The Treasury Stock Method Understates the Economic Dilution of Employee Stock Options in EPS

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First draft: July 1999
Current version: January 2000

We appreciate the research assistance of Irina Faykina, Nazgol Ghandoosh, and Christine Phillips. We thank Bill Baber, Bob Holthausen, Adam Koch, Jim Leisenring, Fred Lindahl, Bob Lipe, P.K. Sen, and workshop participants at Boston University, Columbia University, George Washington University, University of Oklahoma and the Financial Economics and Accounting Conference at the University of Texas at Austin. Core and Guay gratefully acknowledge the financial support of the Wharton School.

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Abstract

We show that the treasury stock method of accounting for the dilutive effects of outstanding options systematically understates the dilutive effect of stock options, and thereby overstates diluted earnings per share. We derive a formula for the economic dilutive effect of stock options and recalculate economic diluted earnings per share using firm-wide data on 731 employee stock option plans. Our results show that, on average, economic dilution from options is 200% greater than reported dilution using the treasury stock method required by SFAS No. 128. Incremental dilutive shares from stock options in the denominator of economic diluted EPS averages 4.5% of common shares outstanding compared to 1.5% in reported diluted EPS. The gulf between the two measures of dilution is substantially larger for relatively intensive users of stock options.

To demonstrate that our economic dilutive effect of stock options is economically meaningful, we estimate the return-earnings relation with and without the economic dilution due to stock options. Because reported diluted EPS *a la* SFAS 128 underestimates the economic dilution of options, we hypothesize that, *ceteris paribus*, the market response to earnings will be decreasing in economic dilution from options. Consistent with this prediction, we find that, controlling for the dilution implied by the SFAS 128 treasury-stock method, the relation between returns and reported earnings is negatively related to the economic dilution from options.

1. Introduction

Firms are using employee stock options more frequently and in sharply larger quantities than just a decade ago (Hall and Liebman, 1998). This rapid growth has drawn intense scrutiny from the investment community, including individual and institutional shareholders, analysts, standard setters, and regulators. Because of concerns about dilution, some institutional shareholders are refusing to approve additional stock options grants for firms with large amounts of options outstanding. In addition to the general concern that the benefits from the incentive effects of stock options may not outweigh their costs to shareholders, many voice a serious concern that diluted earnings per share (diluted EPS) understates stock options' effect on corporate earnings.

As a summary assessment of a corporation's current performance, the EPS number and forecasts of expected EPS are central to fundamental analysis, equity valuation, and performance evaluation (e.g., Frankel and Lee, 1998; Dechow, Hutton, and Sloan, 1999). Investors and analysts have at least two concerns about the economic impact of employee stock options on EPS. First, what are a firm's earnings net of the compensation expense for newly granted employee stock options; that is, what is the appropriate *numerator* in the EPS calculation? Second, regardless of how income reflects the cost of newly granted stock options, how much do firms' outstanding options (i.e., previous grants) dilute existing shareholders' claims; that is, what is the appropriate *denominator* in the EPS calculation?

While we document that both of the above concerns have a substantial effect on EPS, this study addresses only the mis-measurement of the *denominator* in the EPS calculation. Regardless of whether new grants of options are expensed in the numerator, it is important that the number of dilutive shares in the denominator of EPS accurately reflect the dilution that new and previously granted options cause common stockholders.[1] To illustrate this denominator effect, consider a firm that has vested employee stock options outstanding, but has granted no new options, so that there is no argument that earnings in the numerator of EPS should be reduced by the expense of a new option grant. Because the firm has employee stock options outstanding, its earnings do not accrue solely to the common stockholders. This is because the value of the outstanding options is directly linked to the value of common stock. Thus, both the optionholders and stockholders have an economic claim on the firm's earnings, which should be reflected in the denominator of diluted EPS through an adjustment to diluted shares outstanding.

We formalize the above intuition by deriving a method to partition earnings between stockholders and optionholders based on their relative economic claims. In our analysis, we assume that the changes in the value of a firm's equity (the value of common stock plus the value of any outstanding options) are driven by changes in expected future earnings. When firms with no options outstanding experience a shock to expected earnings, the resulting change in equity value accrues entirely to common stockholders. However, in the presence of options, the change in equity value is shared between the firms' common stockholders and optionholders.

We show that the portion of the change in equity value captured by optionholders is a function of the number of options outstanding and how sensitive the value of outstanding stock options is to a change in the stock price. At the limit, the value of an option that is substantially "in the money" moves one for one with the stock price. As such, this option has a claim on firm performance that is roughly

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[1] The expensing of new option grants continues to attract public debate and attention. Statement of Financial Accounting Standards No.123, "Accounting for Stock-Based Compensation" does not require firms to expense most stock option grants, but does require an estimate of expense to be disclosed in the footnotes to the annual report. There is widespread sentiment among market participants that the current calculation of employee stock options expense according to Financial Accounting Standard Board's (FASB) recently issued Statement No. 123 on "Accounting for Stock-Based Compensation" understates the true expense (see, for example, *The Economist*, 1999, pp. 13-14 and 18-20).

equivalent to that of a share of common stock. On the other hand, the value of an option that is "out of the money" moves less than one for one with the stock price. This type of option has a smaller claim on firm performance than a share of common stock. We use this relation to allocate earnings between stockholders and optionholders and show that the earnings allocated to stockholders can be scaled by common shares outstanding to obtain a measure of economic diluted EPS that accurately represents the per share claim that common stockholders have on the firm's earnings.

SFAS No. 128 diluted EPS. Accounting standard setters recognize the need to account for stock options appropriately in the denominator of earnings per share. In 1969, Accounting Principles Board Opinion No. 15 required firms to convert outstanding stock options into an equivalent number of common shares and add these equivalent shares to the denominator of EPS to obtain primary and fully diluted EPS. Later, in 1997, Statement of Financial Accounting Standard No. 128 (SFAS No. 128) made minor adjustments to the treatment of stock options in calculating a diluted measure of earnings per share (diluted EPS). SFAS No. 128 prescribes the treasury stock method to calculate the number of incremental dilutive shares from options that are added to the denominator of diluted EPS. Under the treasury stock method, the number of dilutive incremental shares for each outstanding option is equal to (P-X)/P, where P = price per share of the firm's common stock and X = exercise price of each option.

We argue that the treasury stock method of computing the dilutive effects of employee stock options: i) Understates the actual economic dilution that shareholders experience from outstanding stock options; and ii) Generates a diluted EPS number that understates the implied revision in market valuation per share, as inferred from a return-earnings relation.

The economic intuition for why the treasury stock method understates the economic dilutive effect of stock options is straightforward, and is best illustrated by considering a firm that has outstanding employee options that are at-the-money (i.e., the option exercise price is equal to the stock price). Under the treasury-stock method, the number of incremental dilutive shares from options equals (P-X)/P, or zero incremental shares in the case of at-the-money stock options. However, the firm's existing shareholders do experience dilution from these options. Because the value of at-the-money options are sensitive to changes in stock price, these optionholders share in any increase in equity value that results from an increase in earnings. That is, the optionholders benefit from the increase in equity value at the expense of the current shareholders. We show later in the paper that this intuition is also applicable to in-the-money and out-of-money options.

Summary of results. We show that diluted EPS calculated according to SFAS No. 128 systematically underestimates the economic dilution of employee stock options. In a sample of 731 large firms over the period 1994-1997, we find that the economic dilution of stock options implies a number of incremental shares that is, on average, as much as 200% larger than the incremental shares computed via the treasury stock method. The average dilutive incremental shares due to stock options, as a fraction of weighted average common shares outstanding, is 1.46% using the treasury stock method compared to economic dilution of 4.54%. Because of this understatement of dilution, the treasury stock method conveys to investors that, on average, optionholders' share of earnings amounts to about $4.8 million, whereas our analysis of economic dilution indicates that optionholders' share of earnings is $12.2 million. The degree to which the treasury stock method underestimates economic dilution is substantially greater among the relatively more intensive users of stock options in our sample, such as the high growth, technology firms that are well-known intensive users of stock options.

To demonstrate that the economic dilutive effect of stock options that we estimate is economically meaningful, we show that the return-earnings relation reflects the *economic* dilution due to stock options. Without the economic dilutive effect of stock options in earnings, we argue that the cross-sectional return-earnings relation is weakened. The change in equity value associated with an earnings change accrues not only to common stockholders but also to the optionholders. Therefore, a given earnings increase is expected to result in a smaller change in common stock value for a firm with options outstanding than a firm without options. We hypothesize that, *ceteris paribus*, the market response to earnings will be decreasing in economic dilution from options. Consistent with this prediction, we find that, controlling for the dilution implied by the SFAS 128 treasury-stock method, the relation between returns and reported earnings is negatively related to the economic dilution from options.

Implications. Our study has two main implications. First, our study has implications for equity valuation, financial statement analysis, and fundamental analysis. Specifically, we offer insights into how a firm's aggregate net cash flow (or market valuation of equity) should be apportioned among the claimholders when both shareholders and optionholders have claims on equity value.

Second, because the treasury stock method is not conservative, it systematically underestimates the dilutive effects of outstanding options and overstates diluted EPS. The FASB may wish to re-examine rules governing the dilutive effects of executive stock options. We offer a practical and more conservative recommendation to calculate the dilutive effect of options in section 5 of the paper.

Outline. Section 2 explains the treasury stock method of calculating diluted EPS and our method of calculating the economic diluted EPS to account for the effect of dilutive securities in a firm's capital structure. Section 3 describes sample selection and presents descriptive statistics on diluted EPS and economic diluted EPS for the sample firms. Using return-earnings regression analysis, section 4 tests whether the economic dilutive effect of stock options that we calculate method is economically more meaningful than the treasury stock method. We summarize the paper and discuss the implications in section 5.

2. Computing Diluted EPS

In section 2.1, we summarize how reported basic EPS and diluted EPS are computed using the treasury stock method required by SFAS No. 128. In section 2.2, we introduce the intuition behind a measure of diluted EPS that reflects the economic dilution due to employee stock options. In sections 2.3 and 2.4, we derive and operationalize a general measure of economic diluted EPS. We show that economic diluted EPS is consistent with the SFAS No. 128 objective to produce an EPS number that reflects the effect of dilutive securities. Moreover, our approach to accounting for the dilutive effects of options produces an economic diluted EPS measure that is comparable across firms, with or without outstanding stock options. Our measure is also comparable across years for a firm that varies the intensity of option usage over time. Section 2.5 compares our measure of economic diluted EPS to reported diluted EPS, and discusses the implications of the differences between the two measures.

2.1 EPS calculation under the treasury stock method

SFAS No. 128 requires two earnings per share calculations, basic EPS and diluted EPS. Basic EPS is simply earnings available to common stockholders divided by weighted average common shares outstanding. As recognized in the Accounting Principles Board Opinion No. 15 and demonstrated empirically by Aboody (1996) and Huson, Scott, and Weir (1999), basic EPS fails as a summary performance measure because it does not reflect the share of firm performance that is attributable to dilutive securities. To address this shortcoming, diluted EPS uses the same earnings as basic EPS, but the number of shares is increased to reflect the dilutive effects of stock options and other convertible securities and warrants. In this study, we focus on the dilutive effects of stock options, and ignore any deviations between the reported and economic dilution of convertible debt, convertible preferred stock and warrants. In our sample, stock options account for more than 80% of all incremental shares used in reported diluted EPS. Thus, the dilutive effects of other convertible securities are expected to be of secondary importance, at least on average. Further, because the FASB requires the if-converted method to compute the dilutive effects of convertible debt and preferred stock, an analysis of the dilutive effects of these securities is substantially more complex than for stock options.[2]

The treasury stock method is used to calculate dilutive shares due to stock options under both SFAS No. 128 and Accounting Principles Board Opinion No.15, which was superceded by SFAS No. 128 in 1997. Under the treasury stock method, the number of incremental dilutive shares due to options is equal to the difference between the number of common shares that would be issued upon exercise of the options and the number of common shares that can be purchased with the proceeds from option exercise. If all of a firm's options have the same exercise price, then the dilutive shares due to options is:

$$\text{Treasury stock method dilutive shares from options} = N_O * [(P-X)/P]$$

where N_O is the number of options outstanding, P = price per share of the firm's common stock and X = exercise price of each option.[3] If the number of dilutive shares due to options is less than zero, the number of dilutive shares is set equal to zero. The lower bound of zero is binding when the exercise price of options exceeds the stock price and restricts diluted EPS to be less than or equal to basic EPS.

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[2] The if-converted method sets incremental dilutive shares equal to the number shares that would be issued upon conversion of the security and adds back any dividends or interest to income. Unlike the treasury stock method for options, which systematically underestimates the economic dilution from options, the if-converted method will overstate the number of economic incremental shares for convertibles when these securities are determined to be dilutive, and will understate the number of dilutive shares when the convertibles are anti-dilutive. In addition, it is unclear theoretically whether the entire amount of interest expense or dividends should be added back to the numerator of EPS, as the holders of the convertibles bear a portion of these costs.

When the firm has no other dilutive shares except options outstanding, SFAS No. 128 diluted EPS is computed as follows:

$$\text{FASB diluted EPS} = \text{Earnings} / \{N_S + N_O\,[(P-X)/P]\}$$

$$= (\text{Earnings} / N_S) * \gamma_{FASB} \qquad (1)$$

where N_S is the number of common shares outstanding, and γ_{FASB} is a scaling factor on earnings equal to $1/\{1 + (N_O/N_S)[(P-X)/P]\}$ that produces FASB diluted EPS when it is multiplied by basic EPS.

2.2 Static measures of economic diluted EPS

To provide intuition for economic diluted EPS, we assume that the value of equity is a function of current aggregate earnings, E:

$$V_{equity} = V_{equity}(E). \qquad (2)$$

This valuation form is extremely general and can be obtained as a transformation of the dividend-discount model of equity valuation (e.g., Williams, 1938, Gordon, 1962, Fama and Miller, 1972, Collins and Kothari, 1989, and Ohlson, 1995). In the presence of options (or other securities) that can be converted into common stock, the value of equity is the sum of the value of the common stock plus the value of options:

$$V_{equity}(E) = V_{stock}(E) + V_{options}(E)$$

$$= PN_S + ON_O$$

$$= P\,[N_S + N_O(O/P)] \qquad (3)$$

where V_{stock} = value of the firm's common stock, where $V_{options}$ = value of the firm's outstanding options, and where O = price per option on the firm's common stock. We assume throughout that the

[3] If a firm has options outstanding with differing exercise prices, the incremental shares are computed by summing (P-X/P) over all options outstanding.

value of equity is comprised of the sum of the value of common stock and the value of any outstanding employee stock options. Equation (3) can be re-expressed in per share value of the common shareholder's equity:

$$P = V_{equity}(E) / [N_S + N_O(O/P)]$$

(4)

An immediate implication of equation (4) is that commonly used earnings capitalization valuation models that underlie the earnings response coefficient literature (e.g., Kormendi and Lipe, 1987, and Collins and Kothari, 1989) or models that express value as a function of earnings and book value of equity (e.g., Ohlson, 1995) are misspecified in the presence of stock options (also see Huson, Scott, and Weir, 1999). To see this, consider the popularly-used Ohlson (1995) model:

$$V_{equity}(E) = \pi_0 + \pi_1 BV + \pi_2 E \qquad (5)$$

where BV is the book value of equity. Eq. (5) would yield the wrong share price for a firm with stock options outstanding unless $V_{equity}(E)$ is deflated by $[N_S + N_O(O/P)]$:

$$P = [\pi_0 + \pi_1 BV + \pi_2 E] / [N_S + N_O(O/P)] \qquad (6)$$

Under a price-earnings multiple valuation model, the share price can be expressed as

$$P = k \{E / [N_S + N_O(O/P)]\} \qquad (7)$$

where k is the price-earnings multiple on the share of earnings that accrues to common shareholders. In this setting, the common shareholders' share of earnings, or *static* economic diluted EPS is:

$$\text{Static measure of economic diluted EPS} = E / [N_S + N_O(O/P)] \qquad (8)$$

2.3 A general measure of economic diluted EPS

To derive a general measure of economic diluted EPS, we assume that the change in equity value for a dollar of unexpected aggregate accounting earnings, or the earnings response coefficient, is a constant. In the analysis below, we ignore other determinants of earnings response coefficients, like risk and growth, in examining the implications of outstanding options. The empirical analysis, however, either explicitly controls for the determinants of earnings response coefficients in the cross-section or works with relatively homogeneous cross-sections of firms where the assumption of a constant earnings response coefficient is *a priori* reasonable (e.g., Core and Schrand, 1999). We assume:

$$dV_{equity}/dE = k \qquad (9)$$

where dV_{equity} = change in the value of equity, and dE = change in earnings.

For a firm that has both common stock and options outstanding, the change in equity value for a change in earnings can be expressed as follows:

$$\begin{aligned} dV_{equity}/dE &= dV_{stock}/dE + dV_{options}/dE \\ &= dV_{stock}/dE + (dV_{options}/dV_{stock})(dV_{stock}/dE) = k \qquad (10) \end{aligned}$$

A \$1 increase in earnings increases the firm's equity value, V_{equity}, by \$$k$. However, the common stockholders and optionholders must share this increase in value because an increase in the value of common stock, V_{stock}, also increases the value of the outstanding options. Thus, for a firm with options, basic EPS does not accurately reflect the common stockholders' performance. Specifically, basic EPS overstates the performance attributable to common stockholders because optionholders have a claim on a portion of the change in firm value associated with changes in the firm's earnings. The portions of earnings attributable to common stock and options depends on how these securities' values change with earnings performance.

2.4 Computing economic diluted EPS

To operationalize our method of computing economic diluted EPS, consider economic diluted earnings, E_{ECON} , such that:

$$dV_{stock} = k * dE_{ECON} \tag{11}$$

where $E_{ECON} = \gamma_{ECON} * E$ and γ_{ECON} is a scaling factor that adjusts earnings to incorporate optionholders' claims to earnings such that the sensitivity of common stock to changes in earnings is comparable across firms with and without options.

Substituting $\gamma_{ECON}E$ for E_{ECON}, in equation (11) and rearranging, we obtain:

$$dV_{stock}/d(\gamma_{ECON}E) = (1/\gamma_{ECON})(dV_{stock}/dE) = k. \tag{12}$$

Setting equation (10) equal to equation (12):

$$dV_{stock}/dE + (dV_{options}/dV_{stock})(dV_{stock}/dE) = (1/\gamma_{ECON})(dV_{stock}/dE).$$

Dividing both sides by dV_{stock}/dE, we obtain:

$$1 + (dV_{options}/dV_{stock}) = 1/\gamma_{ECON}$$

or $$\gamma_{ECON} = 1/[1+(dV_{options}/dV_{stock})] \tag{13}$$

Finally, we substitute (N_O*dO) for $dV_{options}$, and (N_S*dP) for dV_{stock} to obtain:

$$\gamma_{ECON} = 1/[1+(N_O/ N_S)*(dO/dP)] \tag{14}$$

where dO = change in price per option on the firm's common stock, and dP = change in per share stock price.

Thus, an earnings number that captures common stockholders' share of firm performance is $E_{ECON} = E* \gamma_{ECON} = E /[1+(N_O/N_S)*(dO/dP)]$. To compute economic earnings per common share, E_{ECON} is simply divided by the number of common shares as follows:

$$\text{General measure of economic diluted EPS} = E_{ECON} / N_S$$

$$= (E / N_S) * \gamma_{ECON} \tag{15}$$

$$= E / [N_S + N_O(dO/dP)] \tag{16}$$

When there are no options outstanding, $N_O(dO/dP) = 0$, and economic diluted EPS is equal to (E/N_S), or basic EPS. When options are outstanding, $N_O(dO/dP) > 0$, because the sensitivity of option value to stock price is strictly greater than zero [i.e., $dO/dP > 0$]. In this case, economic diluted EPS is smaller than basic EPS in magnitude. The deflator to arrive at the economic diluted EPS relative to basic EPS is a simple function of the change in the value of an option per dollar change in the stock price (i.e., the option's "delta," dO/dP). This delta depends on the features of an option, such as the extent to which an option is "in the money" and the time to maturity (see, for example, Brealey and Myers, 2000, ch. 20).

A simple example illustrates the intuition behind the result in Eq. (16). Assume that Company A has no options and 10 shares of common stock. Also assume that k, the earnings response coefficient in the above model, equals 10. Therefore, the total value of equity increases by \$10 for every \$1 increase in earnings. Because there are no options, the firm's performance accrues entirely to common stockholders. Thus, basic EPS is the same as economic diluted EPS and both measures are equal to earnings divided by 10 shares of common stock.

Now consider Company B with a capital structure that consists of 10 shares of common stock and 5 stock options. Assume that each option's value changes by \$0.70 for a \$1 change in the stock price and that, like Company A, the earnings response coefficient k is equal to 10.[4] That is, when earnings increase by \$1, the *total equity value* consisting of common stock plus options increases by

[4] For simplicity, we assume that the use of options in this example is exogenous in that there is no relation between the use of options by firm B and its growth opportunities and thus the price-earnings multiple. Theory and empirical evidence (e.g. Smith and Watts, 1992; Core and Guay, 1999b), however, establish that option use is an endogenous function of firm characteristics such as size, risk, and growth opportunities. This endogeneity issue becomes apparent in the empirical results we present in Section 4.

$10. If Company B's earnings were to increase by $1, the following expression can be solved to determine how the $10 increase in equity value would be divided between common stockholders and optionholders (using Eq. (10) above):

$$dV_{stock}/dE + (dV_{options}/dV_{stock})(dV_{stock}/dE) = k$$

$$dV_{stock}/\$1 + [(5*\$0.70)/(10*\$1)](dV_{stock}/\$1) = 10$$

$$dV_{stock} + 0.35\ dV_{stock} = \$10$$

$$dV_{stock} = \$7.40$$

Thus, when earnings increase by $1, common stock value is expected to increase by $7.40, or [10 shares * $0.74 per common share], and the value of options is expected to increase by $2.60, or [5 options * 0.7 * $0.74 per common share]. From Eq. (16) above, our general measure of economic diluted EPS can be computed as follows:

$$\text{Economic diluted EPS} = \text{Earnings} / \{N_S + [N_O*(dO/dP)]\}$$
$$= \text{Earnings} / [10 + (5 * 0.7)]$$
$$= \text{Earnings} / 13.5$$

For example, if Company B's earnings are $135, then:

Basic EPS = $135 / 10.0 common shares = $13.50 per common share;

and Economic diluted EPS = $135 / 13.5 dilutive shares = $10.00 per diluted share.

2.5 A comparison of economic diluted EPS with SFAS No. 128 EPS

When a firm has stock options outstanding and positive earnings, economic diluted EPS will be less than reported diluted EPS calculated according to SFAS No. 128. An inspection of Eq. (16) and Eq. (1) reveals that the difference between economic diluted EPS and SFAS No. 128 diluted EPS is generated by differences between dO/dP and (P-X)/P. Figure 1 plots dO/dP and (P-X)/P as a function of the price-to-strike ratio (i.e., P/X) for a typical employee stock option. We examine options with price-to-strike ratios between 0.5 and 3.0 because in our sample, less than 4% of firms' option plans have average price-to-strike ratios that are outside these price-to-strike bounds. Figure 1 illustrates that (P-X)/P is always less than dO/dP. Therefore, the economic dilution due to options is far greater than that suggested by diluted EPS in accordance with SFAS No. 128.

The largest discrepancy between dO/dP and (P-X)/P occurs when the price-to-strike ratio is around one, that is, the option is "at the money". For a typical, at the money, long-duration employee stock option, dO/dP, or the Black/Scholes delta, is roughly 0.70. Therefore, each option gives rise to 0.7 incremental dilutive shares in the denominator of the economic diluted EPS calculation. On the other hand, the treasury stock method assumes zero incremental shares for at the money options because (P-X)/P equals zero. Thus, there is a discrepancy between the treasury stock and economic dilution methods of 0.70 incremental shares per option. The maximum possible discrepancy is 1.00 because both dO/dP and (P-X)/P are bounded to be between 0 and 1.

For options with extremely high and low price-to-strike ratios, the gap between dO/dP and (P-X)/P is expected to be the smallest, although the economic dilution of options is always greater than that of reported diluted EPS. To see why this is so, consider an option with a price-to-strike ratio of 2. Because this option is deep in the money, its value changes almost one-for-one with the stock price. Specifically, dO/dP is about 0.8. Because the option is in the money, the treasury stock method recognizes some dilutive effects for this option. However, only 0.50 incremental shares are assigned to this option [(P-X)/P = (2-1)/2 = 0.50]. In other words, although the economic dilution suggests that the optionholder participates in 80% of any value changes experienced by stockholders, the treasury stock method assumes substantially less dilution with a participation rate of only 50%. Like at-the-money options, the treasury stock method assigns no dilutive effects to out-of-the-money options. However, because dO/dP remains substantially greater than 0 for long-dated out-of-the-money options (see Figure 1), these options do participate in changes in firm value and have an effect on economic diluted EPS.

Figure 1 does not depict the dilution from options using the static measure of economic diluted EPS derived in Eq. (8) above. In this static model, economic diluted EPS = $E / [N_S + N_O(O/P)]$. Thus, the difference between reported diluted EPS and static economic EPS depends upon P-X in the treasury stock method versus the option price, O, in the static measure. Option pricing models dictate that the value of an employee stock option is strictly greater than P-X. Therefore, like the general measure of diluted EPS, the economic dilution from options in the static measure will always exceed the dilution in the treasury stock method. In Section 4.1, we summarize the empirical distribution of dilution from options for all three EPS measures.

3. Sample and variable measurement

This section describes our sample selection procedure, explains how we calculate the economic dilution due to employee stock options, and provides descriptive statistics for the dilution effects of options based on SFAS No. 128 and our derived measure of economic diluted EPS. The descriptive statistics show that there is substantial cross-sectional variation in stock option usage, and that the option plans are economically large, especially for firms that are relatively more intensive users of stock options.

3.1 Sample selection

Our data come from four sources. First, we obtain an initial sample of 1,059 firms with December fiscal year-ends firms from the 1998 Execucomp database. Second, we obtain data on outstanding options for fiscal years 1994-1997 from firms' 1997 10-K reports. Third, we use CRSP data to calculate stock returns, stock-return volatility and Treasury bond yields. Finally, we use Compustat as the source for firms' financial data and industry classifications.

We remove firms from the initial sample of 1,059 firms if data is missing from the 10-K, CRSP or Compustat. We exclude firm-years if an acquirer assumes the target company's options in an acquisition. We also remove the firm-year in which a company makes an acquisition using the pooling of interests method, and all firm years prior to this acquisition, because it is not possible to determine the pre-acquisition composition of the firm's option plan. We remove firm-years with losses because existing accounting rules treat the dilutive effects of options differently for firms with negative and positive earnings. Specifically, all options are considered anti-dilutive for firms with losses, whereas only out of the money options are anti-dilutive for firms with positive earnings.[5] Further, Hayn (1995) and others show that the relation between returns and earnings differs across firms with positive and negative earnings. Finally, we eliminate the most extreme 1% earnings change and return observations. The resulting sample consists of 731 firms and 1,787 firm-years of observations for fiscal years 1995 to 1997.[6]

Descriptive statistics. Table 1 summarizes descriptive information about the sample firms' option plans. On average, the firms have 7 million employee stock options outstanding, or 5.8% of weighted average shares outstanding. There is substantial variation in option plan size, with options

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[5] The theory in section 2 suggests that optionholders participate in both increases and *decreases* in firm value. As such, options can be dilutive even for firms that report losses. Specifically, the analysis in section 2 predicts that having options outstanding will dampen the negative impact of poor earnings on the value of equityholders' claims.

[6] We have no observations for 1994, because in order to compare our method with the treasury stock method, we use the 1994 option data to compute average diluted shares outstanding in 1995.

outstanding as a fraction of weighted average common shares outstanding ranging from 0% to over 31%. The average option plan has a Black-Scholes value of $164 million with the largest plan valued at over $9.3 billion. We discuss our use of the Black-Scholes model in detail in Section 3.2. The option plan values are a substantial fraction of firms' market capitalization. The value of the average option plan is 3.1% of market value of the common stock, and over 5% of the plans in our sample have a value that exceeds 10% of their firms' stock values. These large plan values are not surprising given the large number of options outstanding and the fact that, on average, the options in these plans are substantially in the money. The mean price-to-strike ratio of the options outstanding is 1.61, indicating that the stock price exceeds the options' exercise price by 61%, on average.

Table 1

3.2 Measuring the economic dilution of options

Our measure of the economic dilution of stock options incorporates the optionholders' share of the firm's performance. From Eq. (16), the optionholders' share of firm performance depends upon the number of shares under options, N_O, multiplied by dO/dP, the average sensitivity of the option value to stock price. The number of shares under option is easy to identify from the disclosures in the 10-K. The average sensitivity of the option value to stock price is not reported; it must be estimated. There are two issues in the estimation. First, what is the sensitivity of an employee stock option to the firm's stock price? Is it different from that of a traded option's sensitivity to stock price? Second, the outstanding employee stock options are issued over a number of past years with different exercise prices. Disclosure in the annual report or the 10-K does not provide the entire texture. How do we estimate the *average* sensitivity of the employee stock options to the firm's stock price? We discuss these issues in turn.

An employee stock option's sensitivity to stock price. The computation of the sensitivity of option value to stock price is not straightforward. Employee stock options' properties deviate from the assumptions underlying standard option pricing models, such as risk-neutrality of the holder, no vesting period, and the ability to transfer the option to another party (Cuny and Jorion, 1995; Hemmer, Matsunaga, and Shevlin 1994; Huddart, 1994). To measure the option's sensitivity to stock price (i.e., the option's delta), we use a version of the Black-Scholes (1973) model that accounts for the effect of dividends. We explain below why our choice is reasonable.

The Black-Scholes value is a biased measure of option *value* in our setting because we expect a wide range of risk-aversion and likelihood of (sub-optimal) early exercise. For example, Huddart and Lang (1996) show that the degree of early exercise is lower for executives than non-executive employees. While variation in expected early exercise complicates the valuation of an employee stock option, the option *delta* computed using the Black-Scholes model is relatively insensitive to differences in the length of the expected exercise period. For most parameter values, the delta for a two-year option is not substantially different from that of a ten-year option. For example, the delta of an at-the-money ten-year option is 0.67 for a stock with volatility of 30% per year and annual dividend yield of 2% when the risk-free rate is 6%. The delta decreases to 0.63 if the maturity of the option is reduced to two years.

Average delta of the employee stock options. When we compute the option delta, we face the problem that option plan disclosures provide only the weighted average exercise price of end-of-year outstanding options. Evidence in Core and Guay (1999a) suggests this aggregation does not introduce substantial error into our calculations. Their research shows that the correlation between the delta using the weighted average exercise price and the delta that would be computed if the structure of the underlying option portfolio were known is greater than 0.99. To estimate the delta of the entire portfolio of outstanding options at the end of the year, we use a modification of the method described in Core and Guay (1999a). The essence of this method is to calculate the delta of the portfolio as if it were a single grant. This method yields estimates of delta that are unbiased and highly correlated with the measures that would be obtained if the parameters of the individual options in the portfolio were known.

Ideally, dO/dP in Eq. (16) should be estimated as the average sensitivity of the option plan's value to stock price over the year. However, because data on options outstanding are disclosed only as of the fiscal-year end, we compute dO/dP as the average of beginning of year sensitivity to stock price and end of year sensitivity to stock price.

SFAS No. 128 Diluted EPS information. We obtain the number of incremental shares that are included in reported diluted EPS directly from the 10-K disclosures. To isolate the dilutive effect of stock options, we separately record the incremental shares due to stock options and other dilutive securities. In about 10% of the firm-years, the incremental shares due to stock options are lumped together with other convertible securities. In these cases, we estimate the treasury stock method incremental shares from options using data from the option plan disclosures. We compute the average treasury stock method incremental shares at the beginning and end of the fiscal year as a proxy for the actual incremental shares included in reported diluted EPS.

4. Results

We find that reported diluted EPS substantially understates the economic dilutive effect of employee stock options. Specifically, the treasury stock method reflects, on average, only 30% of the incremental shares implied by our measure of economic dilution. Further, we show that the understatement of stock option dilution in reported EPS biases downward the implied revision in a firm's market capitalization as estimated from the relation between returns and reported earnings.

4.1 Economic diluted EPS vs. reported diluted EPS

Table 2 summarizes the dilutive effect of stock options on EPS in our sample. We compute the incremental dilutive shares due to stock options for three measures of diluted EPS: i) SFAS No. 128 diluted EPS, ii) our general measure of diluted EPS from Eq. (16), and iii) our static measure of diluted EPS from eq. (8).

Panel A of table 2 reports that the incremental dilutive shares from stock options under the treasury stock method is, on average, 1.46% of common shares outstanding. Panel B indicates that the average incremental dilutive shares under the general measure of diluted EPS is 4.54% and about 3 times as large as the reported dilutive effect. The maximum economic dilution from options is 24.9% of common shares outstanding compared to a maximum of 14.5% under the treasury stock method. Further, the distribution of the data indicate that reported dilution as a fraction of economic dilution is less than 50% for nearly 90% of the firm-years.

Table 2

Panel C of table 2 summarizes the incremental dilutive shares from options under the static measure of economic diluted EPS derived in section 2.2. While the assumptions underlying the analysis in section 2.2 are quite restrictive, it is interesting to examine how the dilution from options differs under the static EPS measure. The average incremental dilutive shares under the static measure of diluted EPS is 2.96%. Although this average dilution is smaller than under the general measure of diluted EPS, it is about 100% larger than the reported dilution under the treasury stock method. The distribution of the data indicate that reported dilution as a fraction of economic dilution in the static measure is less than 50% for nearly 50% of the firm-years.

4.2 Understated dilution and bias in the return-earnings relation

In this section, we first derive the bias in the return-earnings relation as a result of using reported diluted EPS as compared to using our proposed economic diluted EPS. We then report empirical results that are consistent with the predicted bias. In sections 4.2 and 4.3, we show that the results in this section are robust to using our static measure of diluted EPS and to adjusting aggregate earnings (i.e., the numerator in EPS calculation) for an estimate of the cost of new option grants.

Bias in the return-earnings relation. In sections 2.3 and 2.4, we derived a general measure of economic diluted EPS that facilitates comparison of performance across firms with stock option plans that participate in firm value changes to varying degrees. When the incremental dilutive shares from options in reported diluted EPS deviates from economic dilutive shares, diluted EPS cannot be compared across firms and through time for a given firm. Further, the relation between changes in firm value and changes in earnings will no longer be insensitive to the dilutive effects of stock options as derived in Eqs. (12)-(16) above. Specifically, we predict that the return-earnings relation is negatively related to the degree that the treasury stock method understates the dilution of options. That is, the greater the understatement in the reported diluted EPS, the lower the earnings response coefficient using reported diluted EPS. To see this, consider the following restatement of equation (11), which again shows that the relation between returns and earnings is insensitive to dilution from options when earnings are scaled by γ_{ECON}:[7]

$$dV_{stock} / [\gamma_{ECON} * dE] = k$$

and dividing both sides by N_S gives

$$dP / [\gamma_{ECON} * d(E / N_S)] = k \qquad (17)$$

Note that (E/N_S) is basic EPS and from equation (15), $[\gamma_{ECON} * d(E/N_S)]$ is the change in general economic diluted EPS. Of course, firms do not report economic diluted EPS, but instead report options' dilutive effect on EPS using the treasury stock method, or a dilution adjustment to earnings using γ_{FASB}, as in Eq. (1). We multiply both sides of Eq. (17) by $(\gamma_{ECON} / \gamma_{FASB})$ to derive the return-earnings relation using per share earnings defined as reported diluted EPS:

$$dP / [(\gamma_{FASB}/\gamma_{ECON}) * (\gamma_{ECON} * d(E / N_S)] = (\gamma_{ECON} / \gamma_{FASB})\, k$$

$$dP / [(\gamma_{FASB} * d(\text{basic EPS})] = (\gamma_{ECON} / \gamma_{FASB})\, k$$

$$dP / d(\text{FASB diluted EPS}) = (\gamma_{ECON} / \gamma_{FASB})\, k$$

$$dP / d(\text{FASB diluted EPS}) = k - ((\gamma_{FASB} - \gamma_{ECON})/\gamma_{FASB})\, k \qquad (18)$$

Multiplying Eq. (18) by d(FASB diluted EPS) gives the relation between returns and reported diluted EPS as:

$$dP = [k - ((\gamma_{FASB} - \gamma_{ECON})/\gamma_{FASB})k]d(\text{FASB diluted EPS}) \qquad (19)$$

Thus, the price response to earnings is expected to be a function of the accuracy of the treasury stock method in estimating the options' economic dilutive effect. *Ceteris paribus*, the larger the $(\gamma_{FASB} - \gamma_{ECON})/\gamma_{FASB}$, i.e., the greater the degree of understatement in the treasury stock method, the smaller the

[7] In this section, we consider only the bias in the return-earnings relation and how the general measure of diluted EPS mitigates this bias. Section 4.3 addresses bias in the price-earnings relation and how the static diluted EPS mitigates

response coefficient on reported diluted EPS. Therefore, we predict that the relation between returns and earnings is negatively related to the extent to which the treasury stock method underestimates the options' dilutive effects.

Regression model. We regress annual stock returns on contemporaneous changes in annual earnings per share. To be consistent with previous studies that estimate earnings response coefficients, we use primary EPS in our regressions for sample years 1994-1996. In accordance with SFAS No.128, primary EPS is not reported for fiscal years ending after December 15, 1997. As a result, we use diluted EPS in sample year 1997. Because the treasury stock method for computing the dilution of options is the same for primary EPS and diluted EPS, our use of two different EPS measures is not likely to affect our results. Further, we anticipate that researchers will be forced to mix primary and diluted EPS in the future because many studies will likely use data that include pre- and post-1997 earnings numbers. To ensure that the information in earnings changes is fully reflected in stock returns, we use annual returns beginning in the fourth month of the fiscal year through the third month after the end of the fiscal year.

To measure $(\gamma_{FASB}-\gamma_{ECON})/\gamma_{FASB}$, we restate and simplify the expression for the degree of understatement in the treasury stock method using Eqs. (1) and (14) as follows:

$$
\begin{aligned}
(\gamma_{FASB}-\gamma_{ECON})/\gamma_{FASB} &= 1 - \gamma_{ECON}/\gamma_{FASB} \\
&= 1 - (1 + (N_O/ N_S)((P-X)/P)) / (1 + (N_O/ N_S)(dO/dP)) \\
&= 1- (N_S + N_O((P-X)/P)) / (N_S + N_O(dO/dP)) \\
&= [N_O(dO/dP) - N_O((P-X)/P)] / (N_S + N_O(dO/dP)) < 1 \qquad (20)
\end{aligned}
$$

this bias.

The numerator in equation (20) is the difference between economic incremental shares and treasury stock method incremental shares, and the denominator is weighted average shares outstanding plus economic incremental shares. We refer to this measure as the "error in incremental shares," and use the following regression to test our predictions:

$$\text{Return}_t = a + b\,\Delta\text{EPS}_t + c\,[\Delta\text{EPS}_t * \text{Error in incremental shares}_t] + \text{Control variables} + \text{Year dummies} + e_t \qquad (21)$$

We define Error in incremental shares$_t$ to be [(economic incremental shares – treasury stock method incremental shares)/ (weighted average shares outstanding used in primary (diluted) EPS – treasury stock method incremental shares + economic incremental shares)]. Our hypothesis predicts that b is positive and c is negative in the above regression. To control for cross-sectional variation in the sample firms' earnings response coefficients, we interact ΔEPS$_t$ with firm size (measured as the logarithm of the market value of assets), the ratio of book value of assets to market value of assets, and the standard deviation of stock returns. We also include year indicator variables in all specifications to control for market-wide effects in annual returns.

Regression results. Table 3 reports regression results for the pooled sample of 1,787 firm-years from 1994-1997. The error in incremental dilutive shares has no significant incremental effect on the earnings response coefficient. This contradicts our hypothesis of an incremental negative effect. However, a potential confounding problem is a lack of adequate controls for firm characteristics, such as growth options. For example, the results in table 3 are consistent with a setting where firms' use of employee stock options is positively associated with a firms' growth options, and also that firms with greater growth options have larger earnings response coefficients. Both of these relations have empirical support in previous research. Guay (1999), Core and Guay (1999b), and Bryan, Huang, Lilien (1999) all provide evidence that options use and growth are positively correlated. Collins and Kothari (1989), Biddle and Seow (1991), and Ahmed (1994) find a positive relation between growth and earnings response coefficients. Moreover, firm size and risk are also correlated with both option use and the earnings response coefficient.

Table 3

The control variables, the book-to-market ratio, firm size, and the standard deviation of returns, are included to control for growth and other determinants of earnings response coefficients. However, the results in column 2 of table 3 reveal that the main effect of the inclusion of the proxies for growth and other control variables in the regression model is to reduce the precision with which the coefficient on earnings change is estimated. The t-statistic on the earnings change variable declines considerably and there is only a modest increase in the explanatory power of the model. The results suggest the control variables are highly collinear with the earnings change and earnings change interacted with the error in incremental dilutive shares variables.[8]

More importantly, the book-to-market ratio in the regressions is likely to be a noisy proxy for growth. For example, the book-to-market ratio is commonly used in return regressions to proxy for risk and financial distress (e.g., Fama and French, 1992). Because of this noise and the multicollinearity problems, the book-to-market ratio is potentially not successful in controlling for the effect of growth. We therefore use an alternative research design to provide a more powerful test for the incremental association of the error in incremental shares with stock returns that controls for the effects of growth on both option use and earnings response coefficients.

Quintile portfolio analysis. To better control for the endogenous determinants of firms' option use in our tests, we partition our sample into quintiles based on the firms' economic incremental shares due to options scaled by weighted average shares outstanding, $[N_O*(dO/dP)]/ N_S$. The ranking variable is likely to be highly correlated with the intensity of firms' option usage, and therefore with the firms' growth opportunities and other determinants of option use; the correlated omitted variables in this setting. We use the quintile partitioning procedure to allow the coefficient on unexpected earnings to vary across the quintiles, with the expectation that the coefficient will increase with option intensity as a proxy for growth opportunities.

Table 4 reports results of pooled regressions similar to those in table 3, except that they contain separate coefficients for unexpected earnings in each quintile:

$$\text{Return}_t = a + D_p * (b\ \Delta EPS_{t-1,\,t}) + c\ [\Delta EPS_{t-1,\,t} * \text{Error in incremental shares}_t] + \text{year dummies} + e_t, \qquad (22)$$

where D_p is an indicator variable for each quintile. Based on the analysis with and without the control variables in table 3, we report results in table 4 without the three control variables, namely, size, the standard deviation of returns, and book-to-market ratio. Results with the control variables included in the regressions are qualitatively similar to those reported below and are available on request. The regression specification includes an intercept and year indicators, but for compactness we do not tabulate these coefficients in table 4. The results in table 4 indicate that the earnings response coefficients for the more intensive users of options, as measured by economic dilution, are relatively

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[8] We also experimented with the use of rank regressions to potentially reduce error in estimating dilutive effects of options, non-linearities in the return-earnings relation (e.g., Freeman and Tse, 1992), and potential outliers. The results are similar to those reported using continuous measures of the variables.

large. This increase in the ERC across quintiles is consistent with our quintile ranking capturing increases in growth opportunities.

Table 4

With respect to the test of our main hypothesis, the results in table 4 show that, after controlling for the influence of growth, the association between returns and earnings changes is negatively related to the error in the treasury stock method of computing option plan dilution. The coefficient on earnings changes interacted with the error in incremental dilutive shares is negative and significant, as predicted. Thus, consistent with the hypothesis modeled in section 2, our results suggest that the return response to earnings changes is dampened because the treasury stock method understates economic dilution of stock options.[9]

To investigate the robustness of the standard errors in table 4, we perform a bootstrap procedure where both the independent and dependent variables are randomly sampled with replacement. This procedure yields robust t-statistics that are nearly identical to those reported. The similarity of the inference from the OLS and bootstrap t-statistics suggests that our inference is not affected by heteroscedasticity or outliers (Stine, 1990, Jeong and Maddala, 1993).

4.3 Sensitivity test: Understated dilution and bias in the price-earnings relation

In the previous section, we document bias in the return-earnings relation due to using reported diluted EPS as compared to using the proposed general measure of economic diluted EPS. We now examine the bias in the price-earnings relation that results from using reported diluted EPS instead of the proposed *static* measure of economic diluted EPS. A comparison of equations (8) and (16) and their

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[9] These results are also robust to allowing the coefficient on the interaction between unexpected earnings and error in incremental shares to vary across the quintiles.

derivation reveals that there are two primary differences between the general measure of diluted EPS and the static measure of diluted EPS. First, the static measure is derived from a setting where V_{equity} = k*E, whereas the general measure is derived from dV_{equity} = k*dE. Second, the dilutive incremental shares from options under the static measure is a function of O/P, whereas under the general measure dilutive incremental shares is a function of dO/dP. Integrating both of these factors into our regression framework in Section 4.3 yields regression tests of the static measure as follows:

$$Price_t = a + b\ EPS_t + c\ [EPS_t * \text{Error in incremental shares}_t] + \text{year dummies} + e_t \qquad (23)$$

and

$$Price_t = a + D_p * (b\ EPS_{t-1,\ t}) + c\ [EPS_{t-1,\ t} * \text{Error in incremental shares}_t] + \text{year dummies} + e_t, \qquad (24)$$

where the Error in incremental shares_t is [(static economic incremental shares – treasury stock method incremental shares)/ (weighted average shares outstanding used in primary (diluted) EPS – treasury stock method incremental shares + static economic incremental shares].

Table 5 presents the results from these regressions. Similar to table 4, the coefficient on (EPS * Error in incremental shares) is positive and insignificant in the pooled regression. However, once the coefficients on EPS are allowed to vary across quintiles formed by ranking the firms on static economic dilution, the coefficient on (EPS * Error in incremental shares) is significantly negative. Thus, consistent with the hypothesis modeled in section 2.2, our results suggest that the price response to earnings changes is dampened when the treasury stock method understates the static economic dilution of stock options.

Table 5

4.4 Sensitivity test: Expensing the value of option grants

In our analysis of the return-earnings relation so far, we ignore issues of expensing newly granted stock options in the numerator of diluted EPS. As discussed in section 1, there is widespread belief that (at least a portion of) the value of the newly granted stock options should be deducted as an expense in calculating annual income. SFAS No. 123 recommends, but does not require the expensing of most newly granted options. However, very few firms choose to expense stock options. Regardless of whether firms expense options in reported earnings, investors are likely to consider the cost of options when setting prices. We therefore examine whether our return-earnings analysis in the preceding sections is sensitive to calculating earnings net of the value of newly granted stock options. An important motivation for this analysis is to determine that the economic dilutive effect that we document does not arise spuriously because of the omitted economic expense of stock options from income.

We recalculate firms' annual earnings by deducting the after-tax Black-Scholes value (computed at an assumed marginal tax rate of 40% because all firm-years included have positive earnings) of the option grants in a year. Table 6 reports results for the same set of regressions as in table 4, but using the recalculated earnings numbers. Adjusting earnings for the newly granted stock options' Black-Scholes value has little effect on the tenor of the results. After controlling for variation in the return-earnings relation that is correlated with option intensity, the estimated coefficient on the error in incremental dilutive shares is significantly negative. Moreover, the ERCs increase monotonically across the quintiles, consistent with the quintile ranking procedure capturing increases in growth opportunities across the portfolios. These results are robust to estimating the price-earnings regressions that incorporate economic dilution under the static measure. Overall, the results suggest that the effect of incremental economic dilutive effect of stock options on the return-earnings relation is robust to alternative earnings measures.

Table 6

5. Summary and conclusions

We show that existing accounting rules in SFAS 128 for computing dilutive effects of outstanding options systematically overstate the diluted earnings per share. SFAS 128 fails to adequately take account of the economic dilutive effect of stock options. For firms with positive earnings, FASB diluted EPS is always greater than economic diluted EPS. We derive a formula to estimate the economic dilutive effect of stock options and recalculate economic diluted earnings per share. Empirical results show that diluted EPS under SFAS No.128 incorporates only about 30% of the economic dilution from stock options, on average.

The research in this study has important implications for financial analysis, fundamental analysis, and security valuation. Regardless of whether one employs an earnings-based valuation or cash-flow-based valuation model, valuation per share relies on an accurate apportionment of firm equity value among the claimholders, which include shareholders and optionholders. The analysis in this study offers insights into this issue both for academic researchers and for standards setters.

An example of interest to academic researchers is that our findings suggest that any research using a variation of the dividend-discount model (such as such as the Ohlson (1995) residual income-based valuation model) to generate per share stock valuation is fundamentally mis-specified for a firm that has options in its capital structure. The mis-specification stems from the fact that there is no sharing of equity value with optionholders in these models. Thus, these models are mis-specified for firms with options, and this mis-specification is expected to vary predictably with the determinants of firms' option use (such as size, idiosyncratic risk, and the book-to-market ratio). Equation (16) in this paper offers a means of correcting for this mis-specification with a deflator that varies with the characteristics of firms' option plans.

Implementation based on practical considerations. Our results show that the treasury stock method is not conservative because it systematically overstates diluted EPS. This finding suggests that it would be useful for the FASB to re-consider SFAS 128 and the method for computing incremental dilutive share from options. Ideally, a measure of economic dilution should be used to compute stock options' dilutive effects. However, there are concerns within the profession about the reliability of option valuation techniques. A practical approach is to use the if-converted method to compute the dilution for options. Similar to rules for convertible debt and preferred stock, the if-converted method would count each option as 1 incremental share. This method would be both reliable and conservative in that it would always understate diluted EPS. An alternative method that could better approximate economic dilution is an adjusted if-converted method where each option is assigned less than 1 incremental share.[10] The choice between these measures depends, at least in part, on whether the FASB favors a static measure of dilution or a general measure of dilution as discussed in section 2, as well as the priorities in trading off between conservatism, relevance, and reliability.

[10] For example, if the FASB favored the general method of economic dilution, an adjusted if-converted method where each option counts as 0.8 incremental shares would make average diluted EPS significantly closer to economic diluted EPS in our sample. However, the choice of 0.8 incremental shares follows from the average option delta in our sample and may not be applicable to all other samples. Also, a method that used significantly less than 1 incremental share is not always conservative; that is, diluted EPS is sometimes greater than economic diluted EPS.

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Table 1
Descriptive statistics on firms' option plan characteristics

Descriptive statistics are for a sample of 731 firms and 1787 December fiscal year-end observations from 1995-1997. Option plan details are from the Execucomp database and firms' 1997 10-K reports, stock price data and Treasury bond yields are from CRSP, and financial data are extracted from Compustat. The following observations are excluded from the sample: Firm years with losses; firm years in which an acquirer assumes a target firm's options using the pooling-of-interests method of accounting; and extreme 1% of the firm years ranked according to earnings changes and stock returns. Option values and options' sensitivity to stock price (options' delta) are based on the Black-Scholes formula for valuing European call options, as modified to account for dividend payouts by Merton (1973).

	Mean	Std dev	Min	Q1	Median	Q3	Max
Total number of options, millions	7.01	15.99	0.00	0.99	2.36	5.95	177.22
Total options scaled by weighted average shares outstanding, %	5.79	4.74	0.00	2.55	4.74	7.68	31.31
Total value of options, millions	163.95	529.57	0.00	9.91	33.50	111.25	9323.50
Total value of options scaled by market value of common stock, %	3.08	3.07	0.00	1.02	2.17	4.13	20.41
Average price-to-strike ratio of options (excludes firms with no options)	1.61	0.67	0.35	1.18	1.44	1.87	8.96

Table 2
Descriptive statistics on dilutive incremental shares and diluted EPS

Descriptive statistics are for a sample of 731 firms and 1787 December fiscal year-end observations from 1995-1997. Option plan details are from the Execucomp database and firms' 1997 10-K reports, stock price data and Treasury bond yields are from CRSP, and financial data are extracted from Compustat. The following observations are excluded from the sample: Firm years with losses; firm years in which an acquirer assumes a target firm's options using the pooling-of-interests method of accounting; and extreme 1% of the firm years ranked according to earnings changes and stock returns.

	Mean	Std dev	Min	Q1	Median	Q3	Max
Panel A: SFAS No. 128 dilution [(P-X)/P]							
SFAS No.128 dilutive incremental shares scaled by weighted average shares outstanding	1.46%	1.66%	0.00%	0.33%	0.95%	1.96%	14.47%
Panel B: General measure of economic dilution [dP/dO]							
Economic dilutive incremental shares scaled by weighted average shares outstanding	4.54%	4.02%	0.00%	1.81%	3.51%	6.02%	24.90%
SFAS No.128 dilution / Economic dilution	30.41%	18.03%	0%	17.87%	29.07%	41.93%	99.88%
Panel C: Static measure of economic dilution [P/O]							
Economic dilutive incremental shares scaled by weighted average shares outstanding	2.96%	3.00%	0.00%	0.97%	2.07%	3.90%	22.06%
SFAS No.128 dilution / Economic dilution	48.35%	24.41%	0%	32.42%	49.64%	65.96%	100.00%

Option values and options' sensitivity to stock price (options' delta) are based on the Black-Scholes formula for valuing European call options, as modified to account for dividend payouts by Merton (1973).
SFAS No.128 dilution is the number of dilutive incremental shares due to employee stock options reported by the firm scaled by the weighted average number of shares used in computing basic EPS. In accordance with SFAS No.128, firms use the treasury stock method to compute dilutive incremental shares from options.
General economic dilution is the average Black-Scholes delta for the options in a firm's stock option plan multiplied by the number of options outstanding and scaled by the weighted average number of shares used in computing basic EPS.
Static economic dilution is the average Black-Scholes value for the options in a firm's stock option plan multiplied by the number of options outstanding and scaled by the weighted average number of shares used in computing basic EPS.

Table 3
Variation in the return-earnings relation
as a function of the error in incremental shares from treasury stock method

$$Return_t = a + b\,\Delta EPS_{t-1,\,t} + c\,[\Delta EPS_{t-1,\,t} * \text{Error in incremental shares}_t] + \text{controls} + \text{year dummies} + e_t$$

The sample contains 731 firms and 1787 firm-year observations from 1995-1997. Error in incremental shares$_t$ = [(Economic incremental shares – SFAS No.128 incremental shares)/ weighted average shares outstanding used in primary EPS] in fiscal year t. Return$_t$ is the annual buy and hold stock return from the fourth month of fiscal year t through the third month after the end of fiscal year t. ΔEPS is the change in annual earnings per share from fiscal year t-1 to t scaled by stock price at the beginning of period in which returns are measured for fiscal year t.

	$Return_t$	
$\Delta EPS_{t-1,\,t}$	2.44**	9.82**
	(6.33)	(2.30)
$\Delta EPS_{t-1,\,t}$ * Error in incremental shares$_t$	5.75	8.22
	(0.65)	(0.87)
$\Delta EPS_{t-1,\,t}$ * MV assets		-0.21
		(-1.21)
$\Delta EPS_{t-1,\,t}$ * Std. dev. Of stock returns		-4.73*
		(-1.79)
$\Delta EPS_{t-1,\,t}$ * Book-to-market ratio		-1.81
		(-1.40)
Adjusted R-squared (%)	16.90	16.99

t-statistics in parentheses. * denotes significance at the 0.10 level. ** denotes significance at the 0.05 level.

Table 4
Variation in the return-earnings relation:
ERC varies by quintile portfolios ranked on economic dilution

$$\text{Return}_t = a + (b\ \Delta EPS_{t-1,\ t}) * D_p + c\ [\Delta EPS_{t-1,\ t} * \text{Error in incremental shares}_t] + \text{year dummies} + e_t$$

The sample contains 731 firms and 1787 firm-year observations from 1995-1997. Error in incremental shares$_t$ = [(Economic incremental shares – SFAS No.128 incremental shares)/ weighted average shares outstanding used in primary EPS] in fiscal year t. Return$_t$ is the annual buy and hold stock return from the fourth month of fiscal year t through the third month after the end of fiscal year t. ΔEPS is the change in annual earnings per share from fiscal year t-1 to t scaled by stock price at the beginning of period in which returns are measured for fiscal year t. D_p is an indicator variable that takes a value of 1 for the pth quintile, where the quintile are formed by ranking the firms on economic dilution.

	Return$_t$
$\Delta EPS_{t-1,\ t}$ - Portfolio 1	2.19**
	(3.36)
$\Delta EPS_{t-1,\ t}$ - Portfolio 2	2.59**
	(4.67)
$\Delta EPS_{t-1,\ t}$- Portfolio 3	5.74**
	(4.14)
$\Delta EPS_{t-1,\ t}$- Portfolio 4	4.51**
	(5.75)
$\Delta EPS_{t-1,\ t}$- Portfolio 5	8.31**
	(6.79)
$\Delta EPS_{t-1,\ t}$ * Error in incremental shares$_t$	-55.07**
	(-3.69)
Adjusted R-squared (%)	17.9

t-statistics in parentheses. * denotes significance at the 0.10 level. ** denotes significance at the 0.05 level.

Table 5
Variation in the price-earnings relation

Column 1: $Price_t = a + b\ EPS_t + c\ [EPS_t * \text{Error in incremental shares}_t] + \text{year dummies} + e_t$

Column 2: $Price_t = a + (b\ EPS_t) * D_p + c\ [EPS_t * \text{Error in incremental shares}_t] + \text{year dummies} + e_t$

The sample contains 731 firms and 1787 firm-year observations from 1995-1997. Error in incremental shares_t = [(Economic incremental shares from levels specification – SFAS No.128 incremental shares)/ weighted average shares outstanding used in primary EPS] in fiscal year t. $Price_t$ is the stock price per share at the end of the third month after fiscal year t. EPS is the reported earnings per share in fiscal year t. D_p is an indicator variable that takes a value of 1 for the pth quintile, where the quintile are formed by ranking the firms on economic dilution.

	$Price_t$	
	1	2
EPS_t	10.10** (41.65)	
EPS_t - Portfolio 1		9.42** (28.03)
EPS_t - Portfolio 2		9.78** (32.73)
EPS_t- Portfolio 3		11.56** (30.80)
EPS_t- Portfolio 4		12.27** (29.41)
EPS_t- Portfolio 5		13.01** (19.50)
EPS_t * Error in incremental shares_t	5.15 (0.42)	-82.45** (-4.39)
Adjusted R-squared (%)	59.07	60.21

t-statistics in parentheses. * denotes significance at the 0.10 level. ** denotes significance at the 0.05 level.

Table 6
Variation in the return-earnings relation:
ERC varies by quintile portfolios ranked on economic dilution
(Earnings are net of the after-tax Black-Scholes value of the new option grants in the year)

$Return_t = a + (b\ \Delta EPS\_BS_{t-1,\ t}) * D_p + c\ [\Delta EPS\_BS_{t-1,\ t} * \text{Error in incremental shares}_t] + \text{year dummy} + e_t$

The sample contains 680 firms and 1185 firm-year observations from 1996-1997. Error in incremental shares$_t$ = [(Economic incremental shares – SFAS No.128 incremental shares)/ weighted average shares outstanding used in primary EPS] in fiscal year t. Return$_t$ is the annual buy and hold stock return from the fourth month of fiscal year t through the third month after the end of fiscal year t. EPS_BS is annual earnings per share minus 60% of the per share expense of the annual option grant (valued using the Black-Sholes method and assuming a tax rate of 40%). ΔEPS_BS is the change in EPS_BS from fiscal year t-1 to t scaled by stock price at the beginning of period in which returns are measured for fiscal year t. D_p is an indicator variable that takes a value of 1 for the pth quintile, where the quintile are formed by ranking the firms on economic dilution.

	$Return_t$
$\Delta EPS\_BS_{t-1,\ t}$ - Portfolio 1	3.02** (3.43)
$\Delta EPS\_BS_{t-1,\ t}$ - Portfolio 2	4.06** (5.44)
$\Delta EPS\_BS_{t-1,\ t}$ - Portfolio 3	5.01** (4.87)
$\Delta EPS\_BS_{t-1,\ t}$ - Portfolio 4	5.12** (4.48)
$\Delta EPS\_BS_{t-1,\ t}$ - Portfolio 5	9.89** (5.45)
$\Delta EPS\_BS_{t-1,\ t}$ * Error in incremental shares$_t$	-99.49** (-4.14)
Adjusted R-squared (%)	20.8

t-statistics in parentheses. * denotes significance at the 0.10 level. ** denotes significance at the 0.05 level.

Figure 1. The stock option "delta" versus the treasury stock method

The plots are based on an underlying option with a maturity of 7 years on a stock with a price of $100. The exercise price of the option is determined by the price-to-strike ratio. The stock's dividend yield is 2%, the annualized standard deviation of stock returns is 0.30, and the risk-free rate is 6%. Estimates of the option delta is the change in option value for a $1 change in stock price, is based on the Black-Scholes formula for valuing European call options, as modified to account for dividend payouts by Merton (1973). The treasury stock method is equal to [(P-X)/P], where P is the stock price and X is the option's exercise price. SFAS No. 128 requires firms to use the treasury stock method to compute the incremental dilutive shares due to outstanding stock options.