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Options Pricing and Accounting Practice

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I. Introduction

In the wake of the recent corporate scandals that have damaged investor confidence, policymakers, academics, and pundits have taken aim at accounting rules as one of the areas in need of reform. Proposals for changing the rules governing the accounting for the granting of stock options has become one of the most hotly contested areas. Advocates of reform argue that options are a form of compensation and that granting options entails real costs to stockholders. They argue that it follows that options should be included as an expense item in the firm's financial statements.

In this article, we consider the potential benefits and costs of requiring the expensing options. First, we show that the potential benefits of developing rules for expensing options would be small, even if the valuation of the options were straightforward. Second, we review practical problems that make it extremely difficult to create a set of accounting conventions that would properly value the options. We conclude that the establishment of new accounting rules for expensing options would likely do more harm than good.

II. How Big Are Potential Gains from Establishing a Standard for Expensing Options?

At the outset, it may be useful to review the purpose of regulating *accounting conventions* and to distinguish that regulation from the regulation of the *disclosure of information*. Financial economists typically argue for the irrelevance of accounting measures of earnings for the purpose of valuing stock prices. In finance theory, the standard approach to valuing corporate equity is to estimate future periods' "free cash flows" (the amount of actual operating revenue less cash expenses and cash outlays for

investment) and then discount that stream of expected free cash flows by the appropriate discount rate (the riskless rate plus the appropriate equity risk and liquidity premium for the firm's equity). Students taking an advanced corporate finance course in business school are taught to look beyond the accounting conventions, and to trace the actual streams of cash received and paid by the firm.

Financial economists do not see accounting conventions, or the regulation of accounting conventions, as having an important effect on market prices. Market prices are determined by informed buyers and sellers who devote their energies to estimating free cash flow and deriving the appropriate discount factors to apply to free cash flow estimates. Even if informed investors constitute only a small fraction of the total number of buyers and sellers, they play a central role in determining securities prices *on the margin* as buyers and sellers, because they can marshal substantial resources to buy when prices are low and sell when prices are high relative to their informed view of appropriate valuation.

Accounting regulation can be useful as a form of investor protection, a means for ensuring that small investors who do not perform sophisticated valuations of firms have at least a basic set of numbers that can be used to gauge the type of firm in which they are investing. For example, a small investor may wish to know "true earnings" so that he or she would be better able to select high-growth firms (those with a high price-to-earnings ratio) for inclusion in his or her portfolio. Accounting conventions, therefore, may be useful to small investors that wish to engage in stock picking if those conventions ensure that reported earnings are close to true earnings. By the same token, accounting conventions that add noise to earnings may harm individual investors by making it harder

for them to identify true earnings. Of course, a fundamental problem in this argument for the importance of accounting measures as a form of investor protection is that it presumes that small investors should be picking individual stocks – a presumption that is inconsistent with conventional financial wisdom. Investors who are not sophisticated enough to perform valuation properly would be better off investing in stock index funds, which would permit them to construct diversified portfolios that cater to their investment preferences without having to concern themselves about choosing particular firms in which to invest.

Furthermore, even if it were true that the accuracy of accounting measures of earnings were important, either for sophisticated or unsophisticated investors, it does not follow that the *regulation* of accounting standards would be important. In today's information age, it is probably not desirable to try to impose a single accounting standard through regulation. In bygone days, when paper accounting reports created within firms and circulated to the public by mail were the only means for transmitting information to analysts or to investors, one could argue that it was useful to standardize accounts using a single accounting standard. But in today's world, it is now possible for the relevant facts disclosed by firms to be stored on a spreadsheet, and for analysts to access these spreadsheets on the web, and compete for investor advisory services by showing that their approaches to valuation (and their chosen accounting conventions used as part of that valuation) are superior to those of their competitors (e.g., for forecasting earnings, stock prices, etc.). In today's world, investors are no longer bound by the choices firms make about how to state their accounts. An investor who prefers international accounting standards over GAAP, for example, can have a firm's earnings restated using those

standards. In the information age, investors increasingly will benefit from competition among accounting standards, not uniformity.[1]

Thus our argument that the potential benefits of developing a single accounting standard for measuring the cost of stock options are small (or non-existent) consists of the following observations: Accounting standards cannot substitute for an in-depth analysis of free cash flows by sophisticated analysts. Accounting standards may not be helpful for unsophisticated investors, even if those investors insist (unwisely) on engaging in stock picking, because uniformity limits competition. Competition among various analysts to provide estimates of earnings using the analyst's chosen accounting definitions would enhance the quality of information available to investors, and strengthen the ability of skilled analysts to develop their reputations among investors. From these perspectives, accounting regulation is useless at best, and possibly costly to individual investors. The potential costs could result from (a) the noise produced in accounting earnings by the decisions by the FASB about "true earnings" are ill-advised, and (b) the reduced competition in the market for information production by analysts that results from the imposition of a GAAP standard.

It is important to distinguish between the unimportance and undesirability of regulating accounting standards, on the one hand, and the potential usefulness of providing standardized definitions of income and expense concepts for purposes of disclosure. It may be useful for the government to define "revenue" for the purpose of accurate disclosure, and to require that firms abide by that definition when disclosing their revenues. Such disclosure standards could enhance the ability of sophisticated investors to perform accurate valuations of firms, and could foster competition among

[1] See Litan and Wallison (2000).

analysts. It is worth noting that, with respect to employee stock options, basic information about options is already disclosed to investors. While it may be worth considering whether there might be means of improving the disclosure of relevant facts about stock options, that would be an issue for the regulation of disclosure, not accounting.

III. Would a Simple Accounting Standard Introduce Inaccuracies into Firms' Accounts?

Notwithstanding the observations that we have made thus far about the potential problems of imposing regulatory standards for expensing stock options, if the valuation of stock options were a trivial quantitative exercise, so straightforward and non-controversial that different analysts would all end up using identical methods to value them, then there would be little harm in establishing an accounting convention for expensing options. Unfortunately, that is not the case. The valuation of stock options is a highly complex endeavor, an area where reasonable people can, and do, disagree significantly. The notion that all one needs to do is apply "the obvious formula" to value the options is simply false. There is no obvious formula to apply.

Differences of opinion about the values to attach to options are widespread. Consider, for example, the valuation of Microsoft's options. Microsoft recently worked out a deal whereby employees were allowed to sell their options to J.P. Morgan Chase. About half of Microsoft's employees agreed to sell their options, and the sales prices for the options were reported to be a fraction of the Black-Scholes value of the options.[2]

[2] According to the Seattle Times (July 9, 2003), options with a strike price of $45 were expected to be purchased for $0.25. According to a Black-Scholes valuation model, those options should have been worth roughly $8 (assuming a seven-year term, and 39% volatility). There are several possible explanations (explored below) for this difference. J.P. Morgan may have assumed a shorter effective option term, or a lower volatility, or may have discounted the options for illiquidity, or may have assumed a less positive stock price trend. Microsoft's 10-K report, filed on September 5, 2003, valued its average stock options granted in 2001, 2002, and 2003, using the Black-Scholes formula at prices ranging from $12.08 to $15.79.

In this section, we briefly review the problems of valuing employee stock options, The theoretical controversies relating to option valuation divide into four broad groups, relating to: (1) the economics of valuing non-cash expenses in cash terms, (2) the valuation of highly illiquid options using option-pricing models based on the assumption of perfect liquidity, (3) technical disagreements regarding assumptions about the distribution of returns on underlying assets, or other important parameters relating to the fundamental underlying value of the assets on which the options are written, and (4) differences between the incentives of workers, on the one hand, and market participants, on the other hand, in their strategies regarding the exercising of options.

A. Calculating Cash-Equivalent Values of Option "Expenses"

Option "expenses" represent a cost to shareholders through the dilution of shareholders' wealth that occurs when the stock is transferred to employees. But, from the firm's standpoint, the shadow cost of issuing the stock options may be substantially less than the counterfactual cost of transferring an equivalent amount of cash to the employees. For some firms, a dollar of cash in the form of retained earnings is worth more than a dollar of proceeds from a stock offering. For example, if a firm is raising money on the margin from the stock market (or expecting to have to do so in the near future), then a dollar more of cash available to finance investment can be worth as much as $1.50 in stock sales. In other words, for some firms, $1.50 in gross proceeds from the sale of stock may only increase the value of the firm by $1.00. That is because stock sales entail costs to the firm. These costs consist of (a) expected underpricing of the offering (especially if the announcement of the offering depresses the stock price), and (b) fees

and expenses associated with the offering).[3] For some firms (small, growing firms with large investment needs and low or negative levels of current free cash flow) that difference in the value of cash or stock proceeds could be substantial; for other firms (large, stable firms with high positive levels of current free cash flow) the cost difference between cash and stock would be very small.[4]

Two points warrant emphasis. First, there is a cash premium, implying that the cost to the firm of paying $1 million in cash compensation to employees is typically greater than the cost to the firm of paying $1 million worth of stock options to employees. Second, the cost difference between these two forms of payment is highly *firm-specific*, as it depends on the extent to which the particular firm values cash (as a means of reducing its dependence on high-cost external finance). Thus, an accounting rule that assumes cash equivalence of options for expensing overstates the expense of the options, and overstates the expense more for some firms than for others.

As we discussed above, it is unlikely that sophisticated investors would react to this overstating of employee stock option costs. But, to the extent that investors would take such a measure of (overstated) expenses seriously, a uniform accounting treatment of stock options would tend to penalize firms in growth industries the most, since they are the firms with the largest cost differences. That penalty could conceivably distort decisions by growing firms that heretofore have relied on stock options to conserve on

[3] Underpricing of stock for initial public offerings may be as large as 48% for best-effort IPOs, but for firm commitment IPOs is less than one-third that amount (Ritter 1987). For seasoned equity offerings, average price reactions to the announcement of an offering are roughly -3%. Transactions costs for seasoned equity offerings averaged 6% in 1999, and for IPOs in 1999 averaged 9.3%. (See Calomiris 2002). The average of the top quartile of issuers (those with the highest costs) were roughly double those averages (see Calomiris and Himmelberg 2003).

[4] Calomiris and Himmelberg (2003) discuss ways of estimating cross-sectional differences in this cost differential. Calomiris and Hubbard (1995) explore other evidence for the importance of the cost difference between internal and external equity finance.

scarce cash, leading them to reduce their future reliance on stock options as a form of compensation. Such a decision could reduce investment by such firms, and might also have negative consequences for managerial effort (given that stock options serve an important role in providing incentives for managerial effort).

B. Illiquidity Discounts on Stock Options

Employee stock options tend to be less liquid than options that are issued to investors, for two reasons. First, unlike options issued as a means of raising capital, employee options may be customized to affect the incentives of employees. Customized features (e.g., indexed strike prices and delayed vesting) that are useful features of employee stock options – which tend to maximize their usefulness as incentive devices – also tend to reduce the liquidity of the options (the ability of a holder to quickly find a willing buyer for the option in the market).

Second, firms with stock trading in illiquid markets (small, growing firms) – many of which are highly reliant on stock options to compensate management – will tend to offer options that are particularly illiquid because the underlying securities on which they are written are illiquid.

The implications are that, as before, models of option prices that abstract from illiquidity (e.g., the Black-Scholes model) will tend to overstate the cash-equivalent cost of option "expenses," and this overstatement will be particularly pronounced for young, growing firms. As before, to the extent that investors would take such a measure of (overstated) expenses seriously, a uniform accounting treatment of stock options would

tend to penalize firms in growth industries the most, since they are the firms whose options will tend to be most illiquid.

C. Valuation of Underlying Assets

Stock options are derivative instruments whose values depend on the value of the underlying assets (corporate equity) on which the options are written. To value the options, one must value the underlying assets and design a model that captures the way the future trajectory of the value of the underlying assets depends on the various potential states of the world that may occur in the future. As part of that model, one must decide the extent to which asset values tend to move continuously or discretely (via jumps), the distribution of returns on the underlying assets (e.g., normal, or some other distribution), and the extent to which asset values are serially correlated over time.

It turns out that there is substantial disagreement about these assumptions in the academic literature modeling options pricing. Furthermore, there is no reason to believe that there should be a "one size fits all" approach to modeling underlying assets. One set of assumptions may be more appropriate for some firms than for others. For example, perhaps the appropriate assumptions about the distribution of equity returns of small firms in high-growth sectors are different from the appropriate assumptions about the distribution of returns for established firms in stable sectors.

The literature evaluating stock option modeling has very explicitly addressed this issue, and there is significant disagreement about how to address it. The value of the option depends on the data generating process that is assumed to govern the movements of the underlying asset price. The Black-Scholes formula assumes that the data

generating process is a geometric Brownian motion. It does so for mathematical convenience, not because the assumption has especially strong empirical merit. In particular there is significant evidence that U.S. stock returns deviate significantly from geometric Brownian motion, with studies documenting skewness (a lopsided shape to the returns distribution), excess curtosis (a non-normal tendency for too much of the distribution to lie in the extreme values), serial correlation (momentum or its opposite, mean reversion) and time-varying volatilities.[5] Given these vast and significant departures, alternative measures have been pursued, with the most promising being those that rely on Monte Carlo simulation and nonparametric estimators. (See , for example, Ait-Sahalia and Lo, 1996).

Campbell, Mackinley and Lo (1997) give a simple example that documents how significant these factors can be. For a hypothetical asset with returns that are possibly negatively autocorrelated, they compare the options price that results from Black-Scholes calculations to the "correct" price that accounts for the known autocorrelation. They provide the following table:

[5] See Campbell, Lo, and Mackinley (1997), p. 379.

Option prices on assets with negatively autocorrleated returns.

Strike Price	Black-Scholes Price	Trending O-U Price, with Daily $p_t(1)$ =					
		-0.05	-0.10	-0.20	-0.30	-0.40	-0.45
Time-to-Maturity T-t = 7 Days							
30	10.028	10.028	10.028	10.028	10.028	10.028	10.028
35	5.036	5.037	5.038	5.042	5.051	5.074	5.108
40	0.863	0.885	0.910	0.973	1.062	1.216	1.368
45	0.011	0.013	0.016	0.024	0.041	0.082	0.137
50	0.000	0.000	0.000	0.000	0.000	0.001	0.005
Time-to-Maturity T-t = 182 Days							
30	11.285	11.336	11.394	11.548	11.786	12.238	12.725
35	7.558	7.646	7.746	7.998	8.365	9.014	9.668
40	4.740	4.851	4.976	5.286	5.728	6.491	7.244
45	2.810	2.922	3.048	3.361	3.812	4.595	5.375
50	1.592	1.687	1.797	2.073	2.482	3.214	3.963
Time-to-Maturity T-t = 364 Days							
30	12.753	12.845	12.950	13.218	13.620	14.349	15.102
35	9.493	9.622	9.769	10.133	10.661	11.582	12.501
40	6.908	7.061	7.234	7.660	8.269	9.315	10.343
45	4.941	5.102	5.283	5.732	6.374	7.478	8.566
50	3.489	3.645	3.821	4.261	4.896	6.003	7.106

The differences across the table columns are striking. The value of an option is estimated with less precision by Black-Scholes the farther away the maturity date and the higher the strike price. The Black-Scholes estimate can be off by a factor of two. These results likely significantly understate the inaccuracies of Black-Scholes when applied to employee options, since these can have very long maturities.

For our purposes, the key observation is that other concerns such as non-normal shapes of distributions, the degree of autocorrelation, and the method of parametric or nonparametric estimation technique chosen can have equally powerful results on the possible value of an option, and there is no consensus view from the academic literature to guide firms when choosing the appropriate model to apply for accounting purposes.

Accordingly, one can expect that two identical firms will almost necessarily arrive at significantly different estimates for their accounting statements, unless specifically guided in great detail by FASB. However, FASB would not be able to base such guidance on any consensus surrounding a specific model, as no such consensus exists.

D. Differences between the Exercising Strategies of Employees and Market Participants

The cost to a firm of granting a stock option depends not only on the three factors previously mentioned (external finance costs, liquidity, and the underlying asset returns process), but also on the strategies of the holder with respect to exercising the option. As has been widely recognized, even by proponents of expensing options (e.g., Bodie, Kaplan, and Merton 2003), the probability and timing of the exercising of options by employees will differ from the probability and timing of the exercising of those same options by holders in the market.

Employees face special limitations not faced by market participants. Their options may be forfeited if they leave the company, and they are not allowed to hedge the idiosyncratic risk from holding their options or to post the options as collateral. Special restrictions on employees (for example, black-out periods) also influence the specific timing of the exercise of options. These special limitations result in an average propensity for employees to be less able to exercise options, and to choose to do so sooner than a market participant would. Bodie, Kaplan, and Merton (2003) admit that "some adjustment should be made for forfeiture and early exercise" (p. 6). They argue that this adjustment will be quite complex, as "the actual magnitude of these adjustments needs to be based on specific company data, such as stock price appreciation and distribution of

option grants among employees" (p. 7).[6] In other words, an accurate accounting standard that would apply to all firms, and that would take account of the extent to which forfeiture and early exercise were likely to occur, would be virtually impossible to devise (see also Hassett and Wallison 2003).

IV. Conclusion

There is no convincing argument in favor of requiring firms to expense employee stock options according to a new FASB rule. Informed investors already have the necessary information to value employee stock options for themselves and can use those valuations to value the stock of the firms that use stock options as compensation. Neither are unsophisticated investors in need of new accounting rules about stock options. Given the highly controversial aspects of measuring the costs of these options, that task is best left to the competitive information processing that takes place in financial markets. In the information age, accounting regulation should, and probably will, give way over time to a more flexible, competitive approach to information transmission about firms in which accounting rules have little effect on the way analysts portray firms' accounts to investors.

The primary role for regulation should be in the area of disclosure, which will ensure that competing approaches to measuring option costs are based on the same basic information. Competing analysts can apply their own valuation approaches to companies,

[6] It has been suggested that the large difference between the Black-Scholes and J.P. Morgan valuations of Microsoft's employee options, alluded to above, is traceable in part to J.P. Morgan's assumption that the holding period relevant for the employees was much shorter than that implied by a standard Black-Scholes option pricing model (e.g., two years rather than seven years). In other words, it may be that J.P. Morgan priced the options based on its belief that employees (who faced special incentives to exercise early) would be willing to sell the options at significantly less than their Black-Scholes value. We have been unable to verify this hypothesis, since the details of the options pricing approach taken by J.P. Morgan are not public information.

and the market can select among competing approaches by comparing their track records of relative success in forecasting stock prices over time.

Standardized rules for valuing stock options are liable to introduce noise and distortions into reported earnings. There is no single "correct formula" to apply to the problem of valuing options. Option valuation entails highly controversial distributional assumptions and assumptions about diffusion processes for underlying securities prices, which may also differ across firms. Employees face different incentives to exercise stock options than market participants, further complicating valuation. Additionally, the use of options rather than cash entails different cash-equivalent costs for firms in different circumstances. Furthermore, the illiquidity of stock options also implies differential costs, as options that are more liquid are worth less to employees.

Option valuation is a complex *valuation problem* that is best left to market analysts to estimate and debate. It is disingenuous, and not helpful to investors, to pretend that this difficult valuation problem can be solved adequately by an accounting rule. To the extent that the regulation of accounting rules matters, requiring firms to adopt a one-size-fits-all approach to option valuation using a standardized model of option pricing will tend to mislead investors by misstating the cost of stock options, and overstating the cost of stock options for small, growing firms, for whom illiquidity discounts and high shadow costs of raising external capital are particularly large.

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