**Accounting for Employee Stock Options: An Economics Perspective**

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**Abstract**

Instead of relying on accounting principles and illustrative accounting examples, this paper examines the rationale for ESO expensing from an economics perspective and has the following findings. In principle, while ESO expensing is justified under ESOs' expense-postponing function, it is not under the employee-stimulating function. In practice, ESOs' risk-sharing function poses a fundamental difficulty for option pricing models to estimate ESOs' fair value; and mandatory ESO expensing could unduly deter the use of ESO granting for both incentive and financial purposes. We suggest reservation-wage expensing as an alternative method to achieve the goal of ESO expensing without its disturbance on ESO granting. (JEL G13 G28 M41 M52)

Keywords: ESOs; employee stock options; stock option expensing; accounting

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## 1. Introduction

Employee stock options (ESOs) are employees' right to purchase employers' stocks at predetermined prices. Whether ESOs should be treated as an expense and deducted from the grantor's earnings at the grant date (ESO expensing in short) is a controversial issue at the time of this writing, with accounting standard authorities (e.g. FASB and IASB) at the core of the pro-expensing camp and the high-tech industry (as a major ESO grantor) the core of the anti-expensing group (Chance, 2004).

ESO granting is effectively equivalent to the combination of two transactions (Bodie et al., 2003; Guay et al., 2003). In one transaction the employer uses cash to acquire employee services; in the other the employer recovers the cash by selling the employee stock options of equivalent value. Thus, ESO accounting is essentially to report these two transactions in the grantor's income statement and balance sheet.

The cash spent for employee compensation in the first transaction is an operating cost that should be expensed against earning; whereas the cash premium from ESO issuance in the second one is financial proceeds that, according to common accounting standards, ought to be accounted as equity capital. Therefore, ESO expensing is a process of deducting the value of ESOs from earning in the income statement on the one hand, and accounting it as option holders' equity in the balance sheet on the other (CBO, 2004). This rationale for ESO expensing is well accepted in the literature.[1]

While most of the existing literature approaches the issue of ESO expensing from an accounting perspective, this paper attempts to examine it from an economics perspective. That is, instead of relying on accounting principles and using illustrative accounting

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[1] Although there are many arguments against ESO expensing (e.g. Hagopian, 2004; Templin, 2005), we are aware of no direct challenge against this rationale.

examples to explain the rationale behind ESO expensing, we examine the functions of ESO granting and their implications to ESO expensing in a formal model where agents' interactive behaviors are explicitly considered. The examination sheds some new light to the issue of ESO expensing.

In the next section three functions of ESO granting are examined; their implications to ESO expensing discussed. First, ESO granting can have an expense-postponing function through reducing current cash compensation expenses yet increasing expected future expenses. The main rationale for ESO expensing is to avoid letting such expense postponement misleadingly inflate the grantor's current earnings. Second, ESO granting can have a risk-sharing function through tying the grantor's compensation expenses to its earnings. This function poses a fundamental difficulty for option pricing models to provide an unbiased estimate of the fair value of ESOs. Third, ESO granting can have an employee-stimulating function through the tie between the value of ESOs and the grantor's performance, which gives the grantee an incentive to improve the performance. This function makes ESO expensing unjustified in principle.

We conclude the paper in section 3 with a summarizing discussion and a suggestion that may be able to achieve the goal of ESO expensing without its disturbing side effects.

## 2. Three functions of ESO granting and ESO expensing

In this section we formally examine three potential functions of ESO granting and discuss their implications to the issue of ESO expensing.

Four scenarios are examined under a basic model setup. The first one is a benchmark scenario in which the company simply uses cash for employee compensation. In the second scenario, the company uses a compensation package comprising both cash and ESOs that are not expensed. We use this scenario to show ESO's expense-postponing function, which provides a rationale for ESO expensing. In the third scenario the company also uses ESOs for compensation yet expenses them. We use this scenario to show ESO's risk-sharing function, which poses a technical difficulty for ESO expensing based on option price models. In the last scenario, we examine ESO granting as an employee-incentive mechanism, which provides a case against ESO expensing in principle.

**Scenario I: cash only**

Suppose that period zero is a crucial development stage for a new start company who, from period zero onwards, could either become a star company (with a high-type earning $E^h$) or a lackluster one (with a low-type earning $E^l < E^h$). The probabilities for the high and low states are $\overline{p}$ and $1-\overline{p}$ respectively. Thus, the expected future earnings are

$$E_t^e = \overline{p}E^h + (1-\overline{p})E^l;\ t \geq 1. \tag{1}$$

The company's period-zero earning is equal to period-zero revenue $\overline{Y}$ minus employee compensation expense in the period. Since the company has to pay no less than employee's reservation wage $\overline{W}$ yet has no incentives to pay more than that, the period-zero compensation expense would be equal to $\overline{W}$. Thus, the period-zero earning is

$$E_0 = \overline{Y} - \overline{W}. \tag{2}$$

Earnings are completely distributed to shareholders as dividends in the period when they are realized. The number of shares is normalized to unity for simplicity.

The stock market is efficient; investors are risk-neutral. Therefore, the share price in period zero is equal to the present discount value of (expected) future earnings (Gordon, 1962); i.e.,

$$q_0 = \frac{E_0}{1+r} + \sum_{i=1}^{\infty} \frac{E_i^e}{(1+r)^{1+i}} , \tag{3}$$

where $r$ is the market interest rate.

Substituting equations (1) and (2) into (3) we obtain the period-zero share price

$$q_0 = \frac{\overline{Y} - \overline{W}}{1+r} + \frac{\overline{p}E^h + (1-\overline{p})E^l}{r(1+r)} = \left[r(\overline{Y} - \overline{W}) + \overline{p}E^h + (1-\overline{p})E^l\right]\left[r(1+r)\right]^{-1} . \tag{4}$$

Depending on whether future earnings are high-type or low-type, the period-one share price could be a high-type

$$q_1^h = \sum_{i=0}^{\infty} \frac{E^h}{(1+r)^{1+i}} = \frac{E^h}{r} , \tag{5}$$

or a low-type

$$q_1^l = \sum_{i=0}^{\infty} \frac{E^l}{(1+r)^{1+i}} = \frac{E^l}{r} . \tag{6}$$

Thus, the expected period-one share price is

$$q_1^e = \overline{p}q_1^h + (1-\overline{p})q_1^l = \frac{\overline{p}E^h + (1-\overline{p})E^l}{r} . \tag{7}$$

This benchmark, cash-only scenario is summarized as follows.

**Remark 1.1** *When only cash is used, the period-zero compensation expense is* $\overline{W}$ *; and there is no extra compensation expense in period one. The period-zero earning and share price are* $\overline{Y} - \overline{W}$ *and* $\left[r(\overline{Y} - \overline{W}) + \overline{p}E^h + (1-\overline{p})E^l\right]\left[r(1+r)\right]^{-1}$ *respectively. The high-type,* *low-type, and expected earnings in period one are* $E^h$, $E^l$, *and* $\overline{p}E^h + (1-\overline{p})E^l$ *respectively. The high-type, low-type, and expected share prices in period one are, respectively,* $E^h / r$, $E^l / r$, *and* $\left[\overline{p}E^h + (1-\overline{p})E^l\right]r^{-1}$.

**Scenario II: ESOs without expensing**

Although the company is not able to purchase employee services with compensation less valuable than the reservation wage $\overline{W}$, it can pay the employee less cash in period zero, yet grant her ESOs with equivalent value. In other words, the employee is willing to accept a compensation package $(\overline{C}, m)$ comprising $\overline{C}(<\overline{W})$ amount of cash paid in period zero and *m* unit of ESOs worth no less than the current cash shortage $\overline{W} - \overline{C}$.

*The ESOs' value*

One unit of the ESOs granted in period zero gives the employee an option to purchase one unit of the company's stock in period one at the period-zero share price $q_0$. Should the period-one share price be the high-type $q_1^h$, the ESOs will expire in the money (i.e. $q_1^h > q_0$) with the total intrinsic value worth $m(q_1^h - q_0)$; and the company will redeem them with lump-sum cash.[2] If the period-one share price turns out to be the low-type $q_1^l(< q_0)$, the ESOs will expire with no positive intrinsic value and cost the company nothing. Thus, with the high-type probability being $\overline{p}$, the ESOs' expected present value is

[2] Instead of lump-sum cash, the company can also use stocks to buy back in-the-money ESOs, which essentially settles the ESO liability with a stream of future earnings represented by the stocks. Since the (expected) present value of these future earnings is equal to the lump-sum cash, these two ways of settling ESOs-induced liabilities are not effectively different in the model here.

$$V = \frac{\bar{p}m(q_1^h - q_0)}{1+r}. \tag{8}$$

Accordingly, the present value of the ESO package $(\overline{C}, m)$ is

$$W = \overline{C} + V . \tag{9}$$

Since both the employee and the company are risk neutral, the employee would not accept a ESO package whose expected present value is less than the reservation wage $\overline{W}$; whereas the company would not offer a ESO package with expected present value greater than $\overline{W}$. Therefore, a necessary condition for $(\overline{C}, m)$ to be used is

$$W = \overline{W} ,$$

which, according to equations (8) and (9), implies

$$V = \frac{\bar{p}m(q_1^h - q_0)}{1+r} = \overline{W} - \overline{C} ; \tag{10}$$

i.e., the value of the ESOs ($V$) is equal to the current cash compensation expense saved ($\overline{W} - \overline{C}$). In summary,

**Remark 2.1** *Given the company's performance, ESO granting, if NOT expensed, has a financing function to postpone current expenses to the future.*

*Period-one earning and share price*

The ESOs granted in period zero would incur an extra expense $m(q_1^h - q_0)$ in period one should the future turn out to be high-type, yet would cost the company nothing for a low-type future. Thus, under the ESO package $(\overline{C}, m)$, the high-type, low-type, and expected earnings in period one are, respectively,

$$E_1^h = E^h - m(q_1^h - q_0)\,, \tag{11}$$

$$E_1^l = E^l\,, \tag{12}$$

and

$$E_1^e = \bar{p}E_1^h + (1-\bar{p})E_1^l = \bar{p}E^h + (1-\bar{p})E^l - \bar{p}m(q_1^h - q_0)\,. \tag{13}$$

Accordingly, the high-type, low-type, and expected share prices in period one are, respectively,

$$q_1^h = \frac{E^h - m(q_1^h - q_0)}{(1+r)} + \sum_{i=1}^{\infty}\frac{E^h}{(1+r)^{1+i}} = \frac{E^h}{r} - \frac{m(q_1^h - q_0)}{1+r}\,, \tag{14}$$

$$q_1^l = \sum_{i=0}^{\infty}\frac{E^l}{(1+r)^{1+i}} = \frac{E^l}{r}\,, \tag{15}$$

and

$$q_1^e = \bar{p}q_1^h + (1-\bar{p})q_1^l = \frac{\bar{p}E^h + (1-\bar{p})E^l}{r} - \frac{\bar{p}m(q_1^h - q_0)}{1+r}\,. \tag{16}$$

A comparison between equations (11)-(16) here and equations (1)-(7) in Scenario I gives the following result.

**Remark 2.2** *Given the company's performance, ESO granting, if NOT expensed, has <u>negative</u> impacts on the high-type earning and share price in period one, has <u>no</u> impacts on the low-type earning and share price in period one, and has <u>negative</u> impacts on the expected earning and share price in period one.*

Intuitively, ESOs' expense-postponing function effectively shifts part of the period-one earning to period zero, which tends to have a negative impact on the share price in period one.

*Period-zero earning and share price*

Under the ESO package $(\overline{C}, m)$, the period-zero earning is

$$E_0 = \overline{Y} - \overline{C} \,. \tag{17}$$

According to equation (3), the period-zero share price is

$$q_0 = \frac{E_0 + q_1^e}{1+r} \,. \tag{18}$$

Substituting equations (16) and (17) into (18) we obtain

$$q_0 = \frac{\overline{Y} - \overline{C}}{1+r} + \frac{\overline{p}E^h + (1-\overline{p})E^l}{r(1+r)} - \frac{\overline{p}m(q_1^h - q_0)}{(1+r)^2} \,,$$

which, through substituting in equation (10), can be reduced to

$$q_0 = \frac{\overline{Y} - \overline{W}}{1+r} + \frac{\overline{p}E^h + (1-\overline{p})E^l}{r(1+r)} \,. \tag{19}$$

Comparing equations (17) and (19) here with (2) and (4) in Scenario I respectively we have the following result.

**Remark 2.3** *Given the company's performance, ESO granting, if NOT expensed, has a* *positive* *impact on the period-zero earning yet have* *no* *impact on the period-zero share price.*

Intuitively, since the ESO granting here is merely an earning-advancing process that would not alter the present value of the grantor's total earnings over time, it has no impact on the current share price.

*The "fair" price (value) of the ESOs*

According to equation (10), the (unit) price $P$ of the period-zero ESOs is

$$P = V / m = \frac{\bar{p}(q_1^h - q_0)}{1+r}. \tag{20}$$

We will show that this ESO price coincides with the "fair" price based on an option pricing model.

Based on a simplified option pricing approach in the Black-Sholes spirit (Cox et al., 1979), the fair price $P$ of the period-zero ESO can be determined by the following simultaneous equations

$$q_0 S = D + P, \tag{21}$$

$$(q_1^h + E_0)S = q_1^h - q_0 + D(1+r), \tag{22}$$

$$(q_1^l + E_0)S = D(1+r), \tag{23}$$

which guarantee that one unit of the ESOs (granted in period zero) can be hedged by a certain amount of the underlying stock (denoted as $S$). Equation (21) means that the purchase of $S$ can be financed by $D$ amount of borrowed cash in addition to the premium proceeds from issuing one unit of the ESOs at its fair price $P$. Equation (22) means that should the period-one share price be the high-type $q_1^h$, the principal and earnings of the stock $S$ (represented by the left-hand side ) should be sufficient to cover the total costs for settling the ESO-induced liability and repaying the debt incurred for the hedging (represented respectively by $q_1^h - q_0$ and $D(1+r)$ on the right-hand side). Equation (23) represents a similar relationship for the situation of the period-one share price being the low-type $q_1^l$.

Solving equations (21)-(23) simultaneously we obtain the ESO's fair price[3]

$$P = \frac{(q_1^h - q_0)[(1+r)q_0 - q_1^l - E_0]}{(q_1^h - q_1^l)(1+r)}. \tag{24}$$

According to equations (18) and (16),

$$q_0 = \frac{E_0 + q_1^e}{1+r} = \frac{E_0 + \overline{p}q_1^h + (1-\overline{p})q_1^l}{1+r}, \tag{25}$$

which can be rearranged into

$$\frac{(1+r)q_0 - q_1^l - E_0}{\overline{p}(q_1^h - q_1^l)} = 1.$$

Substituting this equation into (24) we obtain

$$P = \frac{\overline{p}(q_1^h - q_0)}{1+r}. \tag{26}$$

A comparison between this equation and equation (20) gives the following result.

**Remark 2.4** *In the model here, the Black-Sholes ESO price is identical to the equilibrium ESO price that balances the ESO supply (by the company) and demand (from the employee).*

*Expense postponing and ESO expensing*

The ESO package $(\overline{C}, m)$ is effectively a combination of paying the reservation wage $\overline{W}$ in cash and at the same time selling the employee ESOs worth $\overline{W} - \overline{C}$. Thus, the

[3] The mathematical details are shown in Appendix.

ESO-induced extra cash in period zero can be viewed as (implicit) premium proceeds from issuing the ESOs.

However, it is unjustified to account such premium proceeds as the company's earning, since the proceeds essentially comes from "earning advancement" due to the ESO's expense-postponing function. In other words, the current shareholders do not really own such proceeds that correspond to contingent future liabilities of equivalent value.

Remark 2.3 implies that however accounted, the earning advancement, if rationally understood, would not inflate the current share price. However, if investors misinterpret the advanced "earnings" as a sign of good performance, the current share price could be unduly inflated. ESO expensing is thus recommended to avoid such situations.[4]

In sum,

**Remark 2.5** *As far as the expense-postponing function is concerned, ESO expensing is justified in principle and useful in practice.*

**Scenario III: ESO with expensing**

In this scenario we assume that the company uses an ESO package $(\overline{C}, m)$ yet expenses the ESO value $V$ by treating it as provision for contingent future liabilities.

*Period-one earning and share price*

Under this situation the company's high-type earning in period one would be

[4] In the model here, if the company expenses the value of the ESOs by treating it not as earning but as option holders' equity or provision for potential ESO-induced future expenses, it would have an (expected) earning pattern identical to the cash-only case; then the share price inflation can be avoided.

$$E_1^h = E^h + (1+r)V - m(q_1^h - q_0)\,, \tag{27}$$

where the first term on the right-hand side is the normal high-type earning; the second term represents the value of the ESO provision in period one; and the third term represents the cost for redeeming the in-the-money ESOs.

Substituting equation (10) into (27) gives

$$E_1^h = E^h - \frac{(1-\overline{p})(1+r)V}{\overline{p}}\,. \tag{28}$$

With no liability with respect to the ESOs granted in period zero, the low-type earning in period one would be

$$E_1^l = E^l + (1+r)V\,. \tag{29}$$

Thus, according to equations (28) and (29), the expected period-one earning is

$$E_1^e = \overline{p}E_1^h + (1-\overline{p})E_1^l = \overline{p}E^h + (1-\overline{p})E^l\,, \tag{30}$$

which is the same as the cash-only case indicated by equation (1).

According to equations (28) and (29), the high-type and low-type share price in period one are, respectively,

$$q_1^h = \frac{E_1^h}{1+r} + \sum_{i=1}^{\infty} \frac{E^h}{(1+r)^{1+i}} = \frac{E^h}{r} - \frac{(1-\overline{p})V}{\overline{p}} \tag{31}$$

and

$$q_1^l = \frac{E_1^l}{1+r} + \sum_{i=1}^{\infty} \frac{E^l}{(1+r)^{1+i}} = \frac{E^l}{r} + V\,. \tag{32}$$

Accordingly, the expected period-one share price is

$$q_1^e = \overline{p}q_1^h + (1-\overline{p})q_1^l = \frac{\overline{p}E^h + (1-\overline{p})E^l}{r}\,. \tag{33}$$

A comparison between equations (28)-(33) here and (1)-(7) in Scenario I gives the following result.

**Remark 3.1** *Given the company's performance, ESO granting, if expensed, would have* *no* *impacts on the expected earning or share price in period one. However, it would have* *negative* *impacts on the period-one high-type earning and share price, yet* *positive* *impacts on the period-one low-type earning and share price.*

*Period-zero earning and share price*

The period-zero earning is not affected by the ESOs that are expensed; thus,

$$E_0 = \overline{Y} - \overline{W} \ . \tag{34}$$

Therefore, according to equation (33), the period-zero share price is

$$q_0 = \frac{E_0 + q_1^e}{1+r} = \frac{\overline{Y} - \overline{W}}{1+r} + \frac{\overline{p}E^h + (1-\overline{p})E^l}{r(1+r)} \ . \tag{35}$$

Comparing equations (34) and (35) with (2) and (4) respectively we have the following result.

**Remark 3.2** *Given the company's performance, ESO granting, if expensed, would affect* *neither* *the earning* *nor* *the share price in period zero.*

*Risk-sharing and ESO expensing*

Remark 3.1 and 3.2 show that ESO expensing helps correct the earning advancement effect caused by the expense-postponing function of ESO granting.

However, although an expensed ESO granting would not affect the mean of the period-one share price, it would have an impact on its variance—as compared to the cash-only case, the expensed ESO granting lowers the high-type $q_1^h$ while raises the low-type $q_1^l$ (Remark 3.1).

This variance-reducing impact reflects the risk-sharing function of ESO granting. ESO granting is a process not only postponing current expenses but also replacing current *certain* expenses with future *state-contingent* expenses. Since the value of ESOs tends to be positively correlated with the grantor's earnings, this replacement would effectively let the grantee share part of the risk of the grantor's earnings.

While the risk-sharing function of ESO granting has been recognized (Guay et al., 2003), we would like to point out the difficulty it poses against ESO expensing.

According to equation (26), the estimation of the fair price *P* (and accordingly the fair value *V*) of ESO requires information about $q_1^h$ and $q_1^l$. However, according to equations (31) and (32), the value of $q_1^h$ and $q_1^l$ depends on $V$, which is the subject intended to be estimated in the first place. In general,

**Remark 3.3** *Since the value of ESOs has an impact on the volatility of the underlying share price (through the risk-sharing function), option pricing models, which relies on the volatility of share price to estimate the value of stock options, are NOT able to provide unbiased estimation,*[5] *because the Catch-22 here is that the ESO impact on share price volatility depends on the value of ESOs.*

[5] Option pricing models that do not take into account the volatility-reducing impact of ESOs tend to systematically overestimate the value of ESOs.

**Scenario IV: ESO granting as an employee incentive mechanism**

Since the value of ESOs depends on the grantor's earnings, ESO grantees have incentives to exert extra effort (than non-grantees) to improve the grantor's performance. In other words, ESO granting, through tying the grantee's compensation to the grantor's earnings, can have an employee-stimulating function.

To capture this function, we modify the above model by assuming that the probability for the high-type future depends on the employee's effort in such a way that

$$p(X) = \frac{X + \bar{p} - 1}{X} , \tag{36}$$

where $X \in [1, \infty)$ measures the employee's effort in period zero.

Suppose that once hired, the employee has to exert no less than the normal effort $\bar{X} = 1$, which, according to equation (36), would lead to the normal high-type probability $p(\bar{X}) = \bar{p}$.

The employee can choose to exert extra effort $X > \bar{X}$, which, according to equation (36), would have a positive yet diminishing impact on the high-type probability; i.e., $\partial p / \partial X > 0$ and $\partial^2 p / \partial X^2 < 0$.

With the employee-stimulating function, ESOs, notwithstanding valuable, can be costless to the grantor. We show this in the following.

Suppose that the company must pay no less than the reservation wage $\bar{W}$; thus it has no incentives to use ESOs for postponing the current compensation expense. However, ESOs may still be used for its employee-stimulating function.

Under a period-zero ESO package $(\bar{W}, m)$, we first analyze how the employee would react to the ESOs granted and how the company would take into account the employee's reaction in determining the amount of ESOs to grant. Then we examine the aftermath of this ESO incentive mechanism for insights about whether ESOs should be expensed or not.

*The employee's problem*

The compensation package $(\overline{W}, m)$ pays cash $\overline{W}$ in period zero, and has a probability of $p(X)$ to provide $m(q_1^h - q_0)$ more cash in period one if the company is successful. Thus, the expected present value of the employee's period-zero compensation is

$$W^e = \overline{W} + \frac{p(X)m(q_1^h - q_0)}{1+r}. \tag{37}$$

That $\partial p / \partial X > 0$ implies $\partial W^e / \partial X > 0$, which means the employee has incentives to exert extra effort to increase the value of her compensation package. However, since effort incurs disutility, the employee would choose an optimal effort level that balances between the value-added and the disutility. Specifically, the employee's (expected) utility maximization problem is

$$\underset{X}{Max}\, U^e = W^e - \beta \log(X) = \overline{W} + \frac{p(X)m(q_1^h - q_0)}{1+r} - \beta \log(X),$$

where $\beta \log(X)$ measures the disutility from effort *X*; $\beta$ is a parameter measuring the employee's effort-aversion.

Substituting equation (36) into $U^e$ and solving for the first order condition we obtain

$$\frac{\partial U^e}{\partial X} = \frac{(1-\overline{p})m(q_1^h - q_0)}{(1+r)X^2} - \frac{\beta}{X} = 0,$$

which, after rearrangement, gives

$$X = \frac{(1-\overline{p})m(q_1^h - q_0)}{\beta(1+r)}. \tag{38}$$

This equation describes the employee's effort reaction to the amount of ESOs granted; $\partial X / \partial m > 0$ implies that *ceteris paribus*, the more the ESOs are granted, the higher the effort will be.

*The company's problem*

Under the ESO package $(\overline{W}, m)$, the company's (expected) earnings in period zero, period one, and period two onwards are, respectively,

$$E_0 = \overline{Y} - \overline{W},$$

$$E_1^e = p(X)E^h + [1 - p(X)]E^l - p(X)m(q_1^h - q_0),$$

and

$$E_{t\geq 2}^e = p(X)E^h + [1 - p(X)]E^l.$$

Thus, the present discount value of total current and future earnings is

$$E^e = E_0 + \frac{E_1^e}{1+r} + \sum_{i=1}^{\infty} \frac{E_{t\geq 2}^e}{(1+r)^{1+i}} = \overline{Y} - \overline{W} + \frac{p(X)E^h + [1-p(X)]E^l}{r} - \frac{p(X)m(q_1^h - q_0)}{1+r}.$$

The company's problem is to choose an optimal *m* to maximize $E^e$. Suppose that the company takes into consideration the employee's reaction function (38) when making the decision; then the company's maximization problem is

$$\underset{m}{Max}\, E^e = \overline{Y} - \overline{W} + \frac{p(X)E^h + [1-p(X)]E^l}{r} - \frac{p(X)m(q_1^h - q_0)}{1+r},$$

subject to equation (38).

Solving this maximization problem we obtain[6]

$$m^* = \frac{\beta(1+r)}{q_1^h - q_0}\left(\frac{E^h - E^l}{\beta r}\right)^{\frac{1}{2}}, \tag{39}$$

$$X^* = (1-\overline{p})\left(\frac{E^h - E^l}{\beta r}\right)^{\frac{1}{2}}, \tag{40}$$

and

$$p^* = p(X^*) = 1 - \left(\frac{E^h - E^l}{\beta r}\right)^{-\frac{1}{2}}, \tag{41}$$

where $m^*$ is the optimal amount of ESOs to grant; $X^*$ is the optimal effort level under $m^*$; and $p^*$ is the high-type probability under $X^*$.

Only when the ESO granting has a positive impact on the present value of the company's earnings will the company have incentives to use the ESO package. Thus, a condition for the ESO package to be used is

$$\overline{Y} - \overline{W} + \frac{p^* E^h + [1-p^*]E^l}{r} - \frac{p^* m^* (q_1^h - q_0)}{1+r} > \overline{Y} - \overline{W} + \frac{\overline{p}E^h + (1-\overline{p})E^l}{r} \tag{42}$$

where the left and right-hand sides represent, respectively, the present value of earnings with the ESO granting and without.

As shown in the Appendix, inequality (42) can be reduced to

$$(1-\sqrt{\overline{p}})^2 (E^h - E^l) > r\beta, \tag{43}$$

which, according to equation (40), implies

$$X^* > \frac{1-\overline{p}}{1-\sqrt{\overline{p}}} > 1. \tag{44}$$

Inequalities (43) and (44) imply the following.

[6] Mathematical details are provided in Appendix.

**Remark 4.1** *When the employee's effort-aversion (i.e.,* $\beta$ *) is not too large; and/or when the difference between the high-type and low-type earnings (i.e.* $E^h - E^l$ *) is large enough, ESO granting can induce the employee's extra effort that benefits both the company (with higher expected earning) and the employee (with valuable ESOs).*[7]

*Employee stimulating and ESO expensing*

Similar to Scenario II the company here also gives away valuable ESOs in period zero. However, is ESO expensing as justified here as it is in Scenario II? The answer is negative.

ESO expensing is not justified in this scenario because the ESOs, notwithstanding valuable, are costless to the grantor. In fact, we have shown that the ESO granted in period zero for free could actually have a positive impact on the present value of expected future earnings. This is because ESO granting with the employee-stimulating function is a value-added process that would generate extra earnings in the future, which would not only be able to cover the potential "costs" induced by the ESOs but could also benefit the grantor.

In general, although ESOs used as an employee-incentive mechanism are a potential expense to the grantor's *ex post* future earnings, they would not reduce but could rather increase the grantor's *preexisting* future earnings. In other words, the potential *ex post* "expenses" induced by ESO granting are actually, from the *ex ante* point of view, the

[7] The fact that the employee willingly chooses to exert above-normal effort implies that the ESOs are worth no less than the disutility from the extra effort.

employee's share of the *extra* future earnings created by ESOs' employee-stimulating function.

In the above we assume that the company must pay the reservation wage $\overline{W}$ . Without this restriction, the company can pay less cash than $\overline{W}$ in period zero and still satisfy the employee with the valuable ESOs.[8] Thus, similar to Scenario II, the ESO granting here can also reduce the cash compensation expense in period zero. Or from another perspective, rather than granting the ESOs for free, the company can sell them to the employee for positive premiums. Should such compensation costs "saved" by the ESO granting be recognized and expensed against the period-zero earning? In other words, should the premium proceeds from the ESO issuance here be treated as non-income? The answer is also no.

The period-zero compensation saved by the ESO granting in Scenario II should be expensed because it is expense postponement that corresponds to an expected extra expense in period one. Whereas, the period-zero compensation saved here is not expected to incur future expenses and hence should not be expensed. From another perspective, the premium proceeds from the period-zero ESO issuance in Scenario II is not an income because it corresponds to a potential liability in period one. Whereas, the premium proceeds here is associated with no such corresponding liabilities; rather, it represents a rent that the company extracts from the employee's share of the extra earning created by the ESO granting—after all, the company would be willing to grant the ESOs for free.

To sum up,

[8] The employee would tolerate lower current cash compensation as long as the reduction does not outweigh the benefit she obtains from the ESO granting.

**Remark 4.2** *When ESOs are used as an incentive mechanism, expensing them at the grant date is not justified in principle and would unduly deflate the earning at the grant date.*

### 3. Discussion and conclusion

When stock options are granted to an outsider (say Warren Buffett), they should be expensed because they represent the grantor's contingent future expenses. Or more realistically, when stock options are sold to an outsider, the premium proceeds should not be added to the current earning because they are associated with potential future expenses of equivalent value. Similarly, if ESOs have no impacts on the grantor's performance, expensing them is justified in principle because ESOs' financing function merely helps postpone current compensation expenses to the future.

However, ESO granting, as an employee incentive mechanism, is likely to have positive impacts on the grantor's long-term performance.[9] We have shown that the company would be willing to grant ESOs for free when ESOs' employee-stimulating function is expected to generate extra earnings in the future that could not only cover the "costs" of the ESOs but also benefit the grantor. Such ESOs, notwithstanding being an *ex post* expense, are actually costless to the grantor in that they do not reduce but would rather increase the grantor's preexisting earnings. Incentive ESO granting can also save the grantor's current cash compensation; yet this is not expense postponement but represents a rent that the grantor can extract from the grantee by using its bargaining

[9] The quality of current employee services can have positive impacts on the company's long-term performance through R&D, know-how, franchise value, enterprise culture, and so on. Such impacts tend to be more important for new start companies.

advantage,[10] or from the grantee's point of view, a fee she is willing to pay to take part in ESO granting as a win-win value-added process.

Therefore, ESO expensing is not justified in principle for incentive ESO granting. The only justification we can think of for expensing incentive ESOs is that the potential expenses they represent are incurred (albeit not realized yet) at the grant date. However, following the same logic, incentive ESOs' potential positive impacts on future earnings should also be evaluated and "earned" at the grant date, which could further "inflate" the current earning since this process would shift the positive net benefit (generated by the ESO granting and realized in the future) to the present.

In practice, mandatory ESO expensing tends to deter incentive ESO granting. Incentive ESOs are used to improve the grantor's long-term performance through the ESOs' employee-stimulating function. A company may be willing to grant incentive ESOs for free even though they do not help reduce its current compensation expense. Even when incentive ESOs do help reduce the grantor's current compensation expenses, their value tends to exceed the current expenses saved because grantees are not likely to exert extra effort for nothing. Yet, both the benefits and costs of incentive ESOs are supposed to be realized in the future; and they are indeed. Mandatory ESO expensing, nevertheless, would force the grantor to expense these future costs at present, which would unduly deflate the current earning and hence deter the use of incentive ESO granting.

ESO expensing based on option pricing models would also discourage the use of ESO granting for expense-postponing or other financial purposes, which may be important for

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[10] This advantage exists because not all the companies can use ESO granting as an incentive mechanism—recall Remark 4.1 for the conditions for incentive ESO granting being used.

(new start) companies to whom cash is precious. This is because option price models that do not consider the volatility-reducing impact of ESO granting (through the risk-sharing function) tend to overestimate the value of ESOs. However, it is not possible for option pricing models to take into account such impacts because the magnitude of ESOs' volatility-reducing impacts depend on the value of ESOs, which is the subject intended to be estimated in the first place.

If it is essential to report the normal operating earnings in the income statement to avoid misleading investors, we suggest that the proper amount to be expensed is not the value of ESOs but the amount that the grantee's current cash compensation falls short of her reservation wage. In principle, this reservation-wage-expensing method would properly reflect the grantor's current operating earnings and avoid the earning-deflating impacts of ESO expensing.[11] In practice, an ESO grantee' reservation wage can be proxied by the cash compensation of an equivalent non-grantee in the labor market.

In conclusion, the rationale for ESO expensing does not pass our examination from an economics perspective based on a parsimonious model, neither in principle nor in practice. Thus, the justification for mandatory ESO expensing in the more complex real world is questionable.

[11]Since the value of ESOs depends on future share prices and hence future earnings, ESO granting is not an appropriate incentive mechanism for the sake of increasing current earnings. Although incentive ESO granting intended for the improvement of long-term performance could have a positive impact on the grant-date earning, it represents a "windfall" benefit that need not be deducted from the earning.

## Appendix

*Derivations of equation (24)*

Substituting equation (23) into (22) to eliminate $D(1+r)$ we obtain,

$$S = \frac{q_1^h - q_0}{q_1^h - q_1^l},$$

which, substituted in equation (22), gives,

$$D = \frac{(q_1^l + E_0)(q_1^h - q_0)}{(q_1^h - q_1^l)(1+r)}.$$

Substituting S and D into equation (21) to solve for *P* we obtain equation (24).

*Derivations of equations (39)-(41)*

The maximization problem is

$$\underset{m}{Max}\, E^e = \overline{Y} - \overline{W} + \frac{p(X)E^h + [1-p(X)]E^l}{r} - \frac{p(X)m(q_1^h - q_0)}{1+r},$$

subject to

$$X = \frac{(1-\overline{p})m(q_1^h - q_0)}{\beta(1+r)}. \qquad (38)$$

Substituting equation (38) into the objective function we obtain

$$\underset{X}{Max}\, E^e = \overline{Y} - \overline{W} + \frac{p(X)E^h + [1-p(X)]E^l}{r} - \frac{p(X)\beta X}{1-\overline{p}},$$

which is equivalent to the original maximization problem (since X and m, according to equation (38), has one-to-one correspondence) but more convenient to solve.

Substituting the $p(X)$ in equation (36) into the objection function and solving for the first order condition, we obtain

$$\frac{\partial E^e}{\partial X} = \frac{(1-\overline{p})(E^h - E^l)}{rX^2} - \frac{\beta}{1-\overline{p}},$$

which, after rearrangement, gives equation (40).

Substituting equation (40) into (38) and (36) to solve for *m* and *p(X)* respectively we obtain equations (39) and (41).

*Derivations of inequality (43)*

Recall inequality (42)

$$\overline{Y} - \overline{W} + \frac{p^* E^h + \left[1-p^*\right]E^l}{r} - \frac{p^* m^* (q_1^h - q_0)}{1+r} > \overline{Y} - \overline{W} + \frac{\overline{p}E^h + (1-\overline{p})E^l}{r}, \tag{42}$$

which can be reduced to

$$p^*\left[\frac{(E^h - E^l)}{r} - \frac{m^*(q_1^h - q_0)}{1+r}\right] > \frac{\overline{p}(E^h - E^l)}{r}$$

Using equations (39) and (41) to substitute $p^*$ and $m^*$ into this inequality we obtain

$$\left[1 - \left(\frac{E^h - E^l}{\beta r}\right)^{-\frac{1}{2}}\right]\left[\frac{(E^h - E^l)}{\beta r} - \left(\frac{E^h - E^l}{\beta r}\right)^{\frac{1}{2}}\right] > \frac{\overline{p}(E^h - E^l)}{\beta r},$$

which can be reduced to

$$\frac{(E^h - E^l)}{\beta r} - 2\left(\frac{E^h - E^l}{\beta r}\right)^{\frac{1}{2}} + 1 > \frac{\overline{p}(E^h - E^l)}{\beta r},$$

which can be rearranged into

$$\left[1 - \left(\frac{E^h - E^l}{\beta r}\right)^{-\frac{1}{2}}\right]^2 > \overline{p},$$

which gives inequality (43).

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