

## **What's Wrong with Expensing Employee Stock Options?** **By Charles W. Calomiris**

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**AEI scholar and Columbia Business School professor Charles Calomiris proposes that instead of treating employee stock options as an expense in computing their earnings—as required beginning next year by the Financial Accounting Standards Board—companies would better serve their investors by offering a constantly updated calculation of earnings per share. Such a calculation should take into account an estimate of the number of share options granted to employees that are expected to be converted into shares in the future.**

Partly in reaction to recent corporate scandals, public officials and others have urged the Financial Accounting Standards Board (FASB) to require that companies place a value on the stock options they grant to employees and treat that value as an expense in computing their earnings. The FASB has responded with a commitment to impose this requirement for financial statements beginning next year.

However, according to AEI scholar Calomiris, the FASB proposal for expensing is misguided. It is based on a fundamental conceptual misunderstanding of the costs and benefits of employee stock options. Furthermore, because there is no accepted method for establishing the value of employee stock options, which are long-term contracts with many variables and contingencies, the FASB proposal underestimates the difficulties of measurement that the proposed expensing entails. Calomiris's study, *"What's Wrong with Expensing Employee Stock Options?"*, explains the errors in the FASB approach, clarifies the circumstances in which employee stock options create or do not create costs and benefits for firms and issuers, and proposes an alternative accounting reform that would better accomplish FASB's disclosure objectives.

Employee stock options are not an expense of the issuing firm, although their issuance creates gross costs and gross benefits to the preexisting shareholders of issuing firms. From the standpoint of *managerial* accounting, management should weigh the costs and benefits to its shareholders when deciding whether to grant stock options to employees. Calomiris points out that on average, the net benefits of employee stock options should, and apparently do, outweigh their costs, especially after one takes account of incentive and tax considerations often ignored by advocates of expensing. Because benefits typically exceed costs, these stock options do not typically entail "opportunity costs" for firms.

If the intent of proposed expensing under Generally Accepted Accounting Principles (GAAP) is to incorporate appropriate managerial accounting into financial accounts, then it would be improper, and misleading to investors, to include in earnings reports only the expected gross costs of employee stock options but not their expected gross benefits. Furthermore, Calomiris demonstrates that expensing these stock options creates the undesirable consequence of double counting their costs.

Aside from these fundamental conceptual problems, there are multiple and substantial measurement problems associated with gauging even the *gross* costs of employee stock options. Calomiris demonstrates that while marketable options have an observable value, illiquid and heavily constrained employee stock options have a highly uncertain value, and no comprehensive model to date has emerged that provides an adequate and empirically verified guide to employee stock option values.

FASB has attempted to sidestep the valuation problem by granting firms discretion to choose their own valuation model. However, allowing firms to exercise discretion in creating economic models to determine the costs of employee stock options will undermine the credibility, consistency, and comparability of firms' accounts. Furthermore, modeling discretion is of dubious value; under existing knowledge, there simply is no agreed-upon answer or approach to finding an answer to many of these daunting measurement problems.

In light of the conceptual and measurement problems associated with the expensing of employee stock options, expensing is not a desirable policy. The legitimate goal that motivates advocates of expensing—to ensure that unsophisticated investors understand the possible impact that employee stock options could have on share values—would be better achieved by an alternative approach.

It would be better to require that firms estimate on an ongoing basis the cost of the number of options granted to employees that are expected to be converted into actual shares in the future, and include those estimates in a constantly updated calculation of earnings per share. That statistic could be given a prominent place in the public reports of the firm, and would be available as an important source of information for investors.

The computation of expected dilution (the estimate of the number of shares that are expected to be issued for options exercised in the future) would, of course, be subject to the same measurement problems noted above. But the *consequences* of those errors would not be the same.

- First, there would not be double counting of these employee stock option costs.
- Second, there would not be any potential for confusion on the part of investors about the actual expenses of the firm.
- Third, avoiding expensing would eliminate the incorporation of unreliable and misleading measures of “cost” in the companies' earnings.
- Fourth, the costs of expected converted employee stock options could be updated on an ongoing basis, so that changes in stock prices and volatility could be reflected in later analyses.

This forward-looking approach would allow stockholders to take account of dilution before it occurs (an improvement on the current system of measuring earnings per share) and would provide a more accurate measure of future dilution than expensing.

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## **1. Introduction**

The Federal Accounting Standards Board (FASB) has concluded that employee stock options (ESOs) should be expensed by firms that issue options to their employees, and without further action by the SEC or Congress, ESOs will be expensed beginning next year. The debate over the expensing of employee stock options (ESOs) has been intense in recent years. The two central questions of this debate – namely, whether employee stock options should be expensed in the issuing firm's GAAP accounts, and if so, which quantitative model should be used for that purpose – remain hotly contested. In this essay, I show (in Sections 2-6) that advocates of expensing make a variety of conceptual errors about the incidence of costs associated with the granting of employee stock options. When the arguments for expensing are considered carefully, it is clear that there is no legitimate basis for the proposed expensing of employee stock options. In Sections 7-10, I also examine the problems of measurement of the costs associated with employee stock options, which have been severely underestimated by proponents of expensing. Section 11 concludes with an alternative proposal for achieving the legitimate disclosure objectives of the advocates of expensing, while avoiding the errors and distortions that the expensing of ESOs would create.

## **2. Is the grant of ESOs a cost to the firm that grants them?**

No, neither the granting nor the exercising of stock options results in any gross or net costs to the firm, using the definition of cost employed by financial economists. The granting of employee stock options is not a cost to the firm because it does not reduce the value of the

firm. On the contrary, the granting of employee stock options may result in a gain to the firm (an increase in the value of the firm related to higher earnings). The exercising of employee stock options has no effect on the value of the firm. Employee stock options have value to employees, but that does not imply a corresponding cost to the firms that grant the options.

Finance theory *values the assets of any firm* by estimating the stream of future “free cash flows” before debt service, and discounting that stream to arrive at a present value of the firm’s assets. The appropriate discount rate used for valuation reflects the combination of equity and debt used to finance the firm. Free cash flow is defined as earnings before interest, depreciation, taxes, and amortization (EBITDA), minus corporate taxes that would be paid on those earnings if they were earned by an unlevered firm, minus gross investment. Free cash flow captures the amount of cash that an unlevered firm would retain from its operations, after taking account of its corporate tax payments and investment needs. Generally, but not always, free cash flows for all periods are discounted by a single weighted average cost of capital (WACC), which takes into account the mix of debt and equity chosen to finance the firm in order to take into account the income that is sheltered from taxation by debt service costs.<sup>1</sup> The *value of the firm to its owners* (which sometimes is what is meant by financial economists when they use the phrase “the value of the firm”) is the difference between the asset value of the firm and the market value of its outstanding debts.

In this formulation, neither the granting nor the exercising of employee stock options would reduce the value of the firm (defined either as the value of its assets or the value of its assets net of debt), unless such actions (1) result in a reduction in the expected stream of free cash flows earned by the firm, or (2) cause an increase in the discount rate used to value those

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<sup>1</sup>  $WACC = RD(1-t)L + (1-L)RL$ , where  $RD$  is the market rate of return on debt,  $t$  is the corporate tax rate,  $L$  is the leverage ratio of the firm, and  $RL$  is the required rate of return on equity for the levered firm.

free cash flows, or (3) produce an increase in the market value of a firm's debts in excess of the amount of the increase in the value of the firm's assets. Neither the granting nor the exercising of employee stock options would have any of these three effects.

To the contrary, to the extent that the granting of employee stock options results in enhanced incentives for managers and employees to improve free cash flows, one would expect that the granting of employee stock options would increase the value of the firm rather than reduce it. Because the granting of employee stock options does not, on either a gross or net basis, reduce the value of the firm's assets, or the value of its assets minus debt, the granting of employee stock options is not a cost to the firm.

This conclusion is reflected, for example, in the treatment of ESOs by ratings agencies for purposes of gauging the credit risk of firms that issue ESOs. Ratings agencies would never subtract ESO values from earnings for the purpose of performing the credit risk analysis that results in debt ratings. Credit risk refers to the possibility of default on debt, and the loss given default that debtholders might suffer. Credit risk depends on the ability of firms' cash flows to be sufficient to meet debt service obligations, and is properly modeled as a function of the leverage, asset risk (the variability of cash flows and/or the variability of asset values), and the liquidity of the borrower. Because the granting of ESOs, per se, cannot have a negative impact on the free cash flows of the firm (indeed, ESOs tend to increase granting firms' free cash flows), or on the firm's leverage (indeed, the prospect of higher shares being issued may reduce leverage in the future), or on the firm's liquidity, the granting of ESOs cannot increase default risk. Adjusting earnings by subtracting some measure of ESO expenses, therefore, would have the undesirable effect of making ESO-issuing firms unrealistically appear to be less creditworthy than they are.

Consider, for example, the practices of the Credit Market Services Division of Standard & Poor's, as described in their October 16, 2002 publication, "Accounting for Stock Option Grants in Credit Rating Analysis," by Solomon B. Samson. That report confirms that, for credit risk purposes, Standard & Poor's does not adjust the concept of earnings for ESOs, but instead focuses on the determinants of actual cash flows and actual leverage. Here are some of the statements from that report:

[the 'core earnings'] measure – which is calculated by Compustat, in conjunction with Standard & Poor's Investment Services unit – standardizes earnings across companies by adjusting for various items, and among these, expensing stock options grants for all companies. On the other hand, most of the credit ratios – including EBIT and EBITDA coverage, operating margin, and return on capital – will continue to exclude stock option grants, given their non-cash nature. (See Core Earnings and Ratings Analysis, RatingsDirect, June 4, 2002.) Even ratios that Standard & Poor's uses to focus on a company's P&L incorporate a cash-oriented dimension (emphasis added).

No cash changes hands when a company grants its employees stock options. The exercise of the options involves the issuance of shares – again, no cash is required. In fact, to the extent that options substitute for cash compensation or benefits, it can be said that the company has issued equity to fund a portion of its costs. Just as with all issuance of equity, the financial position of the company is enhanced. Ceteris paribus, creditors should be pleased, while shareholders may not appreciate being diluted.<sup>2</sup>

Despite the fact that ESOs are clearly not an expense to the firm that grants them, there is an ongoing debate on the question of whether employee stock options *should be treated* as an expense to the firm that issues them at the time they are granted under generally accepted accounting principles (GAAP). Interestingly, even though Standard & Poor's does not expense stock options in its *credit risk analysis*, it does expense options in the publications produced by its Investment Services division, which are targeted toward equity investors.

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<sup>2</sup> Standard & Poor's does factor effects on cash flows and leverage from granting ESOs into its overall long-term analysis of cash flow and leverage, as part of its credit risk analysis. For example, if the announcement of an ESO grant is expected to have tax implications for free cash flow, they factor those into their analysis. Also, to the extent that corporations commit to change their disbursement policies to shareholders as part of their ESO plans, that effect on available free cash flow in the future is taken into account.

Advocates of expensing make several related errors, which together explain how they arrive at their conclusion that ESOs should be expensed. First, some proponents of the expensing of ESOs argue that ESOs should be expensed because they are simply an alternative form of wages, irrespective of whether ESOs are a cost borne by the firm. Those advocates fail to appreciate the role that employee stock options play as a special incentive device for workers, as a means of economizing on recruitment and training costs, and as a means for firms to raise equity capital. Employee stock options are properly viewed as the creation of a capital income sharing arrangement between the firm and its employees. ESOs save costs other than wage costs for firms and promote teamwork and greater effort by employees. They are not merely a substitute for cash wages.

Consider the survey evidence from 194 “new economy” firms surveyed by Ittner, Lambert, and Larcker, and reported in their 2003 article in the *Journal of Accounting and Economics*. That survey indicated that ESOs were much more than a means for firms to increase the size of their pay packages. Survey respondents gave the goal of encouraging stock ownership a score of 51.4, which was lower than the top-ranked rationale (retaining existing employees), but higher than the goal of simply providing competitive compensation.

More generally, it is widely recognized that ESOs can create additional indirect gains for firms by lowering their costs of external finance. A study by the Enterprise Director General of the European Commission places substantial emphasis on the positive corporate financing effects of ESOs. Corporate finance benefits include the direct effects of infusing firms with equity capital, and avoiding underwriting costs, as well as more indirect effects, including positive signaling of the prospects of the firm to outsiders. The European Commission study notes that

Other factors being equal, providers of capital will be more inclined to invest in a company whose staff is, to a relatively large extent, paid in employee stock options since this indicates quite unambiguously that the staff believe in the company's success. Employee stock options might thus be psychologically more convincing than business plans and similar documents.<sup>3</sup>

Second, some advocates of expensing err by assuming incorrectly that the fact that options have value to employees implies that they must have cost. This argument wrongly assumes that ESOs are a zero-sum game. But, in fact, the granting of employee stock options may create value for both the firm (and its stockholders), on the one hand, and for its employees, on the other hand, if the granting of options substantially improves the firm's future free cash flows. Furthermore, even if the potential value to the employees of the options granted by the firm exceeds the present value of the incremental free cash flows created by the positive incentive effects and cost savings from granting the employee stock options, that does not result in any lost value to the firm itself, but rather to its preexisting stockholders. Thus, the fact that employee stock options have value to employees does not imply that they are a cost to the firm that grants them.

Third, some advocates of expensing intentionally blur the distinction between the firm and its stockholders when measuring the gross costs of ESOs. That failure to distinguish between the firm and its shareholders is based either on a legitimate desire to have financial accounting reflect costs experienced by shareholders. But the notion that a firm's GAAP accounts should reflect the consequences of the firm's decisions for shareholders (a) results in errors of double counting of the gross costs of ESOs, (b) inappropriately and selectively mixes managerial accounting with financial accounting, and (c) neglects offsetting benefits of ESOs

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<sup>3</sup> Enterprise Directorate General, European Commission, "Employee Stock Options: The Legal and Administrative Environment for Employee Stock Options in the EU," Final Report of the Expert Group, June 2003, pp. 21-22.



that would be included in a proper managerial accounting of the consequences for shareholders of granting ESOs. These problems will be examined in detail in Section 4 below.

Fourth, some advocates of expensing believe that firms actually bear a cost when issuing ESOs. This cost is often referred to as the “opportunity cost” of not having issued public options in lieu of ESOs. The view that ESOs constitute a cost to the firm because they entail an opportunity cost is one that is widely cited as legitimate by advocates of expensing, but that argument is fallacious and is based on a misunderstanding of the definition of opportunity cost. Section 5 shows that there there is no reason to believe that firms suffer an opportunity cost from issuing ESOs.

Fifth, some advocates of expensing ESOs point to the use of repurchases of shares around the timing of employee exercise of ESOs to indicate that ESOs, in fact, have negative cash flow consequences for issuing firms. This view, which I discuss in Section 6, confuses expenses and cash distributions to shareholders, and also misunderstands the relationship between the decisions to grant ESOs and to repurchase shares.

### **3. Do ESOs entail costs, and if so, who bears them?**

In Section 2, I showed that the granting of employee stock options creates benefits, but not costs, for *the firm* granting the options. Employee stock options, however, do entail both gross costs and gross benefits to *preexisting stockholders* of the firm granting the options. To address the extent to which the *granting* of employee stock options entails a cost, one must distinguish (a) between costs or gains incurred by preexisting shareholders, as opposed to the firm, (b) between gross costs and net costs to preexisting shareholders from issuing employee stock options, (c) between the tendency to reap net gains from granting options to

management in well managed firms, as opposed to the tendency to suffer net costs from granting options to managers in badly managed firms, and (d) between the uncertain net costs or net gains produced from the granting of options to *management* (which depends on the extent of managerial “agency problems,” discussed below), as opposed to the expected net gains to preexisting stockholders that should result from the granting of options to *non-management* employees, irrespective of managerial agency problems.

(a) The granting of employee stock options entails a *gross* cost to *preexisting shareholders* but not a gross cost to the *firm*, as described in Section 2, above. The granting of employee stock options is a gross cost to preexisting shareholders because one of its consequences is the dilution of preexisting shareholders’ stakes in the firm.

(b) But this gross cost to preexisting shareholders may not entail a *net* cost, since the granting of employee stock options may have other consequences for preexisting shareholders that are positive, and which may more than offset the effect of dilution. Indeed, as many observers have noted, the primary purpose of granting employee stock options is to create a coincidence of interest between employees and their employers, a sharing of capital income as a means of attracting and retaining talented employees, and inducing individual effort and teamwork. Empirical studies suggest that employee stock options are successful in producing greater productivity and higher stock prices for preexisting stockholders, and that “the incentive benefits derived from employee stock option plans outweigh the costs [to preexisting stockholders] associated with the plan.”<sup>4</sup>

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<sup>4</sup> Lynn Rees, “The Value-Relevance of Stock-Based Employee Compensation Disclosures,” *Journal of Applied Business Research*, Vol. 17, 2105-116. Academic research on the effectiveness of stock options is reviewed by Joseph Blasi, Douglas Kruse, and Aaron Bernstein in their book, *In the Company of Owners: The Truth About Stock Options (and Why Every Employee Should Have Them)*, Basic Books, 2003. See also Joseph Blasi, Douglas Kruse, James Sesil, and Maya Kroumova, “Broad-Based Stock Options and Company Performance: What the Research Tells Us,” *Journal of Employee Ownership Law and Finance*, Vol. 12/3, pp. 69-102. These authors conclude that “companies with broad-based stock option plans . . . had statistically significant higher

(c) There is general agreement among financial economists that, in theory, the granting of stock options *to management* sometimes should produce a net gain to preexisting shareholders and sometimes should produce a net cost to preexisting shareholders, depending on the motivations of the managers who decide to grant those options.<sup>5</sup> In a well-managed firm (i.e., a firm whose management seeks to maximize the value of the firm to its preexisting shareholders), managers will only grant stock options to management and other employees if they expect that doing so will result in a net gain to preexisting shareholders. Thus, to the extent that firms are managed properly, the granting of any employee stock options should result in a net gain to preexisting shareholders. Managerial “agency problems” (conflicts of interest between managers and preexisting shareholders), however, may lead to excessive granting of options to senior management, which in some cases might result in a net cost to preexisting shareholders.

(d) The granting of options to *non-management* employees, however, should result in a net gain to preexisting stockholders, irrespective of the motivations of managers, because the granting of options to non-management employees cannot be motivated by the desire by senior management to take resources from their stockholders. That is so because: (i) management does not directly benefit from the granting of options to other employees, and (ii) if the granting of those options results in a net loss to preexisting shareholders, then to the

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productivity levels and annual growth rates than public companies in general and their peers” (p. 69). Some of the studies of stock price reactions to news about employee stock option programs include: Timothy Bell, Wayne Landsman, Bruce Miller, and Shu Yek, “The Valuation Implications of Employee Stock-Option Accounting for Computer Software Firms,” *Accounting Review*, Vol. 77, No. 4, October 2002, 971–96, John Core and David Larcker, “Performance Consequences of Mandatory Increases in Executive Stock Ownership,” *Journal of Financial Economics*, Vol. 64, No. 3, June 2002, 317-340. For a more qualitative assessment, see “Prepared Statement of Arthur W. Coviello, President and Chief Executive Officer, RSA Security,” Capital Markets, Insurance and Government Sponsored Enterprises Subcommittee of the House Committee on Financial Services, March 3, 2004.

<sup>5</sup> For a review of agency theory as it applies to the granting of stock options to top management, see Lucian Arye Bebchuk and Jesse M. Fried, “Executive Compensation as an Agency Problem,” *Journal of Economic Perspectives*, Vol. 17, No. 3, Summer 2003, 71-92.

extent that managers own stock or options, they will share in that net cost. Thus, even in the presence of agency problems, managers have an incentive to grant options to non-management employees only when doing so results in a net gain to preexisting shareholders. Rational managers – whether they properly represent stockholders’ interests or only their own selfish interests – will only be willing to grant options to other employees if doing so increases the value of preexisting shares in the firm (including their own). Thus, one would expect the granting of stock options to non-management employees to result in a net gain to preexisting shareholders irrespective of the motivations of managers.

Grants of stock options to non-executive employees, in fact, are a very large portion of the total amount of options granted. Brian J. Hall and Kevin Murphy point to that fact to show that managerial agency explanations of the granting of stock options are implausible: “The managerial rent-extraction hypothesis is, at best, an explanation for the very top executives . . . in 2002, for example, more than 90 percent of options granted in the S&P 500 went to executives and employees below the top five. A compelling explanation for the escalation in stock option grants must be consistent with the increased use of options throughout the company.”<sup>6</sup>

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<sup>6</sup> Brian J. Hall and Kevin J. Murphy, “The Trouble with Stock Options,” *Journal of Economic Perspectives*, Vol. 17, No. 3, Summer 2003, 49-70. As the title of this article implies, the authors doubt (as a matter of economic theory) that employee stock options are the most efficient means of achieving the goals of attracting, retaining, and incentivizing employees. They believe that employee risk aversion, which they argue should lead employees to undervalue options, makes them an inefficient tool. They conclude that the use of options reflects false perceptions of the costs of using employee stock options on the part of managers. The authors argue for managerial ignorance or irrationality, not based on any evidence of such, but rather, because of theoretical arguments about the costs of options to risk-averse employees. Bebchuk and Fried (2003, p. 87, op cit) criticize Hall and Murphy: “We doubt that executives and their advisers cannot grasp the costs of conventional options to shareholders.” But Bebchuk and Fried offer no explanation for the widespread granting of employee stock options to non-management employees. Richard Lambert and David Larcker, “Stock Options, Restricted Stock, and Incentives,” April 2004, Working Paper, The Wharton School of Finance, show that once one takes proper account of the *incentive* effects produced by employee stock options, “in contrast to prior work, we show that restricted stock is generally *not* the optimal contract form, and that option-based contracts have both efficiency and incentive advantages.” Thus, Lambert and Larcker are able to resolve the concerns of Hall and Murphy without recourse to assumptions about managerial ignorance or irrationality.

In a 2002 survey of multinational firms, the National Center for Employee Ownership found that 79 percent of U.S.-based multinational firms had a non-executive stock option plan for their North American operations;<sup>7</sup> 52 percent of European-based multinational firms indicated that they had a non-executive stock option plan for their North American operations.<sup>8</sup> The survey also showed that 53 percent of production, clerical, and general employees who worked in North America for a U.S.-based multinational firm received stock options;<sup>9</sup> 14 percent of production, clerical, and general employees who worked in North America for a European-based multinational firm received stock options.<sup>10</sup> Among Silicon Valley respondents, 34.5% of ongoing stock option grants and 31.9% of new hire grants go to non-management workers.<sup>11</sup>

Furthermore, empirical studies of the use of employee stock options for non-executive employees provide evidence that the options are used “to attract certain types of employees, provide retention incentives, and create incentives to increase firm value.”<sup>12</sup> Available empirical evidence indicates that (i) employee stock options largely take the form of options granted to non-executive employees, (ii) the use of non-executive employee stock options is consistent with the motivations to attract, retain, and incentivize employees, and (iii) employee stock option grants result in value creation for firms and preexisting stockholders. Thus, both economic theory and empirical evidence provide strong support for the view that preexisting stockholders enjoy net benefits from the use of employee stock options.

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<sup>7</sup> National Center for Employee Ownership & Global Equity Organization, 2002 Global Equity Compensation Benchmark & Trends Results, p. 10.

<sup>8</sup> *Id.* p. 10.

<sup>9</sup> *Id.* p. 14.

<sup>10</sup> *Id.*

<sup>11</sup> National Center for Employee Ownership & Global Equity Organization, Current Practices in Stock Option Plan Design, 2001 (2<sup>nd</sup> Edition), p. 302.

<sup>12</sup> John Core and Wayne Guay, “Stock Option Plans for Non-Executive Employees,” *Journal of Financial Economics*, Vol. 61, 2001, 253-287.

Additional evidence of the value creation for preexisting shareholders from employee stock option programs comes from the decisions by private equity firms – sophisticated investors exerting control over firms prior to their initial public offerings (IPOs) – to maintain broad-based employee stock option programs for their portfolio firms. Because these investors are sophisticated professionals there can be no doubt that they would be fully aware of the gross costs of employee stock options to preexisting shareholders, and therefore, their use of employee stock options would indicate their expectation of a net benefit to shareholders, including themselves. Furthermore, private equity firms’ control or influence over portfolio firms makes managerial rent extraction an unlikely explanation for the granting of employee stock options, even to the top executives of portfolio firms.

For example, I identified high-tech manufacturing firms of significant size based in Silicon Valley that had completed their initial public offering in either 2002 and 2003. I chose firms with IPOs in 2002 and 2003 because these are “post-bubble” years. Some commentators (e.g., Hall and Murphy 2003, Bebchuk and Fried 2003, cited above) argue that the environment for employee stock options was especially generous during the stock market boom that ended in 2000. While one may not agree with the arguments of these commentators about the purposes or effects of employee stock option programs, by choosing a sample from 2002 and 2003, I limit attention to a period that, according to these commentators, should have been less conducive to the granting of employee stock options. A size threshold for the market value of equity of roughly \$100 million results in three subject firms: Seagate Technology LLC, NPTest Holding Corp, and NETGEAR Inc. These companies completed their IPOs in December 2002, December 2003, and July 2003, respectively.

All three subject firms were portfolio firms of private equity investors prior to their IPOs, and all three maintained broad-based employee stock programs. All three of the subject firms were in the process of raising new equity and had substantial cash holdings at the time of their IPOs. The ratio of cash and cash equivalents relative to assets, with adjustments for the effects of the IPOs, for these three firms: 14% (Seagate), 25% (NPTest), and 47.2% (NETGEAR).<sup>13</sup> The ratio of cash and cash equivalents relative to assets (without adjustments) for these firms prior to their IPOs were: 16.6% (Seagate), 8.8% (NPTest), and 21.5% (NETGEAR). Those facts are significant because they imply that their employee stock option programs were likely not to be motivated by the need to pay employees in a non-cash form as the result of capital scarcity.

To summarize, financial economics implies that (a) the granting of employee stock options entails a *gross* cost to preexisting shareholders, but not to the firm, (b) that the granting of employee stock options may either produce a *net gain* or a *net loss* to preexisting non-management stockholders, depending on whether the consequences of the options produce benefits for shareholders that exceed the gross dilution costs, (c) whether net gains or net costs will result from the granting of options to *managers* will depend upon whether management's decision to grant the options is guided by firm and shareholder value maximization (which will imply net gains) or by rent extraction by managers due to a conflict of interest between management and shareholders (which could imply net losses), and (d) the granting of options to *non-management* employees should generally result in net gains to preexisting shareholders, since both value-maximizing managers and rent-extracting

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<sup>13</sup> Seagate Technology LLC: SEC Form S-1A, filed December 4, 2002; NPTest Holding Corp: SEC Form S-1A, filed December 4, 2003; NETGEAR Inc.: SEC Form S-1A, filed July 30, 2003.

managers will grant non-management employee options only when doing so creates net gains for shareholders.

The timing of the exercising of employee stock options, and the spread on exercise, are unrelated to the gross costs from dilution or the net benefits (from increased free cash flows minus the costs of dilution) that shareholders experience as the result of the granting of employee stock options. As discussed in Section 2, the timing and spread on exercise are unrelated to the process of value creation within the firm. They are also unrelated to the gross costs of dilution to preexisting shareholders from issuing employee stock options, which are anticipated by the market and priced into share values before exercise. Exercising employee stock options does not create or measure (by observing the spread on exercise) either the gains from or the costs of employee stock options to non-employee shareholders of issuing firms.

Taking account of these theoretical considerations, and the evidence regarding the actual use and consequences of employee stock options, it is reasonable to conclude that in general the granting of employee stock options results in a net benefit rather than a net cost to preexisting stockholders. The exercising of employee stock options has no effect on the value of preexisting shareholders' shares, except to the extent that exercise is unexpectedly early or late; thus, on average, exercise would have no effect. Thus, it would be incorrect to conclude that either the grant or the exercise of employee stock options represents a net cost to preexisting stockholders, and it would be incorrect to conclude that the granting of ESOs represents a net cost to preexisting stockholders.

**4. Should firms' GAAP accounts reflect the gross costs to shareholders of granting ESOs in order to provide useful information to unsophisticated investors, and if so, how?**



Firms' managers and directors have an obligation to act on behalf of preexisting stockholders, and to weigh the gross costs preexisting stockholders bear from granting options against the gains to the firm and its shareholders from granting them. The marginal benefit of issuing ESOs declines as the amount the firm issues increases. Thus, there will be a crossing point at which any further issue of ESOs would entail a marginal cost to shareholders from dilution that would exceed the marginal benefit of issuing them. Firms' managers have an obligation not to issue options beyond that point, even though the company does not itself bear the gross cost of issuing the ESOs.

This comparison of marginal benefit and marginal cost should be undertaken in the *managerial* accounting of the firm. Managers should base decisions on the granting of ESOs on their judgments about marginal benefits and costs to both the firm and its shareholders.

Some proponents of expensing ESOs believe that managers may be making excessive use of ESOs, and see expensing as a means of ensuring that stockholders have adequate and timely information about the costs of dilution.

But that potentially legitimate concern does not imply that GAAP accounting should take account of costs borne by shareholders that are not borne by the firm, since there are alternative means for providing timely and useful information about dilution to shareholders.

Furthermore, it would be especially inappropriate for GAAP accounting to only take into account the gross costs part of the managerial accounting calculation. The expected benefits from the granting of ESOs constitute an intangible asset to the firm that should more than offset the gross costs to shareholders. Ignoring that intangible asset would introduce distortions into GAAP accounting.

An implication of this logic is that, if ESOs entail substantial intangible value to issuing firms, then expensing ESOs will mislead unsophisticated stock investors. To put it another way, one way to address the question of whether expensing ESOs is desirable is to ask whether failing to expense ESOs (under current GAAP practice) has resulted in an understated price-earnings ratio. To address the question of whether failing to adjust earnings for ESOs results in an unusually low price-earnings ratio for high-ESO firms, I perform a simple empirical test of this hypothesis. Specifically, I investigate whether the price-earnings ratio of firms, after controlling for other influences on that ratio, is lower for firms the more they grant ESOs.

I construct a cross-sectional study of the effect of differences in the ratio of outstanding options relative to outstanding common stock on the price earnings ratios of firms, using Compustat data for 1995 (for reasons of data availability).<sup>14</sup> My regression evidence controls for other differences in firms that could affect their price earnings ratios. In particular, I control for cross-sectional differences in average price-earnings ratios of four-digit SIC industries, for past sales and earnings growth, and for firm size. Table 1 reports summary statistics for the variables used in the regressions.

I report four different versions of regressions in Table 2, which vary according to whether the earnings measure used excludes or includes extraordinary items, and according to whether earnings are not diluted, or alternatively, are fully diluted. In all of the regressions

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<sup>14</sup> Options are measured by the Compustat variable "Common Shares Reserved for Conversion – Stock Options." This item was no longer collected by Compustat after August 22, 1996. Compustat defines the variable as follows: "Prior to August 22, 1996, this item included: 1) shares subject to shareholder approval, and 2) stock appreciation rights attached to or associated with stock options. This item represents shares reserved for stock options outstanding as of year-end plus options that are available for future grants. This variable excludes stock appreciation rights not specifically attached to stock options or associated with stock options. This item is not available for banks, utilities, or property and casualty companies." Compustat does not provide data specifically on total ESOs outstanding. I performed a spot check of the 10-Ks of 5 companies and found that the Compustat item closely, if not exactly, matched the number of ESOs reported in the text of the companies' 10-Ks.

reported in Table 2, the coefficient on the options variable is *positive* – that is, after accounting for lagged sales and earnings growth, firm size, and the industry in which the firm operates, more outstanding options are associated with *higher* price-earnings ratios, no matter how earnings per share is defined. This result directly contradicts the view that price-earnings ratios are unusually low as the result of the granting of ESOs. This result is consistent with the empirical evidence discussed above, which indicates that ESOs promote growth and profitability, which in turn results in higher stock prices and higher price-earnings ratios than those firms would otherwise have had. ESOs are associated with intangible assets valued by the market, which appear to be greater than their dilution costs. Expensing ESOs without taking account of the intangible assets associated with them would send precisely the wrong signal to unsophisticated stockholders.

Finally, treating gross costs to shareholders from dilution as an expense leads to the double counting of the gross costs to shareholders. Dilution costs are already taken into account in the firm's reported earnings per share (in the denominator). The proposed expensing of ESOs would entail making the same dilution cost adjustment twice, once to the numerator and once to the denominator of the earnings per share ratio.<sup>15</sup>

For all these reasons, a better way to proceed (discussed in more detail in the concluding section of this essay) would be to change the way dilution costs are calculated in the earnings per share calculation, to allow expected dilution costs to be reflected in earnings per share at the time ESOs are granted. That approach would avoid the conceptual errors, double counting of dilution cost, and mismeasurement of earnings that would result from expensing ESOs, while offering shareholders valuable information about the potential dilution that results from granting ESOs.

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<sup>15</sup> See Lawrence B. Lindsey and Marc Sumerlin, "Bubble Act Redux," *The Wall Street Journal*, June 21, 2004.

**5. Do firms bear an opportunity cost from granting ESOs, and if so, how would it be measured?**

Some proponents of expensing argue that ESOs actually entail a gross cost to the firms that issue them, because when a firm grants ESOs it forgoes the opportunity to issue an equal amount of publicly traded options with the same maturity and exercise price. The revenue foregone by not issuing the options to the public, it is argued, is an opportunity cost to the firm that grants ESOs. But this argument is fallacious, and the fallacy is based on a misunderstanding of the concept of opportunity cost.

Opportunity cost is a concept that is especially useful in the area of project choice, where one compares two alternative uses of a firm's resources. In general, the opportunity cost of using resources for one project is the net benefit foregone by employing those resources to pursue an alternative project. The application of the concept of opportunity cost requires that the use of the resource in one use result in a loss of opportunity elsewhere. If there is no opportunity foregone by pursuing a project, then there is no opportunity cost to that project.

Empirical evidence suggests that, on average, if an ESO issue were cancelled, the stock price of the erstwhile issuing firm would fall (because ESOs have net benefits for stockholders, on average). Thus, the value of the (alternative) public option in the counterfactual world (where ESOs are not issued) would be lower than the value of a public offering of options made *after* the issuing of ESOs.<sup>16</sup> If a firm could issue public options at a

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<sup>16</sup> Counterfactual refers to the fact that the option is hypothetical. The alternative option would be sold to the public rather than granted to employees. In practice, such long-term options sold to the public are virtually non-existent.

*higher price after issuing ESOs than it could if it did not issue ESOs, then it makes no sense to say that there is an opportunity cost to the firm or its stockholders from issuing ESOs.*

In other words, an appropriate opportunity cost measure of ESOs would take account their *net* costs, not just their gross costs. ESOs impose a gross expected dilution cost on the preexisting shareholders of firms that issue them, but not a net cost on them, on average. The stockholders of firms that would choose to issue options to the public, rather than to their employees, would on net be worse off, on average, not better off, from counterfactually issuing shares to the public rather than to their employees. That implies an opportunity *benefit*, not an opportunity cost.

The logical error of those that advocate the opportunity cost view of ESOs has two parts: First, proponents of expensing based on the opportunity cost view fail to recognize that firms that issue ESOs can still issue public options *after* they issue ESOs. Second, they fail to recognize that issuing firms would, on average, be able to issue those public options at a *higher price after issuing ESOs than if they had not issued ESOs.*

## **6. Do share repurchases associated with the exercise of ESOs imply that issues are an expense to the granting firm?**

One advocate of expensing recently made the argument that ESOs are an expense to the granting firm because granting firms sometimes repurchase shares on the open market to provide to employees that are exercising their ESOs.<sup>17</sup> According to this view, ESOs are an

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<sup>17</sup> This opinion was offered by Mr. Ken Nunes in an expert report filed in U.S. Tax Court in July 2004, in the case of Xilinx Inc. and Subsidiaries, et al. v. Commissioner of Internal Revenue Service, Docket Nos. 4142-01 and 702-03.

expense because the purchase of shares associated with them entails an outflow of cash from the firm.

The argument that share repurchases to effect the issuance of shares to ESO holders constitute a cost to the company implies that the costs of ESOs depends on the ways firms obtain the shares that they sell employees. That is, those cases in which employees purchase new shares issued by companies, as opposed to those in which employees purchase shares from a company share repurchase, according to this view, should be viewed differently, since the “cost” of repurchase only occurs when firms repurchase shares issued to ESOs holders.

The argument that repurchases affect the costs to firms or stockholders of granting ESOs is clearly fallacious for three reasons. First, as is generally understood by financial economists, stock repurchases are a distribution of cash to shareholders, not an expense.

Second, whether to make a stock repurchase is a *separate financial decision*, not one that is caused by having granted ESOs. In general, there are many reasons that a firm may choose to repurchase its shares. It may wish to increase its net leverage by disgorging cash. It may wish to distribute cash to shareholders and choose repurchases, rather than dividends, for shareholder tax reasons. It may believe that its share price is low, and see repurchases as an appropriate means of increasing shareholder value and as a means of signaling its views about undervaluation to the market.

To the extent that firms choose to engage in some repurchases as a means of issuing shares to employees, it is important to bear in mind that this is a choice, not a necessity. Firms can always decide, instead, to issue new shares rather than repurchase. A possible reason that firms choose to use repurchases to effect share issues to employees exercising ESOs is that doing so makes it easier for analysts and investors to track the progress of the firm’s stock

price. Issuing shares to ESO holders via repurchases leaves the total amount of outstanding shares unchanged, so that there is no need to adjust an analysis of the share price over time for periodic expansions in the number of shares associated with ESOs. Also, firms may choose to supply shares to employees via repurchases if there is a perceived benefit (e.g., improved managerial incentives) from increasing the percentage stake of employees in the firm. Nevertheless, firms can always choose to obtain the necessary shares through new issues. There is no necessary connection between ESOs and repurchases.

Third, from the standpoint of stockholder dilution, whether the firm supplies shares to ESO holders with new share issues or via repurchases makes no difference to the extent of gross dilution (dilution before taking into account the benefits from granting ESOs). Thus, preexisting stockholders are indifferent about whether ESO exercise is effected through repurchases or additional stock. If the firm repurchases, then gross dilution will be accomplished with a constant number of shares through a reduction in the book value of equity (equal to the difference between the market price and the exercise price of shares multiplied by the number of ESOs). If the firm issues new shares, gross dilution is accomplished via an increase in the number of shares (by the number of ESOs) and a smaller proportional increase in the total market value of equity (the exercise price multiplied by the number of ESOs). The amount of gross dilution is the same. This result is a matter of simple arithmetic, and is a well-known result in corporate finance. Consider the following example:

Assume that a firm has been informed by its employees that they wish to exercise the option to purchase 100 shares of stock under the firm's ESO plan. The firm has 900 shares of stock outstanding. Prior to exercise, the firm's assets net of debt have a market value of \$18,000. The firm can either issue its employees 100 shares of stock or purchase 100 shares in

the market. The stock currently trades at \$19.50 a share (taking into account market knowledge of the ESO dilution that is about to occur), and the exercise price on the option is \$15.

If the firm issues new shares to its employees, the total number of shares outstanding will now equal 1000, and the total market value of outstanding shares will equal the value of preexisting assets net of debt (\$18,000) plus the cash contributed by new shareholders (\$1,500), for a total of \$19,500. Preexisting shareholders will own 900 shares, and the total price per share will remain \$19.50.

If, alternatively, the firm had used repurchases to issue shares to ESO holders, it would have purchased 100 shares from preexisting stockholders at \$19.50 a share and sold these to employees at \$15 a share. The total number of shares would be 900, of which preexisting shareholders now own 800. The total value of the firm would be \$18,000 minus \$1,950 plus \$1,500, which totals \$17,550, and the price per share would remain \$19.50. Clearly, there is no difference in dilution from whether repurchased shares or new shares are issued to ESO holders.

In summary, the notion that repurchases coinciding with ESOs constitute a cost is incorrect from several perspectives: (a) It incorrectly views stock repurchases as a cost to firms; (b) it implies a necessary connection between ESO grants and stock repurchases, when in fact these are separate financial decisions; and (c) it fails to recognize that, from the standpoint of preexisting shareholders, there is no difference with respect to gross dilution cost whether the exercise of ESOs is associated with new share issues or repurchases.



## **7. Pitfalls in the valuation of gross costs of ESOs**

Sections 2-6 provided a detailed analysis and criticism of conceptual arguments made by proponents of expensing ESOs. In the sections that follow, I turn to the question of the measurement of ESO costs. These sections, in particular, point out conceptual and technical challenges and errors associated with the approach to estimating “fair value” under FAS 123 and the recent proposals for calculating fair value for purposes of mandatory expensing under GAAP. This section provides an overview of the discussion, followed by a detailed analysis of some of the relevant technical issues in subsequent sections.

FASB’s definition of fair value is the conceptual framework that guides the valuation of ESOs for expensing purposes, and FAS 123’s approach to measuring the fair value of ESOs is the specific implementation of that approach for expensing ESOs. Several problems arise from this approach to measuring economic cost. As already discussed at length above, this approach assumes incorrectly that ESOs are a cost to the issuing firm, and fails to take into account the benefits to preexisting shareholders of ESOs. But even as a measure of *gross* economic cost to preexisting shareholders, there are significant problems with the FASB approach.

First, there is the question of whether FASB’s fair value standard can be satisfied by the definition of a non-transferable counterfactual option sold to the public, as envisioned under FAS 123. FAS 123 assumes that the counterfactual option would be transferable. Critics of FAS 123 argue that FAS 123’s assumption of transferability is inconsistent with FASB’s fair value standard. Under the assumption of non-transferability favored by critics of

FAS 123, it would be virtually impossible to gauge the gross cost to the firm of ESOs, since it would not be possible to use any market model to approximate that cost.

FASB's definition of fair value is "the amount at which the asset could be bought or sold in a current transaction between willing parties." But this is only clearly definable if two conditions are met: the characteristics of the asset itself are clearly defined, and that asset (so defined) has a market value that can be determined. In the case of ESOs, a central problem is that ESOs are not transferable, and that they have other features (e.g., termination risk) that would make them hard to trade even if they were transferable.

Some critics of FAS 123 argue that under FASB's own definition of fair value, ESOs should be valued assuming that they retain *all* of their existing contractual features, *including non-transferability*. According to that view, the counterfactual ESO-like option would be sold once by the issuer, subject to the requirement that the option could not be resold, and the ESO-like option would be subject to termination risk by linking the holder's ability to exercise the option to the continuation of a particular employee or group of employees. Some critics of FAS 123 suggest that this would be the appropriate counterfactual option to value under FASB's definition of fair value: "the amount at which the asset could be bought or sold in a current transaction between willing parties."

Such an option would be virtually impossible to value, and could not be valued using any market-based option pricing model (both the Black Scholes and binomial models, for example, rely on the ability to trade the option as a crucial assumption for deriving its value). If an option cannot be traded, then its value is determined by the value attached to it by its holder. To estimate that value (which would be an upper bound to the purchase price for selling the option to that holder) one would have to know the utility function of the buyer,

which cannot be determined with any reasonable certainty. For example, for different parameter values of their model, Professor Brian Hall and Professor Kevin Murphy calculate that the value of ESOs to their holders can range from 2.2% to 71.9% of their Black Scholes values.<sup>18</sup>

A recent transaction involving Microsoft and its employees has created the false impression on some observers that ESOs are salable. To prevent misunderstanding, it is worth going over the facts of that transaction.

Microsoft offered to allow employees to exchange some of their out-of-the-money ESOs *with Microsoft* for cash. J.P. Morgan paid Microsoft, not its employees, and purchased *tradable stock options*, which were amended versions of the ESOs that the employees cashed in with Microsoft.<sup>19</sup> The typical contractual features of ESOs were eliminated in the amended options. The options Microsoft offered for sale to J.P. Morgan had the same exercise prices as the ESOs that employees cashed in, but had shorter maturities than the ESOs, and did not have the same contractual features as ESOs. Microsoft passed on to its employees the cash value from the sale of the amended stock options, which were very different from the ESOs. But Microsoft exercised substantial discretion in this distribution of cash, including delaying some of the cash disbursement to employees, and reallocating the cash among employees as it saw fit. It is also noteworthy that this complicated set of transactions required SEC

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<sup>18</sup> Brian J. Hall and Kevin J. Murphy, "Stock Options for Undiversified Executives," *Journal of Accounting and Economics* 33, 2002, pp. 3-42, Table 1 (p. 12).

<sup>19</sup> See "Program Agreement between Microsoft Corporation and JPMorgan Chase Bank, Relating to the Stock Option Transfer Program of Microsoft Corporation," at <http://www.sec.gov/Archives/edgar/data/789019/000119312503062134/dex99d3.htm>. Other links are accessible via <http://www.corplawblog.com/archives/000253.html>.

cooperation, since many aspects of the transaction could be construed as violating SEC rules. Microsoft sought and obtained SEC approval.<sup>20</sup>

It is incorrect to interpret this set of transactions as a sale of ESOs by Microsoft employees to the market, or as a market valuation of ESOs. It was nothing of the kind. This transaction offered Microsoft's employees an opportunity to swap ESOs for cash from Microsoft, and Microsoft replaced ESOs with a different set of options. Under the assumption that all parties acted in their own self interest, or in accordance with their fiduciary obligations, we can infer that the cash price received by the employees was greater than or equal to the value they placed on the ESOs they tendered, and that the new options represented no greater amount of expected net dilution for Microsoft stockholders than did the outstanding ESOs.

Employees' valuations on ESOs may be much lower than gross expected dilution costs,<sup>21</sup> and net expected dilution costs would be less than or equal to gross dilution costs. Thus, neither of these bounds would provide an accurate measure of gross expected dilution costs, nor do these bounds determine a unique cash value. Thus, there is no basis for believing that the cash value received by the employees was a reasonable estimate of the expected gross dilution cost to preexisting shareholders at the time of the exchange, even under the assumption that all parties acted in their own self interest, or in accordance with their fiduciary obligations.

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<sup>20</sup> See the Letter of October 15, 2003 from Peter R. Douglas and Richard B. Dodd to Brian Breheny of the SEC, and the October 15, 2003 response from Mauri Osherooff of the SEC.

<sup>21</sup> See Brian J. Hall and Kevin J. Murphy, "The Trouble with Stock Options," *Journal of Economic Perspectives*, Vol. 17, No. 3, Summer 2003, 49-70. The authors believe that employee risk aversion, which they argue should lead employees to place a low value on options, makes the difference between the gross expected dilution cost to preexisting stockholders and the value of ESOs to employees very large.

FAS 123 does not encounter the fundamental valuation problem that arises from non-transferability because it *alters the characteristics of the counterfactual option* that it imagines the ESO-issuing firm would sell to the public. The counterfactual option, under FAS 123, is transferable. The value of the option is adjusted to match the expected life of the ESO, and the option's value is adjusted for an estimate of ESO termination risk, but the option is very different from an ESO *because* it is transferable. By making the option transferable, FAS 123 fundamentally has changed the characteristics of the asset.

One could argue, however, that FASB's fair value standard in the case of ESOs should attempt to measure the cost to gross preexisting shareholders of issuing ESOs rather than their value as an asset to employees. But even if one adopts the view that the only goal of the proposed accounting standard is to measure the gross cost of dilution to preexisting shareholders (as opposed to the value of the ESO), FASB's approach to valuing ESOs entails substantial errors of measurement, which are a reflection of the inability of finance theory to produce a reliable measure of the cost of dilution of ESOs. As I will show, the potential errors are large and cannot be bounded.

Options to buy a stock over a period of time at a pre-specified strike price are valuable because they permit holders to exercise the option only in states of the world in which it is profitable to do so. The problem of valuing any option reduces to estimating, on a forward-looking basis, across all possible future states of the world, the potential profits reaped from exercising the option, and discounting back to the present those probabilistic future profits from exercising the option.

The Black Scholes method for valuing options was developed in the early 1970s.<sup>22</sup> It provides a mathematical formula for valuing call options on an underlying stock under a particular set of simplifying assumptions. It is widely recognized as a useful starting point for valuing some publicly traded stock options (e.g., short-lived options on highly liquid stocks whose returns' distributions are approximately normally distributed).

But there is a large and growing literature showing that the Black Scholes model, or the closely related binomial model, is not an appropriate model for valuing employee stock options.<sup>23</sup> That literature concludes that the Black Scholes model overstates the value of employee stock options, that the size of valuation errors is very large, and that differences in the characteristics of individual firms may lead to pronounced differences in the extent of misvaluation. Thus, the Black Scholes model is not a suitable approach to valuing employee stock options. As Paul Atkins, U.S. Securities and Exchange Commissioner, recently said, "I have yet to meet anybody who suggests that Black-Scholes is a good or even fairly good indicator of the value of long-term compensation options – especially those in broad-based stock option plans."<sup>24</sup> Professors Burton Malkiel and William Baumol draw a stronger conclusion, arguing that "there is no way to measure . . . the value of the options at the time

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<sup>22</sup> Fischer Black and Myron Scholes, "The Pricing of Options and Corporate Liabilities," *Journal of Political Economy*, Vol. 81, No. 3, 1973, 637-654.

<sup>23</sup> See, e.g., Steven Huddart and Mark Lang, "Employee Stock Option Exercises: An Empirical Analysis," *Journal of Accounting and Economics*, Vol. 21, 1996, 5-43, Charles W. Calomiris and R. Glenn Hubbard, "Options Pricing and Accounting Practice," Working Paper, Columbia Business School, January 2004, Gurupdes S. Pandher, "Valuation of Stock Option Grants Under Multiple Severance Risks," *The Journal of Derivatives*, Winter 2003, 25-37, and Peter Carr and Vadim Linetsky, "The Valuation of Employee Stock Options in the Intensity-Based Framework," *European Finance Review* 4, 2001, 211-230.

<sup>24</sup> Comments at the Conference, "Expensing Employee Stock Options Looks Like a Major Mistake," American Enterprise Institute, January 8, 2004. A Transcript of the conference is available at <http://www.aei.org/events/filter..eventID.710/transcript.asp>

they are issued . . . with reasonable precision.”<sup>25</sup> My discussion confirms this pessimistic conclusion.

I divide my discussion of the difficulties of measurement of the basic Black-Scholes or binomial models into three parts: (a) the need to adjust for blackout periods, illiquidity discounts, and underwriting costs, all of which would affect the value received by a seller of an option in the market. These issues are discussed in Section 8. A conservative estimate of the average combined effect of these three influences (using a simple example) would be a reduction in the value of the option of roughly 18%. I emphasize that appropriate adjustments for these three influences would vary substantially across firms in ways that are hard, if not impossible, to measure, and which could easily amount to more than double, or less than half, of the average conservative estimate of 18%.

(b) A *gross* measure of the economic cost to preexisting shareholders would have to be based on an *adjusted*, rather than *observed*, stock price and volatility. Adjustment is necessary to remove the effect of the benefits of ESOs from observed stock price and volatility in order to perform the appropriate counterfactual experiment. This adjustment, described in Section 9, requires an estimate of the gross benefits of ESOs and their effects on firm volatility through their effects on managerial behavior and firm capital structure. Given that empirical evidence indicates that, on average, benefits exceed gross costs, the effects of such an adjustment are likely to be large, on average. This adjustment would likely vary substantially across firms.

(c) The assumption of geometric Brownian motion,<sup>26</sup> adopted for computational convenience under the option pricing models allowed under FAS 123 (including Black

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<sup>25</sup> Burton G. Malkiel and William J. Baumol, “Stock Options Keep the Economy Afloat,” *Wall Street Journal*, April 4, 2002, p. A18.

Scholes), is an inaccurate portrayal of the time series behavior of underlying stock returns and the volatility of stock returns. An alternative model (which is by no means “the correct” model) of stock returns and volatility is discussed in Section 10. When applied to the S&P 500, that model implies that roughly ten percent of the time Black Scholes pricing overstates or understates option values by more than 16%. Virtually no work has been done to extend this model of the S&P 500 to individual stocks, which is a challenging empirical exercise. There is every reason to believe that doing so would result in significantly larger errors from assuming geometric Brownian motion, and there is no way to gauge the likely degree of error based on present knowledge.

All of the above shortcomings are independent problems. The cumulative effect of these errors is enormous. When they are considered as a whole, it is clear that FASB’s approach to estimating economic cost is conceptually flawed and produces option valuations that are likely to be highly inaccurate for valuing the long-term stock options of individual firms. The potential inaccuracy is so large that it cannot be bounded.

## **8. Adjusting for the costs of placement, market illiquidity, and blackouts**

Assuming counterfactual ESO-like options that are transferable (as FAS 123 assumes), and ignoring for the moment other important deficiencies in the FAS 123 option pricing framework relating to the measurement of volatility (which are discussed in Section 9 and 10 below), there are additional adjustments to option valuation that must be made. These include downward adjustments for option value due to blackouts, illiquidity, and the costs of placing the options in the market.

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<sup>26</sup> Geometric Brownian motion means that stock returns follow a random walk and are normally distributed.



It is widely recognized that, if ESOs were tradable, they would be properly modeled as Bermudan options.<sup>27</sup> The Black Scholes model of option pricing assumes that all options are exercised at one point in time, which is highly unrealistic as a model of the exercise timing of ESOs. The Bermudan option valuation approach, in contrast, allows options to be exercised at various points in time between vesting and maturity.

The Bermudan approach can incorporate (to some extent) termination risk, vesting periods, and blackout periods (times when holders of ESOs are prohibited from trading – for example, around earnings announcements), as well as the expected duration of options, to estimate market valuations for traded options that are otherwise similar to ESOs. Under the simplifying (and, as I will show below, highly inaccurate) assumption of geometric Brownian motion (which is assumed in the Black-Scholes and binomial models), Table 3 explores the sensitivity of standard option valuation conclusions to various necessary adjustments in a Bermudan option framework. The point of this exercise is not to suggest an alternative approach to accounting for ESOs, but rather to illustrate the difficulty of arriving at a reliable estimate of the value of long-term options even under a more realistic model than Black Scholes. I simulated the value of tradable Bermudan options with realistic vesting periods, termination risks, and blackout periods.<sup>28</sup> I find that blackout periods can significantly reduce the value of options. In the example presented in Table 3, for example, failing to take account of blackout periods exaggerates the value of the option by 6.7%.

Additionally, the FASB definition of fair value implies that one should take into account the costs borne by the issuer in executing a market transaction (underwriting cost) and the illiquidity discount that would be placed on traded options if they were sold into thin

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<sup>27</sup> Bermudan options are options that permit exercise to occur prior to maturity, but which exclude certain exercise dates.

<sup>28</sup> I thank Gurupdes Pandher for his assistance in performing these simulations.

markets. Each of these adjustments would result in additional significant “haircuts” relative to the FAS 123 estimation of cost, and the amount of the requisite haircut would vary significantly across firms by amounts that would be very difficult to estimate.

Option pricing models, including Black Scholes, assume perfect market liquidity. To the extent that secondary markets for trading the counterfactual options would be illiquid, option prices should be discounted for that illiquidity. The liquidity of secondary markets varies according to the size of firm and the size of the offering (with large quantities of long-term options of larger firms enjoying more liquid secondary markets than smaller quantities of large firms, or than similar quantities placed by smaller firms). Because there are virtually no options issued with lives greater than two years, it is not possible to estimate the size of this illiquidity discount. Clearly such options would be more illiquid than existing options of one- or two-year maturity for firms that offer LEAPS, which are highly illiquid. An informal examination of bid-ask spreads for market options maturing in two years shows that they often exceed 15%. For purposes of constructing an example, I will assume that the illiquidity discount for long-term (i.e., five-year) options placed in the market at 5%, which I regard as very conservative.<sup>29</sup>

Similarly, empirical research suggests that underwriting costs can be substantial and vary across firms depending on risk and the opacity of risk. The median underwriting cost for seasoned equity offerings is 7%, and there is substantial variation around that median.<sup>30</sup> In Table 3, I will assume a 7% underwriting cost for purposes of the example.

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<sup>29</sup> The 5% haircut for illiquidity implies an annual increased required return of roughly 1% to compensate for illiquidity.

<sup>30</sup> Underwriting costs vary substantially across firms. Evidence suggests that underwriting costs vary with the riskiness of the security being placed and inversely with the size of the offering. Common stock underwriting costs are higher than convertible preferred, which are higher than preferred, which are higher than straight debt. In addition to risk, other factors also influence underwriting costs. In particular, younger, smaller, and more opaque firms, or firms issuing smaller offerings of common stock, pay higher proportional underwriting costs

Table 3 provides an example of the cumulative effects of adjusting for blackouts, illiquidity of secondary markets, and underwriting costs, using a representative example. In the example, the true value of the Bermudan option, adjusted for blackouts, illiquidity discounts, and underwriting costs is 18% below the value of the option that does not take these adjustments into account (\$8.96 rather than \$10.91).

#### **9. A gross cost estimate of ESOs requires an adjustment of stock price and volatility**

FASB's intent is to measure gross expected dilution costs from issuing ESOs. This is the answer to a counterfactual question about the dilution costs from publicly placed options, assuming that those options were sold instead of ESOs. Unfortunately, the use of unadjusted market prices and observed volatility to value counterfactual public options issued by the firm is not appropriate for the purposes of that counterfactual calculation.

As I discussed at length above, initiating or maintaining an ESO program should have, and apparently does have, on average, a positive effect on the firm's stock price. That positive effect is a measure of the extent to which the gross benefits of granting ESOs exceed their costs. It follows that, if ESOs were issued to the public rather than to employees, the stock price of the issuing firm would fall. Furthermore, the volatility of the stock price could change, as well. There are several potential effects of ESOs on stock volatility, which would typically differ across firms in their importance. If ESOs are relied upon by a firm as a source of equity capital, then their absence might encourage firms to alter their long-run target

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than other firms. Warrants issued at the money are riskier than common stock, so it is conservative to rely on empirical averages of common stock underwriting costs to estimate the costs of placing warrants comparable to ESOs. Charles Calomiris, "Banking and Financial Intermediation," in *Technological Innovation and Economic Progress*, edited by B. Steil, D. Victor, and R. Nelson (Princeton, 2002, p. 306) reports median underwriting costs for seasoned equity of 6.9%. The top quartile of underwriting costs as a percentage of equity raised averages 14%; the bottom quartile averages 4.5%.

leverage ratio, which would increase stock price volatility. On the other hand, ESOs held by top management may increase management's taste for risk. Furthermore, ESOs may be a screening device for targeting non-management employees with a lower level of risk aversion. In that case, in the absence of ESOs, volatility would decline. The sign and size of the effect of ESOs on volatility, therefore, may depend in complicated ways on the firm's access to external markets, on the size of management's holdings.

Thus, even if it were appropriate to expense ESOs, even if it were appropriate to define the counterfactual option sold to the public as a tradable option, and even if the Black Scholes model were the appropriate model for calculating the gross economic cost to preexisting shareholders, *it would still be necessary to adjust the stock price and the volatility of the counterfactual option for the fact that it was being sold to the public rather than to employees.*

The appropriate adjustment would, on average, require that the initial stock price be reduced (by an estimate of the gross benefits per share from the ESO program) and that volatility be adjusted to take into account the changes on employee and firm behavior that would result from the absence of the ESO plan. FASB does not recognize the need to make these adjustments to achieve its objective of estimating gross dilution cost. This is a major conceptual shortcoming of FAS 123.

#### **10. The importance of departures from geometric Brownian motion in stock returns**

In Section 9, I showed that, even under the assumption of geometric Brownian motion, an appropriate application of FASB's fair value rule as a measure of gross economic cost would imply substantial and hard to estimate adjustments to option valuation under FAS 123.

Here, I will summarize some of the academic literature on the ways that departures from geometric Brownian motion in stock returns further complicate option pricing and lead to further inaccuracies from the FAS 123 approach to measuring gross economic cost.

To preview my conclusion, research shows that the potential errors in valuing long-term stock options using a trailing four-year measure of volatility (which would be standard practice for valuing an ESO with an expected life of four years) to project future volatility are potentially very large. For the S&P 500 index, there is 10 percent chance that those errors will be greater than 16%. Under current knowledge, it is not possible to gauge the comparable error for individual stocks, but there are several reasons to believe that the errors would be larger. Assuming geometric Brownian motion when estimating the value of long-term stock options for individual firms likely would produce errors greater in magnitude than those for long-term S&P 500 options.

Together, my discussion of conceptual problems with FAS 123 and departures from geometric Brownian motion indicate that academic research neither supports the assumptions about the structure of options assumed under FAS 123, nor the assumptions about the underlying process that generates stock prices. I will show that realistic departures from the assumptions of FAS 123 result in substantial differences in the estimated value of options.

I will describe the important departures from geometric Brownian motion and the relevance of those departures for the valuation of long-term stock options. More detailed analysis is presented in “Option Pricing and the Data Generating Process for Equity Returns,” by Geert Bekaert, Mikhail Chernov, and myself.<sup>31</sup>

It is now well-established in the academic literature on stock returns and the pricing of stock options that geometric Brownian motion – a simplifying assumption used in the Black

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<sup>31</sup> Working paper, Columbia Business School, July 2004.

Scholes framework – is not an accurate representation of the process generating stock returns. Geometric Brownian motion implies that volatility is constant, that returns are normally distributed, that the implied volatilities of options are the same for options regardless of whether the options are in or out of the money, and that implied volatility does not vary with the maturity of the option.

In fact, however, those implications are easily shown to be false. Indeed, in the basic capital markets course taught at Columbia Business School, students are taught about these violations of the assumption of geometric Brownian motion, and are shown how, to some extent, these important empirical deviations can be explained by positing more complex models of the time series processes governing stock returns and stock returns volatility, which allow stock returns and volatility to change over time depending on each other, their own recent past, the long-run level of volatility, and the direction of returns (positive vs. negative) in the stock market.

There is no single consensus model that captures in a fully satisfactory way all the observed deviations from geometric Brownian motion that have been identified in the literature. The literature for explaining the processes governing returns and volatility for the S&P 500 – which is the returns process that receives the most attention in the literature – is still evolving. Bekaert, Calomiris, and Chernov (2004) provides an example of a simple model illustrating some of the most important deviations that have been identified in the literature. This model is by no means the “true” model, but rather a heuristic model that illustrates some important deviations from geometric Brownian motion.

If one applies a simple model of volatility and returns to the S&P 500, and compares the estimated values of long-term (four-year) European options derived from that model to the

value of European options that is derived from applying the FAS 123 Black Scholes approach, the results are striking. There are important differences between the option values implied by the (more accurate) model and those implied by the Black Scholes model, which uses trailing volatility to forecast future volatility in a manner consistent with FAS 123.<sup>32</sup> Under the assumptions of the simple alternative model, using the Black Scholes model to estimate the four-year option value results in under-valuation errors greater than 16% more five percent of the time, and over-valuation errors greater than 22% five percent of the time.

These errors likely substantially understate the amount of error that would occur in applying the Black Scholes model to the valuation of long-term S&P 500 index options for two reasons. First, the alternative model is not really the “true” model of volatility or returns. The parameters of this model are estimates measured with error. Second, the model is very simple. Recent models appearing in the literature include “jumps” in both stock returns and volatility, which can have important effects not considered here.

Even more important, the size of measurement errors for option values for *individual companies*’ long-term stock options are likely to be much larger than those for stock market indexes, for four reasons. First, the standard errors for coefficient estimates in a model of individual companies’ returns and volatilities will be larger. For example, for a firm that has existed for only twenty years, it may be very hard to estimate its long-term volatility with any precision.

Second, any reasonable model of individual firms’ returns and volatilities is necessarily more complex than the model of the index, because a model of firm-level data must distinguish between idiosyncratic and systematic influences on returns and volatility.

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<sup>32</sup> Specifically, to compute the value of a four-year option, I assume that the Black Scholes model uses the last four years of observed volatility as its estimate of future volatility. This is consistent with FAS 123’s approach to estimating volatility when there is an estimated time to exercise of four years on a firm’s ESOs.

Firm-level volatilities can be substantially larger and more variable than overall market volatility, which can lead to more pronounced differences in option valuation between the Black Scholes model and the more accurate alternative framework.

Third, there are reasons to expect that idiosyncratic volatility may regress to the mean (mean-revert) faster than the volatility of the index, especially when one takes firm life-cycle effects into account. As firms mature, volatility and returns are less prone to dramatic sudden change (“jumps”), which can imply a substantial reduction in long-term expected volatility for young, small firms. This can produce large differences between the alternative model’s estimate of option values and the Black Scholes estimate.

Fourth, no satisfactory model has been constructed yet for individual stock returns and volatility analogous to the S&P 500 model. The reason is twofold: First, this is an enormously challenging undertaking. Second, given the virtual absence of very long-term traded options, it is perhaps understandable that financial economists have not been drawn to explore the pricing effects of long-term swings in volatility on options.

In summary, realistic deviations from geometric Brownian motion in individual stocks are likely to imply large potential errors from assuming the framework of FAS 123 to measure the value of long-term stock options. The potential size of those errors is not known at present, but (judging from the evidence regarding the S&P 500 index) it is reasonable to surmise that more than 10 percent of the time valuation errors would exceed 20 percent.

One could argue that some of the measurement errors described in Sections 6-10 could be minimized if firms were permitted to devise their own customized methods for valuing ESOs. Indeed, some observers interpret FASB’s proposed amendments to FAS 123 as allowing an extraordinary amount of latitude to firms in modeling the costs of ESOs. The



extent to which firms would have latitude is unclear, but three points warrant mention: First, permitting firms to develop their own models of options valuation may not improve accuracy, since firms will have an incentive to selectively choose assumptions that minimize measured cost. Second, greater discretion in modeling will undermine the comparability and consistency of accounting standards.<sup>33</sup> Third, many of the measurement problems described here cannot be solved under existing knowledge by simply allowing firms to generate more complex models of options pricing. Under existing knowledge, there simply is no agreed upon answer, or approach to finding an answer, to many of the daunting measurement problems described here.

## 11. Conclusions

This essay has tried to draw on logic and evidence from financial economics to shed light on the intense debate over the expensing of ESOs. I draw the following conclusions:

1. ESOs are not an expense of the issuing firm.
2. ESOs create gross costs and gross benefits to the preexisting shareholders of issuing firms, and on average, the benefits should, and apparently do, outweigh the costs.
3. Firms only suffer an opportunity cost from issuing ESOs if the ESOs they grant entail net costs to shareholders. On average, ESOs do not represent an opportunity cost to issuing firms.
4. From the standpoint of *managerial* accounting, management should weigh the costs and benefits to its shareholders when deciding whether to grant ESOs.

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<sup>33</sup> See Kevin A. Hassett and Peter J. Wallison, "The Economic and Legal Consequences of Requiring the Expensing of Employee Stock Options Without Specifying the Valuation Method," Working Paper, American Enterprise Institute, 2003.

5. If the intent of proposed expensing under GAAP is to incorporate appropriate managerial accounting into financial accounts, then it would be improper, and misleading to investors, to include gross costs of ESOs and not gross benefits.
6. Expensing ESOs creates the undesirable consequence of the double counting of dilution costs in the earnings per share ratio.
7. There are multiple and substantial measurement problems associated with gauging even the *gross* costs of dilution from ESOs, even under the simplifying assumption that it is appropriate to measure expected dilution costs using counterfactual *tradable* ESOs. The errors in measuring gross dilution costs cannot be bounded given current knowledge.
8. Allowing firms to exercise discretion in modeling the costs of ESOs will undermine the credibility, consistency, and comparability of firms' accounts. Furthermore, modeling discretion is of dubious value; under existing knowledge, there simply is no agreed upon answer, or approach to finding an answer, to many of these daunting measurement problems.

In light of the conceptual and measurement problems associated with the expensing of ESOs, I conclude that expensing is not a desirable policy. The legitimate goal that motivates advocates of expensing (i.e., ensuring that unsophisticated investors are aware of the gross dilution costs of ESOs) would be better achieved by an alternative approach. Specifically, it would be better to require that firms estimate expected dilution from existing ESOs on an ongoing basis, and include those estimates in the *denominator* of a constantly updated calculation of earnings per share. That statistic could be given a prominent place in the public

reports of the firm, and would be available as an important source of information for investors.

The computation of expected dilution (that is, the estimate of the number of shares granted that are expected to be converted in the future) would, of course, be subject to the same measurement errors noted in Sections 6-10 above. But the *consequences* of those errors would not be the same. First, there would not be double counting of dilution costs. Second, there would not be any potential for confusion on the part of investors about the actual expenses of the firm, or the warranted value of the firm. Third, avoiding expensing would eliminate the incorporation of unreliable and misleading measures of “cost” in the firms accounting earnings. Fourth, expected dilution costs could be updated on an ongoing basis, so that changes in stock prices and volatility could be reflected in forward looking estimates of dilution.

This forward-looking approach to measuring dilution would allow stockholders to take account of dilution before it occurs (an improvement on the current system of measuring earnings per share), and would provide a more accurate measure of future dilution than expensing, since FASB’s proposal would fix the magnitude of expensing at the grant date and not update it.

Table 1

## Summary Statistics of Variables in Cross-Sectional OLS Regressions for 1995

Variable	Mean	Median	Std. Dev.	10 <sup>th</sup> percentile	90 <sup>th</sup> percentile
Log (Price / Non-Dil. EPS (Excl. Ext. Items))	3.010	2.885	0.917	2.140	4.122
Log (Price / Non-Dil. EPS (Incl. Ext. Items))	2.996	2.883	0.974	2.098	4.145
Log (Price / Fully Dil. EPS (Excl. Ext. Items))	3.160	3.019	0.940	2.255	4.310
Log (Price / Fully Dil. EPS (Incl. Ext. Items))	3.146	3.019	0.994	2.218	4.348
Opts / (Exist. Shares + Opts)	0.095	0.084	0.073	0.000	0.184
Log (Sales)	4.377	4.529	1.479	2.430	6.287
(Log (Sales)) <sup>2</sup>	21.343	20.510	12.089	5.942	39.521
Sales Growth <sub>-1</sub>	0.426	0.181	2.832	-0.040	0.727
Earn. Growth (Excl. Ext. Items)	0.153	0.021	2.107	-0.029	0.196
Earn. Growth (Incl. Ext. Items)	0.156	0.021	2.061	-0.032	0.213

Notes: Definitions of variables: The price-earnings ratios are all for 1995. Specifically, price is observed at the end of the period for which earnings are measured. Non-Diluted earnings per share (EPS) defines EPS using only outstanding common stock in the denominator of EPS. Fully Diluted EPS defines EPS using outstanding common stock plus all shares reserved for conversion related to options, convertible preferred stock, convertible debt, warrants, and other securities. Extraordinary items are either included or excluded in alternate specifications of the Price/EPS regressions. "Opts" are shares reserved for stock options outstanding plus options that are available for future grants. Opts / (Exist. Shares + Opts) is the ratio of shares reserved for options to the sum of shares reserved for options and outstanding common stock. Sales are in millions of dollars for 1995, as reported in Compustat. Sales growth is the percentage growth in sales from 1994 to 1995. Earnings growth is defined as earnings (either excluding or including extraordinary items, depending on the regression) in 1995 minus earnings in 1994, divided by sales in 1994. This definition of earnings growth avoids problems that result from scaling by past earnings when earnings are negative. All data are from Compustat. Compustat labels a company's fiscal year to be 1995 if the fiscal year ended between June 1, 1995 and May 31, 1996.

**Table 2**  
**The Effect of Options on Price-Earnings Ratios**  
**Cross-Sectional OLS Regressions for 1995**

<u>Dependent Variable</u>	<u>Independent Variables</u>					# Obs	Adj R <sup>2</sup>
	Optns / (Exist. Shares + Optns)	Log (Sales)	(Log (Sales)) <sup>2</sup>	Sales Growth <sub>-1</sub>	Earn. Growth <sub>-1</sub>		
Log (Price / Non-Dil. EPS (Excl. Ext. Items))	0.624 (0.245)	0.179 (0.046)	-0.019 (0.006)	0.026 (0.007)	-0.005 (0.009)	3,098	0.136
Log (Price / Non-Dil. EPS (Incl. Ext. Items))	0.563 (0.260)	0.242 (0.046)	-0.025 (0.006)	0.034 (0.007)	-0.013 (0.009)	3,095	0.137
Log (Price / Fully Dil. EPS (Excl. Ext. Items))	2.328 (0.245)	0.160 (0.046)	-0.017 (0.006)	0.029 (0.007)	-0.006 (0.009)	3,098	0.172
Log (Price / Fully Dil. EPS (Incl. Ext. Items))	2.263 (0.261)	0.221 (0.046)	-0.023 (0.006)	0.038 (0.007)	-0.015 (0.009)	3,095	0.170

Notes: Definitions of dependent variables: The price-earnings ratios are all for 1995. Specifically, price is observed at the end of the period for which earnings are measured. Non-Diluted earnings per share (EPS) defines EPS using only outstanding common stock in the denominator of EPS. Fully Diluted EPS defines EPS using outstanding common stock plus all shares reserved for conversion related to options, convertible preferred stock, convertible debt, warrants, and other securities. Extraordinary items are either included or excluded in alternate specifications of the Price/EPS regressions. All regressions include indicator variables for each four-digit SIC coded industry, which capture industry-specific averages for Price/Earnings ratios. Those coefficients are not reported here. "Optns" are shares reserved for stock options outstanding plus options that are available for future grants. Optns / (Exist. Shares + Optns) is the ratio of shares reserved for options to the sum of shares reserved for options and outstanding common stock. Sales are in millions of dollars for 1995, as reported in Compustat. Sales growth is the percentage growth in sales from 1994 to 1995. Earnings growth is defined as earnings (either excluding or including extraordinary items, depending on the regression) in 1995 minus earnings in 1994, divided by sales in 1994. This definition of earnings growth avoids problems that result from scaling by past earnings when earnings are negative. All data are from Compustat. Compustat labels a company's fiscal year to be 1995 if the fiscal year ended between June 1, 1995 and May 31, 1996. Coefficient standard errors are given in parentheses.

**Table 3**

**Bermudan Option Calculation  
Assuming Geometric Brownian Motion of Returns  
and 12% Annual Termination Risk**

Expected Life of Option	5.5 years
Riskless Interest Rate for Expected Life	4.8%
10-year Riskless Rate	5.2%
Volatility	35%
Annual Dividend Yield	2.5%
Contractual End Date	10 years
Implied Bermudan End Date	8.48 years
<b>Bermudan Option without Adjustment for Blackouts</b>	<b>\$10.91</b>
Bermudan Option with Adjustment for Blackouts	\$10.18
<b>Option Adjusted for Issuing and Illiquidity Costs</b>	<b>\$ 8.96</b>

Note: Options are issued at the money on stock with a price of \$50. Matched maturity under termination risk and the corresponding Bermudan option value are determined as follows. First, the maturity of the Bermudan option ( $T^*$ ) is determined by matching the conditional expected exercise time (conditional on exercise occurring after the vesting date) to the option's expected duration (5.5 years). The value of the Bermudan option under termination risk is then computed using the matched maturity with a vesting period of 3 years. Specifically, let  $\tau$  be the random option exercise time. Then, the conditional expected time to exercise post-vesting is  $E(\tau / \tau > \nu)$  where  $\nu$  is the vesting period (3 years). The option's expected duration matching condition involves finding the maturity  $T^*$  so that  $E(\tau / \tau > \nu) = \text{duration}$  (e.g. 5 in the case of category 1). The probabilities needed in this computation are obtained from exercise probabilities produced by the CRR binomial tree extended to include termination risk. The option pricing model is based on a special case of Pandher (2003, *Journal of Derivatives*) with a single option termination risk. Blackouts occur randomly in half of the trading days post-vesting. The last line of the table adjusts the Bermudan option value for the issuing and illiquidity costs, which are assumed conservatively to be 12%.