exercise behavior.

To handle the possibility that an employee will leave the company (voluntarily or involuntarily) without having previously exercised the option we assume an employee exit rate, e. This is the proportion of the remaining employees who leave each year. If an employee leaves during the vesting period options are forfeited. If the employee leaves after the vesting period, the option is forfeited if it is out of the money and exercised immediately if it is in the money. The employee exit rate, e, can be estimated directly from historical data on employee turnover rates. Like the early exercise multiple it is liable to different for different categories of employees.

For ease of exposition we assume that M and e are constant. However, they can both be functions of time with causing any difficulties for our valuation approach.

The valuation can be accomplished by using a binomial tree similar to that proposed by Cox, Ross and Rubinstein (1979). Suppose the length of each time step is δt. The rules for calculating the value of the option at each node of the tree are:

1. Options can be exercised only after the vesting period.
2. A vested option is exercised prior to maturity if the stock price is at least M times the exercise price.
3. There is a probability $e\,\delta t$ that the option will be forfeited in each short period of time during the vesting period.
4. There is a probability $e\,\delta t$ that the option will terminate in each short period of time δt after the end of the vesting period. When this happens the option is forfeited if it is out of the money and exercised immediately if it is in the money.

Suppose that there are N time steps of length δt in the tree. Suppose further that $S_{i,j}$ is the stock price at the jth node of the tree at time $i\,\delta t$, and $f_{i,j}$ is the value of the option at this node. Define K as the strike price of the option and v as the time when the vesting period ends. The equations describing the backwards induction through the tree are:

$$f_{N,j} = \max\left(S_{N,j} - K, 0\right)$$

When $0 \le i \le N-1$

$$\begin{array}{lll}
\text{If } i\delta t > v \text{ and } S_{i,j} \ge KM & \text{then} & f_{i,j} = S_{i,j} - K \\
\text{If } i\delta t > v \text{ and } S_{i,j} < KM & \text{then} & f_{i,j} = \left(1 - e\,\delta t\right) e^{-r\delta t}\left[pf_{i+1,j+1} + \left(1-p\right) f_{i+1,j}\right] \\
 & & \quad + e\,\delta t \max\left(S_{i,j} - K, 0\right) \\
\text{If } i\delta t < v & \text{then} & f_{i,j} = \left(1 - e\,\delta t\right) e^{-r\delta t}\left[pf_{i+1,j+1} + \left(1-p\right) f_{i+1,j}\right]
\end{array}$$

The value of the option is f_{00}.[5]

The early exercise strategy we are assuming leads to the employee stock option being a type of barrier option. As explained in Hull (2003) it is computationally more efficient to use a trinomial rather than a binomial tree when valuing a barrier option. Three branches emanate from each node and the spacing between the stock prices considered is adjusted so that there are nodes on the tree where the stock price equals KM. The probabilities on the tree are chosen so that the expected change and standard deviation of change in the stock price in a short period of time are correct in a risk-neutral world.

Table 1 provides data for a sample option. (This is an option considered by FASB 123 in one of its examples). Table 2 shows the price of the option in Table 1 for different assumptions about M and e. As mentioned earlier the value of an option is not unduly sensitive to the value of M. For example, if M is set equal to 2.0, the value of the option is unlikely to be in error by more than 20%.

[5] These equations assume that the employee exit rate is expressed with continuous compounding. If u is the annual employee turnover rate, $e = \ln(1+u)$. If the company wants to assume that all options vest and later reverse the charge for those that do not, it should set $e = 0$ when $\iota\,\delta t < v$.

Empirical Evidence on Exercise Behavior

There are relatively few statistics available on the actual exercise behavior of employees in different types of companies to assist in choosing the early exercise multiple, *M*. Huddart and Lang (1996) looked at over 50,000 employees working for eight different corporations between the mid 1980s and the mid 1990s. They found that the mean ratio of the stock price to the exercise price at the time of exercise was 2.2. Carpenter (1998) looked at a sample of option exercises by top executives at 40 firms between 1979 and 1994. All the options had 10-year lives. In this case the stock price at the time of exercise was 2.8 times the exercise price. Unfortunately the mean ratio of the stock price to the exercise price at the time of exercise provides only an approximate estimate of *M*. This is because at the end of the vesting period the stock price might be well above the minimum necessary to trigger exercise. Also at the end of the life of an option, exercise will take place for all stock prices above the exercise price.

The average time to exercise and the ratio of the stock price to the strike price at the time of exercise is lower for the Huddart and Lang sample than for the Carpenter sample. This suggests that top executives may wait longer than more junior employees before exercising. We can conjecture that this may be because they have less need to exercise options for personal liquidity reasons.

Dilution

We now consider how dilution can be taken into account in our model for the valuation of employee stock options. First we consider when the dilution (if any) takes place. Consider a company where 100,000 shares are outstanding and the current share price is $50. The company decides to grant 100,000 stock options to its employees with a strike price of $50 and a vesting period of three years. If the market anticipates this decision there is no impact on the stock price. The adverse effect (if any) of this action is already reflected in the current $50 stock price. If the action is unanticipated, and the market sees little benefit to the shareholders from the employee stock options in the form of reduced salaries and more highly motivated managers, the stock price will decline immediately after the announcement of the employee stock options. Suppose that the stock price

declines to $45. The dilution cost to the current shareholders is $5 per share or $500,000 in total.

Suppose that the company does well during the vesting period so that by the end of the vesting period the share price is $100. Suppose further that all the options are exercised at this point. The payoff to the employees is $50 per option. It is tempting to argue that there will be further dilution in that 100,000 shares worth $100 per share are now merged with 100,000 shares for which only $50 is paid so that a) the share price reduces to $75 and b) the payoff to the option holders is only $25 per option. However, this argument is flawed. The exercise of the options is anticipated by the market and already reflected in the share price.

The argument we have just given shows that there may be some dilution of the stock price at the time the employee options are granted, but there is no subsequent dilution. If we assume that the post-grant process for the stock price is geometric Brownian motion we are effectively in the same position as when we ignore dilution providing we base our value of the option on the post-grant rather than the pre-grant stock price.[6] Geometric Brownian motion (with perhaps a volatility skew adjustment) is almost certainly the assumption that would be made for a regular over-the-counter or exchange-traded option. There is no reason for not making the same assumption for an employee stock option.

To summarize, we should always value employee stock options in the same way as the corresponding over-the-counter or exchange-traded options and ignore dilution. The only proviso is that we should base our valuations on the post-grant-announcement stock price, not the pre-grant-announcement price.

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[6] An alternative more theoretically correct assumption is to assume that the value of the stock plus all outstanding employee stock options (as well as warrants and convertibles if any) follow geometric Brownian motion. This is the approach used by Galai and Schneller (1978). Unfortunately it is extremely difficult to extend their work to the situation where there is more than one option issue outstanding. To test the assumption that the stock price follows geometric Brownian motion we considered the case where there is only one stock option issue and compared the assumption with the assumption in the Galai-Schneller model that the stock plus options follow geometric Brownian motion. Except in cases of extreme dilution we found the price difference between the two models to be very small. This is reassuring.

Conclusions

Employee stock options are neither debt nor equity. They are contingent claims against the assets of the company. They should be valued on the grant date and on subsequent reporting dates. They valuation method we propose involves two parameter estimates, M and e, in addition to the parameters that usually have to be estimated to value an option. The parameter, M, is a multiple defined so that employees choose to exercise their options as soon as the stock price exceeds M times the strike price. The parameter, e, is the employee turnover rate.

The main focus of this paper has been on the most common type of employee stock option plan where a) the exercise price of an option remains constant during the option's life, b) the option can be exercised at any time during its life after an initial vesting period, and c) the employee cannot continue to hold the options after he or she has left the company. The approach we suggest can be extended to value other options, for example those where the exercise price changes through time and those where the exercise price is linked to the value of a stock index.

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Table 1: Sample Option	
Life of option	10 years
Vesting period	3 years
Stock price	$50
Exercise price	$50
Risk-free rate	7.5%
Expected volatility	30%
Expected dividend yield	2.5%

Table 2: Impact on Valuation of Option in Table 1 of Alternative Values of *M* and *e*.

The parameter, *M*, is the ratio of the stock price to the exercise price necessary to trigger voluntary early exercise. The parameter *e* is the employee exit rate (assumed to be the same pre-vesting and post-vesting).

	e = 3%	*e* = 5%	*e* = 7%	*e* = 10%
M = 1.2	13.13	12.28	11.47	10.33
M = 1.5	15.13	14.06	13.07	11.69
M = 2.0	17.09	15.80	14.61	12.97
M = 2.5	17.97	16.57	15.28	13.53
M = 3.0	18.34	16.89	15.56	13.75