

**Employees' Perceived Value of Their Stock Option Holdings:
How Training Affects the Cost-Value Gap**

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ABSTRACT

Analyzing a unique dataset from an equity compensation service provider, we examine how employee stock option recipients perceive the value of their option holdings and explore an educational training program as a mechanism for improving recipients' perceived value of their options. Results show most recipients perceive their options as less valuable than the corresponding Black-Scholes cost. Supplemental analyses provide mixed evidence that risk aversion decreases perceived value, and that wealth concentration and prior stock option experience increase perceived value. Importantly, we find that a training program which clearly articulates the economic fair value of recipients' options increases both their perceived value and their confidence in related decision-making.

Keywords: *Employee stock options (ESO), perceived value, Black-Scholes, training.*

Data availability: *Proprietary data are obtained under a confidentiality agreement with Net Worth Strategies, Inc. (NWSI), as indicated in the text.*

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Most stock options are worth considerably less to the executives they are meant to motivate than to the shareholders of the companies that grant them. This “wedge” in value represents a significant cost to the firm’s shareholders—one that could tilt the balance toward the use of restricted stock or cash-based compensation instead. (Hall 2003, 22)

1. Introduction

Over the past twenty years, employee stock options have become a widely-used mechanism for compensating employees, expanding beyond the CEO level to the rank-and-file (Hall and Liebman 1998; Hall and Murphy 2002; Murphy 1999). The use of employee stock options has grown because they are believed to provide a means of attracting, retaining, and motivating employees (Core and Guay 2002; Elson 2003). Yet, practitioners are questioning the incentive benefits of stock option compensation because of employees’ inability to appropriately value their options (Enright and Reilly 2002; Reilly et al. 2003; Schneider 2003; Watson Wyatt Worldwide 2003). In this paper, we provide evidence on how employee stock option recipients perceive the value of their current stock option holdings and on how that valuation is affected by the completion of a stock option education and planning program.

Prior academic research distinguishes between the opportunity cost to firms of issuing employee options and employees’ perceptions of the value of those options. Specifically, while firms incur an opportunity cost equal to the market value of an unrestricted stock option (estimable with, e.g., Black-Scholes), an undiversified and risk-averse employee is likely to perceive option compensation with its trading and hedging restrictions at a much lower value (Hall and Murphy 2002; Mollen et al. 2003). Indeed, Hall and Murphy (2002) use analytic modeling with numeric examples to show that undiversified and risk-averse employees will

place lower value on stock options as compared to the Black-Scholes value; that is, that there is a “cost-value gap”.

We contribute to this line of research by empirically examining the difference between the Black-Scholes opportunity cost and the recipients’ perceived value of their employee stock options using a unique data set from the proprietary records of a leading provider of equity compensation planning services, Net Worth Strategies, Inc. (NWSI). The extant research provides only limited insight into the difference between the cost and perceived value of employee stock options and finds mixed results. For example, while a recent study conducted by Watson Wyatt Worldwide (2006) finds that employees do indeed discount option values, others find that employees overvalue options relative to Black-Scholes valuation models (e.g., Larcker and Lambert 2001). Hodge et al. (2006), the most recent of these studies, also finds that option recipients’ perceived value is higher, on average, than the corresponding Black-Scholes value. However, in all of these studies, participants evaluate a partially or fully hypothetical setting. In contrast, our dataset consists of actual employees’ estimates of their own current stock option holdings, which arguably allows us to provide a better estimate of the true underlying distribution of value estimates (Libby et al. 2002, 798).

We also contribute by empirically examining the extent to which a stock option education and training program affects the cost-value gap. A recent survey (PriceWaterhouseCoopers 2005) finds that employee communications regarding equity plans is one of the most challenging aspects (behind compliance and administration) of offering equity compensation. This difficulty of educating employees about stock options is echoed in the field interviews conducted by Hodge et al. (2006, 34), which indicate a general reluctance to provide employees with personal finance assistance, in part because of concerns over the potential liability associated with

discussing potential future stock prices. Our dataset allows us to directly observe the effects of providing employees with a stock option education and planning program that explains how stock options operate and clearly articulates the Black-Scholes value of the recipients' current options. Specifically, for a subsample of recipients, our dataset includes both their initial (before training) and revised (after training) value estimates of their current stock option holdings. This allows us to directly evaluate the impact of an intervention that companies could implement to improve recipients' perceived value of their options.

Results show a difference between recipients' perceived value of their current stock option holdings and the corresponding Black-Scholes cost, with 75% of recipients' perceived values *lower than* the corresponding Black-Scholes cost. This finding is consistent with our analysis of a secondary source of data in which 78% of stock plan *professionals* (e.g., consultants, plan administrators) underestimate stock option value for a hypothetical employee relative to the Black-Scholes cost. These results suggest that even people who make their living understanding equity compensation display a cost-value gap.

In supplemental analyses, we find only partial support for the economic factors that Hall and Murphy (2002) suggest should affect recipients' perceived values (risk aversion and wealth concentration¹), as well as recipients' level of prior experience with stock options. Consistent with predictions, univariate tests show that recipients' perceived values are negatively related to our risk aversion proxy and positively related to recipients' level of prior experience with stock options. Contrary to predictions, univariate tests show that recipients' perceived values are positively related to the perceived share of recipients' wealth invested in their employer's stock, and this is the only effect that remains significant in multivariate analyses.

¹ Although Hall and Murphy (2002) refer to *diversification*, their analyses incorporate the percentage of wealth held in employer stock, which reflects the *concentration* of the recipients' holdings in employer stock rather than diversification *per se*.

Importantly, results show that the training program offered by NWSI, aimed at improving employee knowledge about their stock option compensation, leads to a significant reduction in the cost-value gap. We find a statistically significant increase in perceived value, with the majority (84%) of the recipients who initially perceived a lower value than the Black-Scholes cost increasing their perceived values after training. We no longer find any evidence of a discount in recipients' perceived values relative to the Black-Scholes cost, and find some evidence that recipients may now value their options holdings at a premium over the Black-Scholes cost. We find strong evidence that training improves the recipients' confidence in their financial decision-making concerning their option holdings. In spite of a probable ceiling effect because the majority of recipients already display high levels of agreement, we find some evidence that training can improve recipients' motivation and company loyalty as well.

These results have notable implications for current compensation practices. Until recently, part of the appeal of employee stock options resulted from their favorable accounting treatment as compared to, for example, cash compensation or restricted stock. However, the Financial Accounting Standards Board's Statement 123(R) now mandates that firms record an income statement expense for employee stock option compensation. This change has led numerous firms to consider reevaluating the use of options in pay packages (e.g., Deloitte 2005; Wilson and Altmansberger 2003).² Concurrently, compensation and human resource consultants recognize the importance of understanding the gap between the opportunity cost and employees' perceived value of stock options (see, e.g., Enright and Reilly 2002; Mercer Human Resource

² There remains some uncertainty as to the extent of the impact that Statement 123(R) will have on firms granting stock option compensation (Knowledge@Wharton 2003, 2006). For example, after Microsoft announced its stock option program conversion, Intel issued a statement defending the value of using options (Guth and Lublin 2003; Knowledge@Wharton 2003). While the use of stock options as compensation appears to have recently decreased, approximately 65% of sampled firms still grant options, either alone or in combination with other forms of long-term incentive compensation such as restricted stock or performance shares (Carter et al. 2006, Table 4; Mercer Human Resource Consulting 2006b, 2). There is also some evidence suggesting that the use of option grants has stabilized over the last two years, at least at the CEO level (Mercer Human Resource Consulting 2006b, 2).

Consulting 2006a; Watson Wyatt Worldwide 2003, 5), and of communicating the potential value of employees' pay packages (Mercer Human Resource Consulting 2006a). Our research informs this practical cost-benefit assessment of the use of stock options by providing added insights into the individual factors that affect the option cost-value gap, and evaluating communications aimed at reducing the cost-value divergence (e.g., training programs).

The remainder of this paper is organized as follows. The next section develops our hypotheses. Section 3 describes the dataset and training program in greater detail, and Section 4 presents the empirical methodology and results. Section 5 concludes.

2. Background and Hypothesis Development

Employee stock options (ESOs) have become widely used by firms as a mechanism to attract, retain, and motivate employees (Core and Guay 2002; Elson 2003). The ability of ESOs to achieve these objectives, however, requires firms to restrict the trading (i.e., with vesting provisions) and hedging activities of the employee recipients. These restrictions likely result in a divergence between the opportunity cost to the firm of issuing options and the value placed on options by undiversified and risk-averse recipients; that is, these restrictions result in a cost-value gap.³ As Hall and Murphy (2002, 5) note,

The opportunity cost of an option to a company is the amount the company could receive if it were to sell a tradable and hedge-able option to an outside investor rather than giving it to the executive. This cost often significantly exceeds the value of the option from the perspective of a risk-averse, undiversified executive who can neither sell the option nor hedge against its risk. Executives receiving options will therefore value the options below their cost to shareholders, and this differential must be weighed against the incentive benefits in determining the optimal level of stock option compensation.

³ Consistent with this reasoning and the application of a valuation discount, employees commonly exercise their options well before the options would expire (see, e.g., Bettis et al. 2005; Huddart 1994; Huddart and Lang 1996), at least partially because of affective reactions to stock price trends (Heath et al. 1999). However, not all researchers agree that early exercise necessarily implies a valuation discount (e.g., Hallock and Olsen 2006).

The opportunity cost of an ESO can be estimated using common valuation techniques such as Black-Scholes. Notwithstanding numerous academic critiques, the Black-Scholes valuation model remains “the best known and most widely utilized method for calculating the company’s cost of granting an executive stock option” (Murphy 1999, Chapter 38, Section 2.3).⁴

The incentive benefit of an ESO, on the other hand, is a function of employees’ perceptions regarding the value of the option and, hence, is less easily measured. We know little about how employee stock option recipients perceive the value of their current stock option holdings or about the factors affecting the cost-value gap. Lambert et al. (1991, 129) point out that the incentive effects of a compensation contract would be determined by how a manager's actions affect his or her valuation of his or her compensation. Thus, our ignorance of how recipients perceive the value of current stock options likely contributes to the general lack of knowledge regarding the individual and firm performance effects of ESOs (Ittner et al. 2003).

Failure to understand the value employees place on ESOs may also lead to inefficient use of ESO compensation (as expressed in the opening quote from Hall 2003). Indeed, options should only be granted if the incentive effect exceeds the difference between the perceived value and the firm’s opportunity cost as determined by, for example, the Black-Scholes valuation model (Murphy 1999); that is, if the cost-value gap is sufficiently small. In the following subsections, we develop our hypotheses regarding the cost-value gap.

2.1. Empirical Estimation of the Cost-Value Gap

With data availability representing a substantial research obstacle (Core and Guay 2002),

⁴ Similar sentiments are expressed by Hill and Stevens (2002, 45) and Levine and Luft (2003, 10). For example, Maris et al. (2003, 672) identified the option valuation model applied by the S&P 100 firms in their 1996 fiscal year, finding that only one firm (1.4%) reported using a binomial model while the remainder (98.6%) reported using the Black-Scholes model. Similarly, Hall and Murphy (2002, 6) also note its continuing prevalence in academic research, commenting that “for example, every empirical paper in the recent *Journal of Financial Economics* special issue on stock options (a Symposium on Executive Stock Options, July 2000) uses Black-Scholes to value executive stock options.”

extant empirical research that examines the value employees place on ESOs is understandably limited in scope and, unfortunately, presents mixed results. For example, a 2004 web-based survey of 400 respondents conducted by Watson Wyatt Worldwide (2006) suggests that employees *undervalue* stock options by 30%-50% relative to the Black-Scholes cost of the option. This finding of a cost-value gap is consistent with economic theory in that option valuation models such as Black-Scholes assume stock options are tradable and that the option owner is a diversified (and, hence, risk-neutral) investor.⁵

In contrast, a survey of 122 *Knowledge@Wharton* readers by Larcker and Lambert (2001) reports that employees significantly *overvalue* ESOs relative to the corresponding Black-Scholes value (e.g., 50% higher for at-the-money, and double the valuation for options out-of-the-money by 50%). They conclude that this overvaluation is based, in part, on “unrealistic expectations as to what will happen to the stock price.”

Similarly, Hodge et al. (2006) survey 193 executive/evening and daytime MBA students and find that they, too, systematically overvalue stock options relative to the Black-Scholes value. Their results suggest that “optimistic” managers extrapolate recently rising stock prices to option values and that option overvaluation reflects firm sorting practices aimed at identifying optimistic employees.

In all of these prior studies, participants are asked to evaluate a partially or fully hypothetical setting. Such hypothetical settings can be used to great effect in experiments in order to control background information, holding it constant, while focusing the analyses on the directional effects of carefully manipulated variations (e.g., as in Hodge *et al.* 2006). As Libby

⁵ We do not intend to suggest that the employees who receive incentive stock options should be fully diversified. A risk-averse CEO or rank-and-file employee should prefer to increase their level of diversification to lower the idiosyncratic risk in their investment portfolio. However, from the firm’s perspective, maximizing the incentives generated by the stock options may imply decreasing the CEO’s or employee’s level of diversification.

et al. (2002, 798) note, however, “it is usually difficult to ensure a representative sample of independent variable values, which limits the interpretability of levels of effects and parameter estimates in most experiments.” In other words, because effect *levels* (e.g., the overall magnitude of the cost-value gap) are dependent on the many specific choices inherent in the experiment’s design and case materials, effect levels are more reliably estimated using a broader and more representative sample of naturally occurring values (i.e., “real-world” data).

We are not aware of any other studies that directly examine how employee recipients value their *own* current ESO holdings. The closest endeavor is Ikaheimo et al. (2004), which analyzes the market trading of vested ESOs on the Helsinki Stock Exchange, finding a mean discount of 15.5% relative to the corresponding Black-Scholes values. Their multivariate analyses suggest an overall discount rate of approximately 25%, which then varies with time to expiration and the relative difference between the strike price and the current stock price (as well as several control variables). Excluding country-specific differences, their results likely represent an upper limit to employees’ perceived ESO values in that, to be included in their research sample, the ESOs must have been both vested and transferable. Still, an analysis of the market trades of vested ESOs falls short as an examination of employee perceptions of their own stock option values.

Therefore, in predicting actual employees’ estimates of their own current stock option holdings, we return to the predictions consistent with economic theory: there will exist a cost-value gap such that recipients’ perceived value of their employee stock option holdings will be lower than the Black-Scholes value of those options. Stated formally:

H1: There is a cost-value gap such that employee recipients will perceive a value for their employee stock option holdings that is *lower* than the corresponding Black-Scholes value of those options.

The economic theory further suggests various factors that affect the perceived value of an ESO and, hence, the cost-value gap. Specifically, Hall and Murphy (2002) suggest that the value of an ESO depends not only on the six Black-Scholes option valuation model parameters (i.e., exercise price, stock price, dividend yield, stock return volatility, the risk-free rate, and time until expiration), but also on two characteristics of the recipients themselves: the value placed on an ESO by an employee should be negatively associated with the employee's level of risk-aversion and with his or her level of wealth concentration (i.e., the share of wealth invested in the employer's stock). In supplemental analyses, we examine the extent to which the propositions put forth in Hall and Murphy (2002) hold in practice.

Option recipients may also exhibit less than economically rational judgments in formulating their perceptions of value, depending on their level of knowledge about stock options (see reviews by, e.g., Libby 1995; Libby and Luft 1993). As noted by Hall (2000, 123), "stock options are bafflingly complex financial instruments. They tend to be poorly understood by both those who grant them and those who receive them." Reflecting this complexity, employees and even many stock plan professionals (e.g., plan administrators) likely find it difficult to assess the value of personal option holdings.

Basic research in cognitive psychology (e.g., Bettman and Sujan 1987; Chi et al. 1981; Schoenfeld and Herrmann 1982) as well as in accounting (e.g., Elliott 2006; Frederickson and Miller 2004; Tubbs 1992) suggests that less knowledgeable individuals are more likely to respond to salient but superficial aspects of a problem setting, whereas more knowledgeable individuals are better able to incorporate more of the relevant contextual factors. In our setting, however, the effect of incorporating additional contextual factors could be positive (increasing perceived value by, e.g., applying the Black-Scholes model instead of a simple intrinsic value) or

negative (decreasing perceived value by, e.g., adjusting the Black-Scholes model for trading or hedging restrictions). Because our dataset does not allow us to directly examine the cognitive processes by which employees value their stock options, we perform supplemental analyses to examine the narrower question of whether between-subject differences in recipients' knowledge of stock options are associated with the perceived value of their stock option holdings.

2.2. The Overall Effect of Employee Stock Option Training on the Cost-Value Gap

We now turn to the steps a firm can take to affect the cost-value gap and improve the incentive benefits of the options granted. We rely on prior research that suggests learning opportunities for the decision-maker affect both the store of knowledge and the effectiveness with which that knowledge is organized and retrieved, ultimately leading to improved judgment performance (Libby and Luft 1993). Accordingly, similar to Hill and Stevens' (2002) suggestion, we posit that firms can influence the cost-value gap by implementing training programs designed to increase ESO recipient knowledge. That is, we predict that stock option education and planning programs that explain how ESOs operate and that clearly articulate to employees the value of the options received (e.g., by illustrative value under particular growth patterns - Larcker and Lambert 2001) will improve employees' ability to value ESOs.

However, as discussed previously, the effect of improved ESO knowledge in our setting could be positive (increasing perceived value by, e.g., applying the Black-Scholes model instead of a simple intrinsic value) or negative (decreasing perceived value by, e.g., adjusting the Black-Scholes model for trading or hedging restrictions). Although we are implementing an experiment (discussed in Section 5) to disentangle the factors which may contribute to the training program effects, our archival dataset does not allow us to directly examine the cognitive processes by which employees value their stock options. Therefore, we make no directional

prediction; rather, we currently predict only that perceived value, and hence the cost-value gap, will change following employee training. Stated formally:

H2: The recipient's perceived value of their employee stock option holdings will change following the completion of an ESO training program.

3. Methodology

3.1. Sample and Data Collection

Our sample consists of the confidential training data files of Net Worth Strategies, Inc. (NWSI), a national leader in equity compensation planning services. NWSI provides employee stock option analysis software, and educational services aimed at enabling companies and individuals to maximize the value of equity compensation.

During the period September 2004 through March 2006, NWSI conducted ESO employee training programs at five client sites, hereafter Companies A through E.⁶ Although NWSI collects detailed information about each recipients' option grants (for which options remain unexpired and unexercised), we only have access to the values of recipients' aggregated holdings due to confidentiality constraints. We have also been granted only limited descriptions of the participating companies and recipients. The participating companies are all mid- or large-cap (i.e., with market capitalization of at least \$2 billion), and are all non-manufacturing (most commonly, financial services). In all cases, the recipients invited to participate by their employer-companies were from selected organizational units within larger companies, and, according to NWSI sources, are compensated in the top 10% of the respective larger companies.

As a mandatory part of the training registration process, recipients are asked to provide selected financial information, including confirmation of the company-provided Black-Scholes

⁶ The dataset only includes firms that consented to allow NWSI to provide data under company and recipient anonymity.

inputs (i.e., current stock price, stock price volatility, dividend yield, and risk-free rate),^{7,8} and the recipient-provided level of diversified investments, future financial goals, income tax rates, and the number and cost basis of any other share ownership in their employer. In addition, recipients complete a six-question Stock Option Survey (Appendix A).

In turn, employee-recipients receive an individualized “Equity Compensation Profile Report” (Profile), prepared by NWSI within two weeks prior to the registered training session. Appendix B includes a sample of the tables provided in the Profile.

The training program consists of an interactive group seminar session, approximately 60-90 minutes in length, that explains fundamentals about stock option valuation, leverage, risk, taxation, planning strategies and considerations for taking action, referring to recipients’ individual Profiles as the seminar progresses. After training, recipients are asked to complete a second copy of the Stock Option Survey (Appendix A) and an anonymous post-training evaluation form.

3.2. Variable definitions

Our key variables are summarized in Table 1, and are discussed further below.

3.2.1. Dependent variables

Our hypotheses center around the potential difference between recipients’ perceived values for their employee stock option holdings and the corresponding Black-Scholes values of those options. We measure the initial perceived value of employee stock options with

⁷ Inputs for computing Black-Scholes values are initially collected from a firm representative. These values are then listed as the “default” values when recipients enter their personal information, and it is possible (though unlikely) that recipients changed the values from those reported by the firm. Per our discussions with NWSI, if a recipient overrode the default values, NWSI worked with the recipient-provided values. Therefore, the computations are consistent with recipients’ beliefs about the Black-Scholes inputs.

⁸ Prior research documents that, on average, “firms systematically select inputs that jointly decrease fair values” (Hodder et al. 2006, 3). This implies that using independent benchmarks rather than the firm-provided Black-Scholes model inputs would likely result in an even greater perceived discount than that which we report in this paper.

$FORFEIT_{BT}$,⁹ the recipient-estimated value of stock options and restricted stock¹⁰ forfeited if the recipient decided to leave the company immediately, collected as part of the Stock Option Survey during the initial registration process. We measure the cost of employee stock options with $FORFEIT_{BS}$, the computed Black-Scholes value of stock options and restricted stock forfeited if the recipient decided to leave the company immediately (that is, the total Black-Scholes value less any intrinsic value for vested items, which would not be forfeited).

Consistent with Hall and Murphy (2002), we measure the divergence between the cost and perceived value of employee stock options as the ratio of the perceived value to the Black-Scholes cost. Thus, our primary dependent measure, $RATIO$, is defined as $FORFEIT_{BT} / FORFEIT_{BS}$. H1 predicts that $RATIO$ will be less than one; that is, that the perceived value will be lower than the Black-Scholes value (i.e., a discount). In contrast, a $RATIO$ greater than one indicates that the perceived value is greater than the Black-Scholes value (i.e., a premium).

We track recipients' revised valuations after training. The perceived value of employee stock options after completing the training, $FORFEIT_{AT}$, is each recipient's response to the same perceived value question as $FORFEIT_{BT}$ but is collected after training. We then also compute $RATIO_{AT}$, and the change in both variables from before-training to after-training. Thus, H2 predicts that the change in $RATIO$ will be significant.

⁹ We use the subscripts BT to denote "before training," AT to denote "after training," and BS to denote "Black-Scholes."

¹⁰ Although included in the elicitation question, restricted stock primarily affects only one participating company. Thirty-six of the 42 recipients (85.7%) from Firm E report restricted stock ownership. A minimal number of recipients from the other four firms in our dataset report restricted stock ownership (5 of 168, or 3.0%). Omitting the recipients who report restricted stock ownership from the analyses leaves the inferences from our hypothesis tests unchanged, as does omitting all responses from Firm E. We also consider 'sensitivity to stock returns,' or 'leverage' (e.g., Core and Guay 1999), as an alternate measure for recipients' perceived value of their employee stock option holdings. Specifically, as part of the Stock Option Survey, recipients were also asked to estimate the percentage increase in the value of their stock option holdings if the firm stock price were to increase by 20%. This question asks only about stock options (i.e., it omits restricted stock). When we compare the before-training ($LEVERAGE_{BT}$) and after training ($LEVERAGE_{AT}$) values to the NWSI-computed percentage ($LEVERAGE_{ITM}$), the inferences from our hypothesis tests are unchanged.

Panel A of Table 2 lists the number of observations by company, for both the full sample and the subsample of recipients for whom we have both the before- and after-training responses for our primary dependent variable, *RATIO*. Descriptive statistics for our dependent variables are provided in Panel B of Table 2, for both the full sample and for the subsample. Correlations are provided in Panel F of Table 2.

3.2.2. Variables for supplemental analyses

Economic theory suggests that the value placed on an ESO by an employee will be negatively associated with the employee's level of risk-aversion (Hall and Murphy 2002). We proxy for a recipient's level of risk aversion using the unfunded amount of his or her long-term financial goals. We assume that a higher proportion of unfunded financial goals reflects conservative past investment behavior and, hence, relatively higher levels of risk aversion on the part of the employee.¹¹ In other words, a large unfunded difference indicates a smaller willingness to accept higher risk, resulting in historically lower-return investments and a greater need to ensure that the employee's current nest egg remains protected. In contrast, a small unfunded amount indicates a greater willingness to accept higher risk, both historically in order to help achieve the financial goal and currently because any loss could likely be weathered by the reserves already accumulated. We measure our proxy for risk aversion, *UNFUNDED*, as the percentage of a recipient's estimated future financial needs that are currently unmet by his or her diversified investments (that is, $1 - \text{INVESTMENTS} / \text{WEALTHGOAL}$). The level of diversified investments (*INVESTMENTS*) is the recipient-provided value of assets outside of

¹¹ An alternative interpretation is that lower levels of funding will lead to more risk-taking (i.e., less risk aversion) going forward. Becker (2006) argues that wealth data may provide a good proxy for the level of absolute risk aversion when risk aversion itself is not observable. In sensitivity tests (untabulated), we therefore also consider the two individual components of *UNFUNDED* (that is, *WEALTHGOAL* and *INVESTMENTS*) as potential proxies for recipients' risk preferences, with similar results. The lack of a more precise measure of risk aversion is a limitation of our data set.

employer stock, options, and restricted stock, and excluding the value of their personal residence. The estimated future financial needs (WEALTHGOAL) is the recipient-provided value of money needed today to meet future financial needs.

The value placed on an ESO by an employee should also be negatively associated with his or her level of wealth concentration (i.e., the share of wealth invested in the employer's stock) (Hall and Murphy 2002). We measure recipients' wealth concentration with $CONCENTRATION_{BT}$, the recipient-estimated percentage of their total investment assets that consist of stock option holdings and employer stocks. We also use as a measure of actual wealth concentration, $CONCENTRATION_{ITMAfterTax}$, the computed percentage of total investment assets that consist of stock option holdings (based on after-tax intrinsic value)¹² and company stocks.

In addition to these economic factors, we proxy for recipients' knowledge of options using two measures: experience with stock options (estimated with YEARS, the number of years since the earliest date of options granted to the recipient for which any options remain unexpired and unexercised),¹³ and recipients' self-assessed confidence in financial decision-making regarding their stock option holdings (estimated with $CONFIDENCE_{BT}$, the recipients' level of agreement with the statement they can make timely and tax efficient decisions regarding their stock options and restricted stock, collected as part of the Stock Option Survey during the initial registration process). Recipients assess their confidence on a five-point scale from 1 (strongly agree) to 5 (strongly disagree); NWSI then applies a reverse scoring, such that higher values indicate greater confidence.

¹² This intrinsic-value-based percentage is reported to recipients in their customized Profile, rather than one based on the Black-Scholes value of all options. Given that our measure of perceived value is the amount forfeited if the recipient leaves the company, this measure is well matched to the Hall and Murphy construct because it includes only company investments that would not be forfeited.

¹³ NWSI confirmed that each of the participating firms typically grants options annually. Therefore, we estimate the number of years of option grants received by each recipient based on their earliest options grant for which options remain unexpired and unexercised. However, this estimate may underestimate recipients' true experience because it is based on the oldest grant which is still active (i.e., it omits prior grants that expired or were fully exercised).

Descriptive statistics for our supplemental variables are provided in Panel C of Table 2. Descriptive statistics for other individual-level and for company-level inputs into the Black-Scholes model are provided in Panels D and E of Table 2, respectively. Selected correlations are provided in Panel F of Table 2.

4. Empirical Results

4.1. H1: Empirical Estimation of the Cost-Value Gap

4.1.1. Primary data source: Employee stock option recipients

As seen in Figure 1, the distribution for RATIO is asymmetric—heavily skewed with heavy tails—with a zero minimum ratio value but an infinite maximum ratio value. Therefore, we begin by describing and testing the distribution of RATIO, then apply non-parametric tests to estimate the central tendency.

We find strong evidence that recipients apply a discount relative to Black-Scholes. Overall, 158 of the 210 recipients (75.2%) perceive that the value of their stock options and restricted stock forfeited upon leaving the company is *less than* the corresponding Black-Scholes value. The median RATIO of 0.396 represents a statistically significant discount ($p < 0.0001$ for a one-sided signed rank test of the median < 1), as well as an economically significant one. While these results vary across participating companies, Panel A of Table 3 shows that the majority of recipients in each company discount their perceived value relative to the corresponding Black-Scholes value (ranging from 53.8% up to 100.0%), with a median RATIO of less than one in all cases (and significantly so in all except two of the participating companies).^{14, 15}

¹⁴ NWSI believes that prior exposure to the Profile contents contributes to the lack of significant results for these two companies. In *post hoc* analyses, NWSI identified that approximately one quarter and one half of the recipients in Firms B and C, respectively, had previously been introduced to some or all of the concepts presented in the

With only five companies, there is insufficient variation in the Black-Scholes model inputs in our data to effectively assess the extent to which the discount rate varies with those inputs (e.g., dividend rate, risk free rate, expected volatility). Thus, we are unable to assess whether the applied discount reflects a misunderstanding of the influence of these Black-Scholes inputs on value. However, we can confirm that recipients' perceived value, $FORFEIT_{BT}$ is positively correlated with the corresponding Black-Scholes cost, $FORFEIT_{BS}$ (Spearman rank correlation, $r = +0.5015$, $p < 0.0001$). This positive correlation suggests that recipients' perceived values are at least partially consistent with some of the Black-Scholes model inputs.¹⁶

4.1.2. Secondary data source: Stock plan professionals

We corroborate these findings using valuations provided by compensation professionals. As an exhibitor at the 13th Annual Conference for The National Association of Stock Plan Professionals (NASPP),¹⁷ NWSI conducted a series of contests, asking conference attendees to estimate the value associated with a hypothetical employee's option and restricted stock holdings for actual, known companies. Each contest provided conference attendees with the details of the hypothetical employees' holdings, the name of the company, and the company's current stock

training Profile (e.g., time value component of the options). Thus, although none of the recipients had completed a training session, the prior exposure to these concepts may foreshadow the effects of training (in this case, reducing the extent of the discount). Excluding those recipients with prior exposure to some or all of the concepts presented in the training Profile leaves the inferences from our hypothesis tests unchanged. Further, while unable to quantify the affected recipients, NWSI is aware that a number of recipients from Firm B were informed that they would no longer be receiving stock options. Excluding all recipients from Firm B leaves the inferences from our hypothesis tests unchanged. NWSI confirmed that these issues are unique to Firms B and C.

¹⁵ For parametric tests, we note that the mean $RATIO$ is sensitive to an extreme outlying observation (one that is nearly 13 standard deviations above the mean). When this outlier is excluded or when the data are winsorised at the extreme 1%, the mean $RATIO$ s are also less than 1 ($p = 0.0117$ and 0.0297 , respectively, for one-sided Student t tests).

¹⁶ The elicitation question does not specify whether recipients' estimates of the amount they would forfeit upon leaving the company should be specified on a before- or after-tax basis. However, in untabulated analyses, we find that there is a weakly positive relation between the recipients' $TAXRATE$ and $FORFEIT_{BT}$ and between $TAXRATE$ and $RATIO$. This suggests that the lower value that recipients' perceive relative to the corresponding Black-Scholes equivalent is unlikely to be caused by recipients' interpreting the question on an after-tax basis.

¹⁷ According to their website (<http://www.naspp.com/miscNASPP/aboutNASPP.htm>), NASPP is "the leading membership association devoted to meeting the needs of stock plan professionals," with members "whose responsibilities relate, directly or indirectly, to stock plan design and administration."

price; the conference attendee who submitted the value closest to NWSI's computed value in each contest won a \$50 Visa gift card, and all participants were entered into a drawing for an Apple Ipod Nano. Panels A and B of Figure 2 present the information provided to conference attendees for the two contests focusing on $FORFEIT_{BS}$.

Results are qualitatively similar for the two contests; therefore, we only present the analysis on the combined datasets (Panel C of Figure 2). Overall, 47 of 60 participating stock plan professionals (78.3%) perceived the value of the hypothetical employee's stock options and restricted stock forfeit upon leaving the company as *less than* the Black-Scholes value (i.e., $RATIO < 1$). The median $RATIO$ value of 0.634 represents a statistically significant discount ($p < 0.0001$ for a one-sided signed rank test of the median < 1).^{18,19} These results are qualitatively similar to the results using our primary data source, suggesting that our results are not driven by the particular group of employees who might be interested in participating in option training sessions. Rather, these analyses suggest that even people who make their living understanding equity compensation display a cost-value gap.

4.1.3. Supplemental analyses

The median $RATIO$ s from our data of 0.396 and 0.634 imply discounts relative to the Black-Scholes cost of 60.4% and 36.6%, respectively. These $RATIO$ magnitudes are consistent with Hall and Murphy's (2002, Table 1) numeric examples, which range from 0.022 to 0.719, although the majority of the examples are contained within a $RATIO$ range of 0.30 to 0.70. They are also consistent with Meulbroek's (2001, 6) $RATIO$ estimate of 0.53 for undiversified

¹⁸ NWSI recorded several estimates from stock plan professionals for which the contest number was not recorded. We identified an additional 22 estimates that relate to one of these two contests. As a conservative test, we assume that these estimates are for the contest with the *lower* Black-Scholes forfeit value (contest 1), which biases against our hypothesis. Even still, we find that 18 of the 22 (81.2%) additional estimates are lower than the Black-Scholes value, with 65 of the 82 total (79.3%) participants' estimates lower than the Black-Scholes value.

¹⁹ Similar to our primary data source, we note that the mean $RATIO$ of 0.856 is also less than 1, but is not significantly so using a one-sided Student t test ($p = 0.1172$).

managers of Internet firms. They are also below the upper bound of 0.75 (i.e., minimum 25% discount) suggested by Ikaheimo et al.'s (2004) analysis of vested ESOs trading on the Helsinki Stock Exchange. Our evidence of a strong discount is, of course, inconsistent with Hodge et al.'s (2006) findings of an overall valuation premium; we discuss a possible reconciliation between our findings and Hodge et al.'s (2006) findings following our analysis of H2 on employee stock option training.

We also assess the individual characteristics posited by Hall and Murphy (2002) to affect recipients' perceived value (risk aversion and wealth concentration), as well as recipients' level of prior experience with stock options. We report the results for $RATIO$; the results are similar in direction for $FORFEIT_{BT}$, although some of the significance levels vary. Spearman rank correlations (reported in Panel F of Table 2) show that, as predicted, $RATIO$ is negatively related to our measure of risk aversion, $UNFUNDED$ ($r = -0.138$, $p = 0.0465$), but unexpectedly positively related to our measures of wealth concentration, $CONCENTRATION_{BT}$ and $CONCENTRATION_{ITMAfterTax}$ ($r = +0.371$ and $+0.086$, $p < 0.0001$ and 0.2161 , respectively). Spearman rank correlations also show that $RATIO$ is positively associated with the length of recipients' experience with stock options, $YEARS$ ($r = +0.254$, $p = 0.0002$), but not with their self-assessed confidence in financial decision-making, $CONFIDENCE_{BT}$ ($r = -0.029$, $p = 0.672$).

We report multivariate analyses in Table 4. In Model 1, we regress $RATIO$ on $UNFUNDED$, $CONCENTRATION_{BT}$, $CONCENTRATION_{ITMAfterTax}$, $YEARS$, and $CONFIDENCE_{BT}$. In Model 2, we repeat these multivariate analyses, regressing $FORFEIT_{BT}$ on these same variables while including $FORFEIT_{BS}$ as a control variable. For each model, we report the results using the percentile ranks for all variables (Models 1A and 2A) as well as using unranked variables winsorized at the extreme 1% to limit the effects of outliers (Models 1B and

2B). Results show that only the positive association with $\text{CONCENTRATION}_{\text{BT}}$ remains significant in the multivariate analyses. Results (untabulated) remain similar when we re-rank the variables within each company in Models 1A and 2A, and with the company added as a categorical control variable in Models 1B and 2B.

Some of our mixed results could certainly be due to our measures being weak proxies for the underlying constructs. However, Hodge et al. (2006) use a more established measure of risk aversion developed by Kahneman and Tversky (1979) and similarly fail to find a consistent association between their measure and perceived option value. They also fail to find consistent associations with their measures of wealth concentration and of knowledge.²⁰

4.2. H2: Overall Effect of Employee Stock Option Training

4.2.1. Changes in the Cost-Value Gap

Consistent with our predictions for H2, we find that recipients' perceived values are significantly affected by training. For the 124 recipients for whom we have post-training data, Figure 3 shows the distribution for RATIO before and after training.²¹ The median RATIO after training is 1.000 (i.e., equal to the Black-Scholes cost), compared to 0.386 prior to training (i.e.,

²⁰ We note that YEARS is significantly and positively correlated with the recipients' intrinsic value of their options, both in total (Spearman rank correlation $r=+0.683$, $p<0.0001$) and only vested options (Spearman rank correlation $r=+0.771$, $p<0.0001$). Therefore, it is possible that recipients' perceived values are associated with the intrinsic value of recipients' options holdings, rather than their continuing experience with options *per se*. However, our measure of perceived value is the amount forfeited if the recipient decided to leave the company immediately. Recipients should *not* forfeit the intrinsic value of their vested options; for any vested options, recipients could capture the intrinsic value by exercising the options and selling the shares just prior to terminating their employment.

²¹ Of the 210 recipients for whom we have pre-training data, 158 (52) perceived value as less (more) than the Black-Scholes cost. Of those recipients, we have post-training data for 93 (31). To address potential self-selection biases, we note that the drop-out rate does not vary with whether the recipient initially perceived value as less (41.1%) or more (40.4%) than the corresponding Black-Scholes cost ($p = 1.0000$ under Fisher's Exact Test). We also compare the before training RATIO values between those 108 recipients who completed the after-training survey (median $\text{RATIO}_{\text{BT}} = 0.386$) and those 59 recipients who did not (median $\text{RATIO}_{\text{BT}} = 0.429$), and do not find any significant difference ($\chi^2_1 = 0.4230$, $p = 0.5154$, for a two-sided Kruskal-Wallis test of a difference in the medians).

a discount of 61.4% compared to the Black-Scholes cost). This increase is statistically significant (median *change* in RATIO = +0.671, $p < 0.0001$ for a signed-rank test).²²

These changes in the median RATIO vary significantly by company. Panel B of Table 3 shows that our reported results are largely driven by the participating companies that displayed significant discounting before training, with generally insignificant results for the other two companies (see footnote 14).

4.2.2. Supplemental analyses

During training, recipients' individualized Profiles clearly display the Black-Scholes forfeit value of the recipients' option holdings. That explicitly stated value likely acts as an anchor (e.g., Slovic and Lichtenstein 1971; Tversky and Kahneman 1974), shifting recipients' perceived values toward the Black-Scholes value of their option holdings. However, anchoring and adjustment is unlikely to fully explain our results because the training effects we observe are not symmetric. Of the 93 recipients who initially perceived a lower value than the Black-Scholes cost, 78 (83.9%) increased their perceived value while only 7 (7.5%) decreased their perceived value following training. In contrast, of the 31 recipients who initially perceived a higher value than the Black-Scholes cost, 21 (67.7%) decreased their perceived value while another 10 (32.3%) increased their perceived value following training. The tendency for recipients who initially perceive a lower value than Black-Scholes to *increase* their perceived value after training is significantly stronger than the tendency for recipients who initially perceive a higher value than Black-Scholes to *decrease* their perceived value after training ($p = 0.0014$ under Fisher's Exact Test). Anchoring and adjustment does not imply this asymmetry.

²² Similar to Hodge et al.(2006), we find that parametric tests of the the mean RATIO after training consistently suggests a valuation premium relative to the Black-Scholes cost. Specifically, after training, the mean RATIO of 1.469 is significantly greater than 1.000 using a two-sided Student t test ($p = 0.0030$). This finding is not sensitive to extreme outlying observations, with a similar premium when the data is winsorized at the extreme 1% and 5% of observations (all $p < 0.01$).

We further investigate the effects of the training program by examining changes in self-assessed confidence, motivation, and loyalty.²³ We find strong evidence that training improves the recipients' confidence in their knowledge of options ($CONFIDENCE_{BT}$). Overall, 74 (16) of the 118 available post-training respondents reported increased (decreased) confidence in their knowledge of options, with a mean and median increase of +0.95 and +1.00 on the five-point scale (both $p < 0.0001$). This increase in confidence varies by participating company, with respondents in all but one of the participating companies reporting a significant increase in their confidence.

We also find some evidence that training improves the recipients' self-reported motivation and company loyalty. Specifically, recipients rated their agreement (on similar five-point scales) with propositions that their stock options and restricted stock encouraged them to (1) work harder to contribute to the financial performance of their employer (WorkHard), or (2) continue their employment with the company (Loyalty). Despite a likely ceiling effect because the majority of recipients agree with these statements even before training (mean = 4.152 and 4.119, median = 4.000 and 5.000, for WorkHard and Loyalty, respectively), we find a marginally significant increase in the agreement after training (revised mean = 4.390 and 4.364, revised median = 5.000 and 5.000, with mean increase = +0.237 and +0.246, $p = 0.0417$ and 0.0383 , and with median increase = +0.000 and +0.000, $p = 0.0785$ and 0.0625 , for WorkHard and Loyalty, respectively). The increase in motivation does not vary significantly by participating company;

²³ For completeness, we note that the anonymous post-training evaluation form asked recipients to rate the improvement in their understanding of stock ownership holdings, the value of their Profile, the value of the educational training session, the knowledge level of the instructor and the effectiveness of the instructor's presentation. The mean ratings of the recipients who returned the anonymous post-training evaluation were all significantly above the midpoint of the 6-point response scale. (Respondents from all but one of the participating companies were asked these questions. Respondents from the other participating company were asked generally similar questions on 3- or 5-point scales, with similar results.) Interestingly, although the respondents' mean rating of their need for assistance in developing a tax efficient implementation strategy was lower than the other evaluation measures, it too was significantly above the midpoint of the response scale. Respondents also strongly indicated their desire for updated reports, with all but one respondent indicating a desire for at least annual updates. This suggests that respondents from the participating companies perceived a benefit from the training and a likely additional future benefit from continuing education about their options.

the increase in Loyalty does appear to vary significantly by participating company (with one company showing a mean decrease relative to the other companies' mean increases).

4.3. Discussion

Our results provide fairly convincing evidence of a tendency for employee option recipients in our sample to value their options below the corresponding Black-Scholes value; that is, to exhibit a cost-value gap. In contrast, the prior research of Hodge et al. (2006) finds perceived option values to be higher than the Black-Scholes value and attributes this to optimism regarding future stock price performance. Further investigation of our results suggests a potential explanation for the difference.

Because the before-training distributions for RATIO are positively skewed with heavy tails, we use non-parametric tests to estimate the central tendency, focusing on the median. Our analyses, however, show an interesting difference between the medians and means of our sample. Prior to training, although the majority of recipients perceive the value of their stock option holdings to be less than the corresponding Black-Scholes value, the mean perceived value is not always significantly lower than the corresponding Black-Scholes cost (see footnotes 15 and 19). In contrast, results *after training* are similar to Hodge et al. (2006, 16), with the median perceived value suggesting little valuation difference and the mean perceived value suggesting a valuation premium relative to the Black-Scholes cost (see footnote 22). We conjecture that Hodge et al.'s (2006) design choice to provide their participants with a Black-Scholes 'fair value' benchmark in their experimental materials mimics, in their artificial setting, the real-world effects of completing the NWSI stock option education and planning program: the explanation of how stock options operate and the clear articulation of the Black-Scholes value of the recipients' current options.

Because Hodge et al. (2006) include the Black-Scholes value as a salient benchmark in their case materials, the observed valuation premium may imply that their participants consciously decided to demand more than that fair value for their hypothetical options. If actual option recipients believe a premium is appropriate (e.g., because of the optimism effects suggested in Hodge *et al.* 2006) but initially underestimate an option's value because they do not normally have easy access to a 'fair value' benchmark, then the net value may still be lower than the corresponding Black-Scholes value (as in our pre-training data). Perhaps the availability of a salient 'fair value' benchmark reduces the noise in recipients' perceived values to allow the optimism premium to then be observed. Below we describe our ongoing research efforts to disentangle the factors contributing to the training program effects.

5. Conclusion and Directions for Future Research

Using a unique dataset from the proprietary records of a leading provider of equity compensation planning services, we examine the difference between the Black-Scholes cost and employees' perceived value of their stock option holdings. In contrast to prior studies (e.g., Hodge *et al.* 2006; Larcker and Lambert 2001; Watson Wyatt Worldwide 2006) in which participants evaluate a partially or fully hypothetical setting, our data consist of actual employees' estimates of their own current stock option holdings, which arguably allows us to provide a better and more realistic assessment of the value employees place on their stock option holdings.

We find a significant difference between recipients' perceived values of their current stock option holdings and the corresponding Black-Scholes costs, with 75% of recipients' perceived values *lower than* the corresponding Black-Scholes costs. This finding is consistent with our analysis of a secondary source of data, in which 78% of stock plan professionals (e.g., consultants, plan administrators) underestimated the value for a hypothetical employee's option

holdings relative to the Black-Scholes cost. These results suggest that even people who make their living understanding equity compensation display a cost-value gap.

In supplemental analyses, we find only mixed support for the individual characteristics that economic theory suggests will affect recipients' perceived value (risk aversion and wealth concentration), and for recipients' level of prior experience with stock options. Univariate tests show that recipients' perceived values are negatively related to our risk aversion proxy and positively related to recipients' level of prior experience with stock options. Unexpectedly, univariate tests show that recipients' perceived values are also positively related to the perceived share of recipients' wealth invested in their employer's stock, and this is the only effect that remains significant in multivariate analyses.

Perhaps of greatest practical significance, we also examine the effects of completing a stock option education and planning program that explains how stock options operate and clearly articulates the Black-Scholes value of the recipients' current options. For a subsample of recipients, our data include both their initial (before training) and revised (after training) value estimates of their current stock option holdings. We find a statistically significant increase in perceived option value after training, with the majority (84%) of the recipients who initially perceived a lower value than the Black-Scholes cost increasing their perceived value after training. Importantly, we no longer find any evidence of a discount in recipients' perceived values relative to the Black-Scholes cost, suggesting that investments in employee training can significantly decrease the cost-value gap and increase the incentive benefit of employee stock options. Training participants also report greater confidence in their financial decision-making concerning their option holdings and marginally greater levels of motivation and company loyalty.

The results presented in this paper provide convincing evidence that a training program can be effective in altering the perceptions of employees regarding the value of their stock options. What remains unclear, however, is the process by which training mitigates this undervaluation. To this end, we are currently implementing an experiment to provide additional insight on employee stock option valuation and to disentangle the various effects of a valuation training program.

During the NWSI training program, the employees in our sample are not only educated about how stock options operate and informed of an applicable valuation model, but they are also clearly provided with the current Black-Scholes value of their option holdings. That explicitly stated value likely acts as an anchor (e.g., Slovic and Lichtenstein 1971; Tversky and Kahneman 1974), shifting recipients' perceived values toward the current Black-Scholes value of their option holdings. Any such anchoring effect is unlikely to fully explain our results because the training effects we observe are not symmetric. That is, the tendency for recipients who initially perceived a lower value than Black-Scholes to *increase* their perceived value after training is significantly stronger than the tendency for recipients who initially perceived a greater value than Black-Scholes to *decrease* their perceived value after training. However, how their improved knowledge about stock options, their new understanding of an applicable valuation model, and the explicit statement of the current Black-Scholes value of their option holdings interact to lead to the dramatic increases we have observed in recipients' perceived values and reported confidence remains an open question. The experimental portion of our study investigates this fundamental question. In doing so, we expect to provide a better reconciliation between the results from the archival portion of our study, which document that employees (and stock plan professionals) undervalue stock options, and prior suggestions that employees may generally overvalue stock options.

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Table 1
Key Variable Definitions

Panel A: Dependent Variables

Variable	Source	Definition	Expected range
Ratio _{BT}	Computed	Forfeit _{BT} / Forfeit _{BS} ,	Ratio, with a lower bound of 0
Forfeit _{BT}	Recipient response to Q6 on Stock Option Survey	Fill-in-the-blank response before training (BT) to the following question: “If I were to leave the company today, the value of options and restricted stock I would forfeit would be about what amount?”	\$ value, with a lower bound of \$0
Forfeit _{BS}	NWSI computed value to Q6 on Stock Option Survey	NWSI computed Black-Scholes (BS) value of options and restricted stock forfeited if the recipient leaves their employer.	\$ value, with a lower bound of \$0

The subscripts BS to denote “Black-Scholes” and BT to denote “before training.” Ratio_{AT}, Forfeit_{AT}, and Rate_{AT}, are all defined similarly after training (AT). The change in each of these variables (Variable_Change) is defined as the after-training variable minus the before-training variable (e.g., Ratio_Change = Ratio_{AT} – Ratio_{BT}).

Panel B: Variables for Supplemental Analyses

Variable	Source	Definition	Expected range
Unfunded	Computed	1– DiversifiedInvestments / WealthGoal	Ratio, with an upper bound of 1.
WealthGoal	Recipient response to financial background questions	Fill-in-the-blank response to the following statement: “Please estimate the amount of money needed today to meet future financial needs.”	\$ value, with a lower bound of \$0
Diversified Investments	Recipient response to financial background questions	Fill-in-the-blank response to the following statement: “Please estimate the before-tax value of assets outside of company stock, options, and restricted stock. Do not include any company stock or options or the value of the personal residence.”	\$ value, with a lower bound of \$0
Concentration _{BT} , Concentration _{AT}	Recipient response to Q5 on Stock Option Survey	Fill-in-the-blank response before training (BT) or after training (AT) to the following question: “Of my total investment assets, my total stock option holdings and company stocks are about what percentage?”	%age [0%, 100%]
Concentration ITMAfterTax	NWSI computed value to Q5 on Stock Option Survey	NWSI computed percentage of after-tax cash-out (in-the-money, ITM) value of employer-company holdings relative to total investment assets	%age [0%, 100%]
Years	Computed	Number of years of grants received based on Earliest date of active grants (based on stock option grant summary information provided by each company)	Integer value, with a lower bound of 1
Confidence _{BT} , Confidence _{AT}	Recipient response to Q3 on Stock Option Survey, reverse scored by NWSI	Rated agreement before training (BT) or after training (AT) with the following statement on a 5-pt Likert scale: “I am confident I can make timely and tax efficient decisions regarding my stock options and restricted stock.”	1 (strongly disagree) to 5 (strongly agree)

Panel C: Other Individual-Level Variables

Variable	Source	Definition	Expected range
Restricted	NWSI computed, based on recipient response to financial background questions	Before-tax value of restricted shares, based on the product of the participant response to the following statement “Please provide the number of unvested company shares (do not include options as shares)...” and current stock price (see ‘StockPrice’ in Panel D).	\$ value, with a lower bound of \$0
SharesOwned	Computed, based on recipient response to financial background questions	Value of owned shares, based on the participant response to the following statement “Please provide the number of vested company shares (do not include options as shares)... These may have come from prior exercises, vestings or purchases on the open market” then multiplied by the current stock price (see ‘StockPrice’ in Panel D).	\$ value, with a lower bound of \$0
BlackScholes	NWSI computed	Total Black-Scholes value of all options holdings, based on stock option grant summary information (grants, vestings, exercises, etc., provided by company) and Black-Scholes assumption inputs (see Panel D below).	\$ value, with a lower bound of \$0
ITM	NWSI computed	Total intrinsic (in-the-money, ITM) value of all options holdings, based on stock option grant summary information (grants, vestings, exercises, etc., provided by company) and the current stock price (see ‘StockPrice’ in Panel D).	\$ value, with a lower bound of \$0
ITM _{Vested}	Computed	Total before-tax intrinsic (in-the-money, ITM) value of only the vested options, computed as “ITM – ITM _{Unvested} ”, where ITM _{Unvested} is the total before-tax in-the-money value of only the unvested options as computed by NWSI.	\$ value, with a lower bound of \$0
Pct Options Vested	Computed	Percentage of total options held that are vested, computed as the number of vested options held, divided by the total number of options held (both vested and unvested), both counted by NWSI.	%age [0%, 100%]
Pct Options ITM	Computed	Percentage of total options held that are in-the-money, computed as the number of options held that are in-the-money (both vested and unvested), divided by the total number of options held (both vested and unvested), all counted by NWSI.	%age [0%, 100%]
Pct Options VestedITM	Computed	Percentage of total options held that are both vested and in-the-money, computed as the number of options held that are both vested and in-the-money, divided by the total number of options held (both vested and unvested), all counted by NWSI.	%age [0%, 100%]
TaxRate	Computed	Estimated personal tax rate, computed as “ $1 - (ITM_{VestedAfterTax} \div ITM_{Vested})$ ”, where ITM _{Vested} is defined above, and ITM _{VestedAfterTax} is the total after-tax value of those options that are both vested and in-the-money (as computed by NWSI). Missing TaxRate values are assumed to be equal to the median.	%age [0%, 100%]

Panel D: Other Company-Level Variables

Variable	Source	Definition	Expected range
StockPrice	Company and recipient responses	Share price of company stock	\$ value, with a lower bound of \$0
Dividend	Company and recipient responses	Expected dividends on company stock (per-share annual dividends in dollars)	\$ value, with a lower bound of \$0
RiskFreeRate	Company and recipient responses	Estimated risk-free rate of return	%age, with a lower bound of 0%
Volatility	Company and recipient responses	Estimated volatility of company stock	%age, with a lower bound of 0%

Inputs for computing Black-Scholes values are initially collected from a company representative. These values are then listed as the “default” values when recipients enter their personal information, and it is possible (though unlikely) that recipients changed the values from those reported by the company. Per our discussions with NWSI, if a recipient overrode the default values, NWSI worked with the recipient-provided values.

Table 2
Descriptive Statistics

Panel A – Sample Sizes by Company

Firm	Training Participants	Obs with Forfeit _{BT}	Obs with Forfeit _{BT} and _{AT}
A	75	72	51
B	26	26	15
C	35	34	15
D	36	36	27
E	67	42	16
Total	239	210	124

Panel B – Descriptive Statistics for Dependent Variables

Variable	Observations with Perceived Value Before Training (N=210)								Observations with Perceived Value Both Before and After Training (N=124)							
	N	MEAN	STD	MIN	Q1	Median	Q3	MAX	N	MEAN	STD	MIN	Q1	Median	Q3	MAX
Forfeit _{BS}	210	137,954	245,216	3,451	32,037	63,492	129,697	1,605,499	124	116,318	169,981	3,451	32,541	64,464	122,334	1,053,846
Forfeit _{BT}	210	89,756	206,713	0	8,000	25,000	75,000	2,000,000	124	88,500	168,997	0	9,000	30,000	77,500	1,000,000
Ratio _{BT}	210	1.63	11.83	0.00	0.13	0.40	0.98	171.40	124	2.27	15.37	0.00	0.13	0.39	1.02	171.40
Forfeit _{AT}									124	181,504	335,166	0	22,951	74,894	150,000	2,152,584
Ratio _{AT}									124	1.47	1.73	0.00	0.96	1.00	1.71	15.39
Forfeit_Change									124	93,003	288,160	-969,500	0	40,500	90,157	2,102,584
Ratio_Change									124	-0.80	15.10	-166.17	0.00	0.67	0.99	15.26

Panel C – Descriptive Statistics for Variables Used in Supplemental Analyses

Variable	Observations with Perceived Value Before Training (N=210)								Observations with Perceived Value Both Before and After Training (N=124)							
	N	MEAN	STD	MIN	Q1	Median	Q3	MAX	N	MEAN	STD	MIN	Q1	Median	Q3	MAX
Unfunded	210	0.00	11.49	-165.67	0.73	0.88	0.98	1.00	124	0.76	0.37	-1.50	0.70	0.88	0.97	1.00
DiversifiedInvestments	210	409,210	496,263	0	50,000	255,000	550,000	3,000,000	124	422,743	526,320	0	68,500	250,000	627,500	3,000,000
WealthGoal	210	2,509,636	1,569,932	3,000	2,000,000	2,000,000	2,658,000	17,000,000	124	2,436,322	1,743,275	100,000	2,000,000	2,000,000	2,579,000	17,000,000
Concentration _{BT}	210	0.25	0.24	0.00	0.06	0.15	0.35	1.00	124	0.28	0.26	0.00	0.09	0.20	0.50	1.00
Concentration _{ITMAfterTax}	210	0.35	0.35	0.00	0.08	0.19	0.59	1.00	124	0.33	0.33	0.00	0.09	0.20	0.55	1.00
Concentration _{AT}									112	0.35	0.31	0.00	0.10	0.25	0.60	1.00
Years	210	5.66	2.76	1.00	3.00	6.00	8.00	10.00	124	5.92	2.83	1.00	3.50	6.00	8.00	10.00
Confidence _{BT}	210	3.00	1.13	1.00	2.00	3.00	4.00	5.00	124	3.02	1.18	1.00	2.00	3.00	4.00	5.00
Confidence _{AT}									118	3.99	0.97	1.00	3.00	4.00	5.00	5.00
Confidence_Change									118	0.95	1.35	-2.00	0.00	1.00	2.00	4.00

Panel D – Descriptive Statistics for Other Individual-Level Variables

Variable	Observations with Perceived Value Before Training (N=210)								Observations with Perceived Value Both Before and After Training (N=124)							
	N	MEAN	STD	MIN	Q1	Median	Q3	MAX	N	MEAN	STD	MIN	Q1	Median	Q3	MAX
Restricted	210	10,487	44,897	0	0	0	0	422,450	124	8,566	45,164	0	0	0	0	422,450
SharesOwned	210	77,538	228,517	0	0	8,550	54,000	2,700,000	124	95,653	281,605	0	0	12,845	69,250	2,700,000
BlackScholes	210	238,884	497,274	3,451	42,798	84,864	187,543	3,532,427	124	216,129	346,831	3,451	47,646	85,807	216,771	2,152,584
ITM	210	143,962	334,586	0	13,419	38,851	101,604	2,255,988	124	141,269	284,831	0	14,107	44,137	131,944	2,202,576
ITM_Vested	210	114,868	310,919	0	1,534	20,088	69,623	2,147,347	124	113,945	270,025	0	2,558	25,711	94,548	2,147,347
RatioITM	210	0.52	0.60	0.00	0.32	0.48	0.66	8.24	124	0.49	0.28	0.00	0.32	0.48	0.66	1.25
RatioITM_Vested	210	0.30	0.28	0.00	0.02	0.20	0.53	1.21	124	0.33	0.29	0.00	0.03	0.26	0.56	1.21
PctOptionsVested	210	0.52	0.36	0.00	0.13	0.60	0.84	1.00	124	0.49	0.35	0.00	0.13	0.55	0.81	1.00
PctOptionsITM	210	0.70	0.33	0.00	0.41	0.84	1.00	1.00	124	0.71	0.31	0.00	0.52	0.84	0.99	1.00
PctOptionsVestedITM	210	0.38	0.35	0.00	0.04	0.28	0.71	1.00	124	0.41	0.34	0.00	0.05	0.35	0.72	1.00
TaxRate*	164	0.33	0.06	0.18	0.30	0.32	0.35	0.44	99	0.32	0.06	0.18	0.30	0.30	0.34	0.44

* Missing TaxRate values are assumed to be equal to the median value for the full sample.

Panel E – Descriptive Statistics for Other Company-Level Variables

Variable	N	MEAN	STD
StockPrice	210	36.25	13.43
Dividend	210	0.01	0.01
RiskFreeRate	210	0.04	0.00
Volatility	210	0.29	0.03

Table 3
Results of Hypotheses Tests

Panel A: Value-cost ratio for employee stock option recipients (H1)

Firm	Ratio _{BT}		Recipients' Value < Cost (Ratio _{BT} < 1)	
	Median	p*	Count	Percent
A	0.5340	0.0087	50 of 72	69.4
B	0.7610	0.4073	14 of 26	53.8
C	0.6650	0.2873	21 of 34	61.8
D	0.1140	<0.0001	31 of 36	86.1
E	0.2486	<0.0001	42 of 42	100.0
Combined	0.3959	<0.0001	158 of 210	75.2

Panel B: Change in the value-cost ratio for employee stock option recipients after training (H2)

Firm	Change in Ratio (Ratio _{AT} -Ratio _{BT})		Increase in Ratio (Change in Ratio > 0)	
	Median	p*	Count	Percent
A	0.9851	<0.0001	44 of 51	86.3
B	0.0000	0.7609	7 of 15	46.7
C	-0.1168	0.2166	6 of 15	40.0
D	0.7015	0.0083	18 of 27	66.7
E	0.3492	0.0020	13 of 16	81.3
Combined	0.6714	<0.0001	88 of 124	71.0

* In Panel A, p is the one-sided p-value for a signed-rank test of the median Ratio_{BT} < 1. In Panel B, p is the two-sided p-value for a signed-rank test of the median Change in Ratio = 0.

Table 4
Supplemental Analyses

Variable	Sign	RATIO _{BT}						FORFEIT _{BT}					
		Model 1A: Percentile Rankings			Model 1B: Winsorized @ 1%			Model 2A: Percentile Rankings			Model 2B: Winsorized @ 1%		
		Estimate	t	p	Estimate	t	p	Estimate	t	p	Estimate	t	p
Intercept		39.38	6.14	0.000	0.62	1.52	0.131	20.56	3.65	0.000	-10,106.77	-0.23	0.822
Forfeit _{BS}	+							0.39	6.54	0.000	0.36	9.08	0.000
Unfunded	-	-0.13	-1.51	0.133	0.28	0.94	0.347	-0.17	-2.38	0.018	2,986.61	0.09	0.928
Concentration _{BT}	-	0.36	4.65	0.000	1.34	3.29	0.001	0.35	5.42	0.000	217,876.66	4.84	0.000
Concentration _{ITMAfterTax}	-	-0.06	-0.61	0.544	-0.52	-1.88	0.061	-0.01	-0.15	0.884	-40,346.44	-1.32	0.188
Years	?	0.07	0.89	0.376	0.03	0.82	0.415	0.09	1.25	0.215	2,853.71	0.71	0.479
Confidence _{BT}	?	-0.05	-0.75	0.456	-0.11	-1.45	0.149	-0.04	-0.74	0.460	-4,321.95	-0.53	0.595
F-Statistic			8.24	0.000		3.83	0.002		25.76	0.000		25.96	0.000
Adjusted R ²			14.76			6.35			41.55			41.74	
N			210			210			210			210	

All p values are for two-sided tests.

Figure 1
H1 Results: The Value-Cost Ratio for Employee Stock Option Recipients

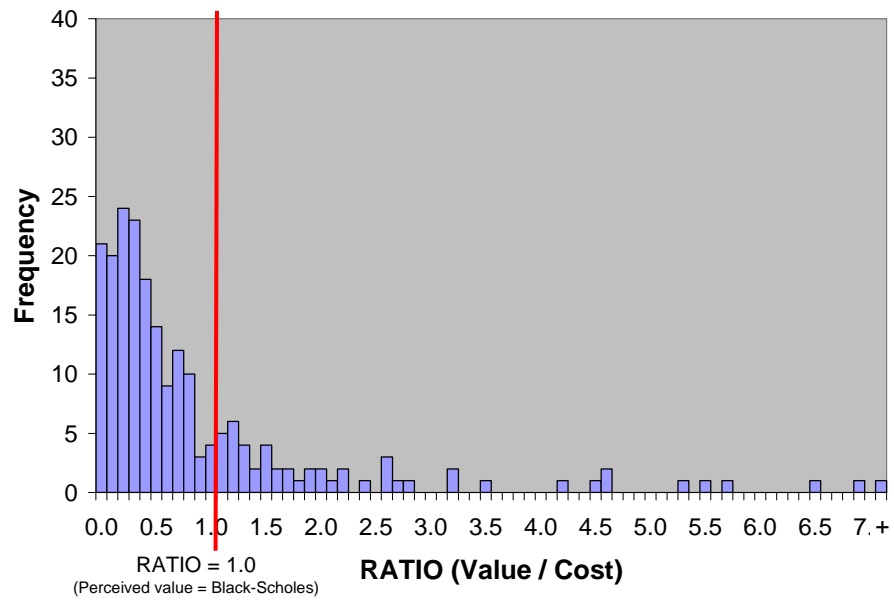
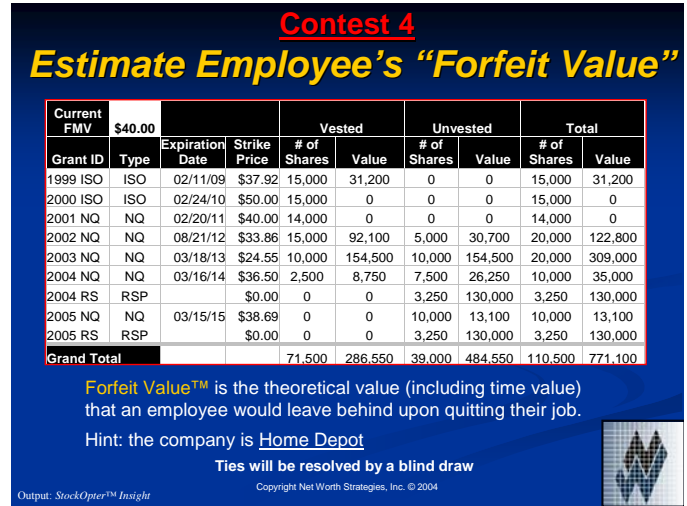
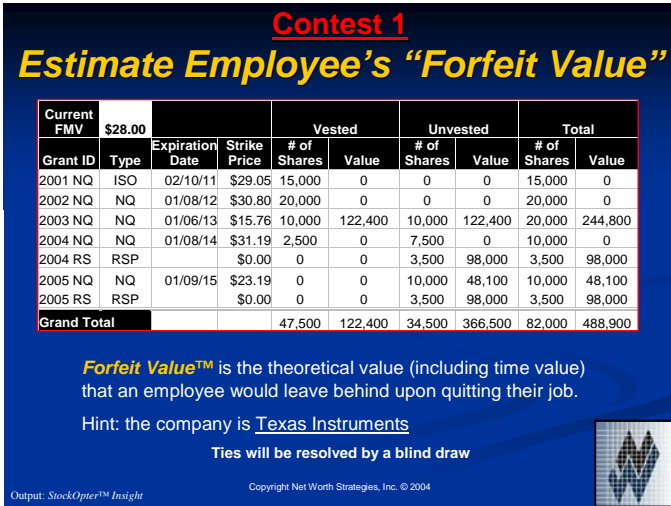
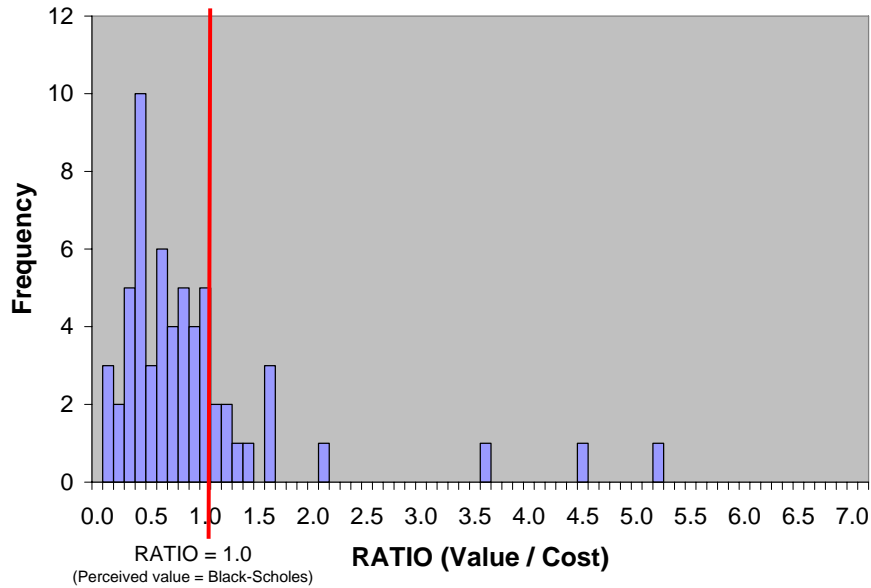


Figure 2
Secondary Results for H1: The Value-Cost Ratio for Stock Plan Professionals



Panel A: Hypothetical Employee Holdings for Contest 1 (Source: NWSI)

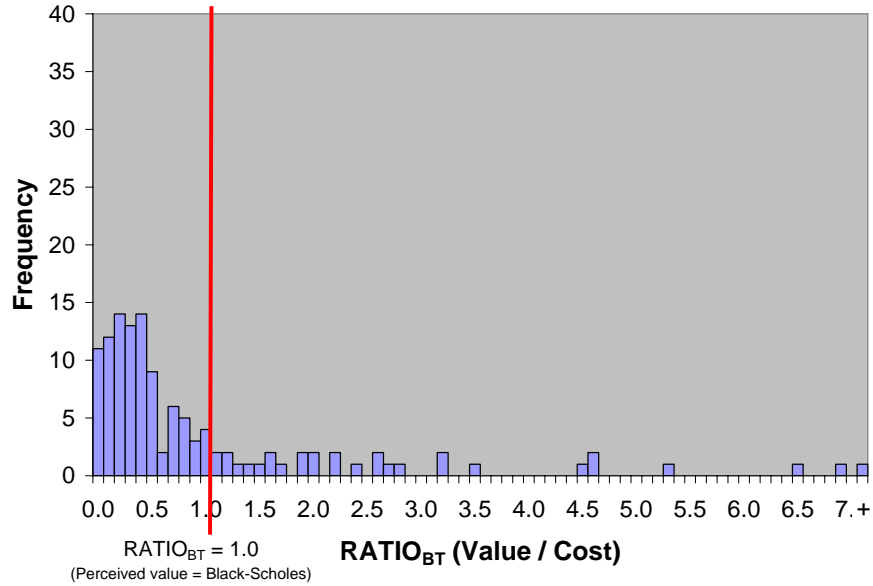
Panel B: Hypothetical Employee Holdings for Contest 4 (Source: NWSI)



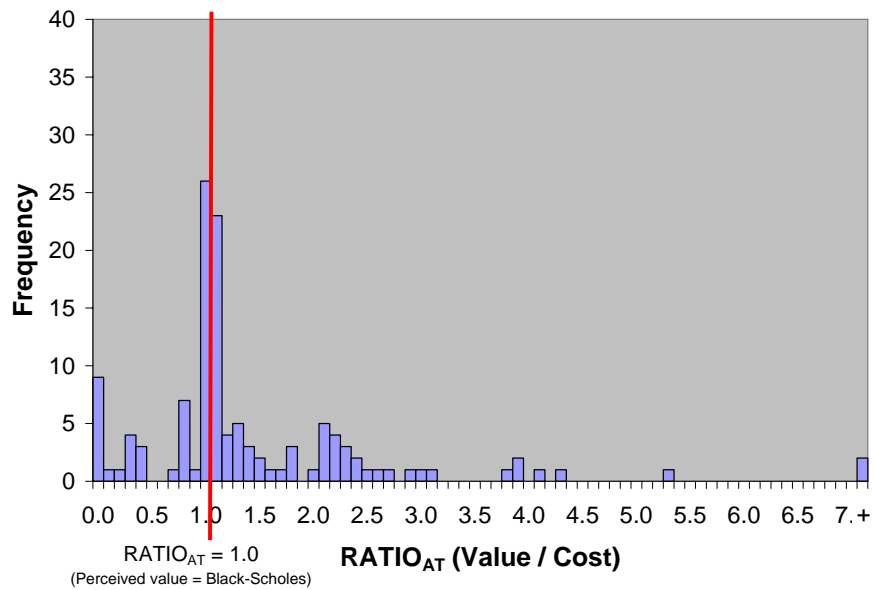
Panel C: Histogram of Perceived Value to Cost (RATIO) for Contests 1 and 4 (Combined Datasets)

Figure 3
H2 Results: The Value-Cost Ratio for Employee Stock Option Recipients
Before Training (*above*) and After Training (*below*)

Panel A: Matched Value-Cost Ratios for Employee Stock Option Recipients Before Training



Panel B: Matched Value-Cost Ratios for Employee Stock Option Recipients After Training



APPENDIX A
Stock Option Survey Administered by NWSI

Responses to the following survey questions were required of all NWSI training program registrants prior to the start of the training. The survey was also completed on a voluntary basis immediately following the training program.

	Strongly Agree				Strongly Disagree
1. My stock options and restricted stock encourage me to work harder to contribute to the financial performance of the company.	1	2	3	4	5
2. My stock options and restricted stock encourage me to continue my employment with the company.	1	2	3	4	5
3. I am confident I can make timely and tax efficient decisions regarding my stock options and restricted stock.	1	2	3	4	5
4. If my company stock price were to increase 20%, the value of my option holdings would increase about what percentage?					%
5. Of my total investment assets, my total stock option holdings and company stocks are about what percentage?					%
6. If I were to leave the company today, the value of options and restricted stock I would forfeit would be about what amount?					\$

APPENDIX B

Excerpts from the Sample NWSI Equity Compensation Profile Report (Profile)

Section I of the Profile summarizes the employee's current option holdings divided into sections based on four valuation methods: 1) In-the-money (or intrinsic) value, 2) Cash-out (after-tax) value, 3) Black-Scholes value and its related time value, and 4) Forfeit Value.

In-The-Money Value of All Options

The table below shows the gross value (before tax) the employee would realize from exercising and selling his or her options, or the difference between the current "fair market value" (FMV) per share (the current stock price) and the exercise price times the number of options. That is, the table provides the "in-the-money" (ITM) value or "intrinsic" value. The table shows this value for both vested and unvested options.

FMV	\$20.00	Vested				Unvested		Total		
		Grant ID	Option Type	Expiration Date	Strike Price	# of Options	ITM Value	# of Options	ITM Value	# of Options
1	ISO 97	ISO	01/01/07	\$13.00	40,000	280,000	0	0	40,000	280,000
2	ISO 98	ISO	01/01/08	\$15.00	25,000	125,000	0	0	25,000	125,000
3	NQ 00	NQSO	01/01/10	\$41.80	40,000	0	0	0	40,000	0
4	NQ 02	NQSO	01/01/12	\$19.65	30,000	10,500	20,000	7,000	50,000	17,500
5	NQ 04	NQSO	01/01/14	\$20.11	0	0	40,000	0	40,000	0
Grand Total					135,000	415,500	60,000	7,000	195,000	422,500

Cash-Out Value of Vested Options

The table below estimates what the employee can realize from the vested options at the given FMV. The "Potential Tax" column is computed by applying the employee's estimated marginal income tax rate. The "cash-out" value for each vested grant is determined by subtracting the potential tax burden from the ITM value. The cash-out value for any vested Incentive Stock Options (ISOs) is computed as if they are sold at the time of exercise.

FMV	\$20.00	Vested						Cash out Value, Vested
		Grant ID	Option Type	Expiration Date	Strike Price	# of Options	ITM Value	
1	ISO 97	ISO	01/01/07	\$13.00	40,000	280,000	98,000	182,000
2	ISO 98	ISO	01/01/08	\$15.00	25,000	125,000	43,750	81,250
3	NQ 00	NQSO	01/01/10	\$41.80	40,000	0	0	0
4	NQ 02	NQSO	01/01/12	\$19.65	30,000	10,500	3,675	6,825
5	NQ 04	NQSO	01/01/14	\$20.11	0	0	0	0
Grand Total					135,000	415,500	145,425	270,075

Black-Scholes / Time Value of All Options

In this section of the report, NWSI provides detailed instruction to the employee regarding Black-Scholes valuation of options. Included in this instruction are definitions of the four key inputs to Black-Scholes Value: (1) expiration date, (2) strike price, (3) volatility, and (4) risk-free rate of return.

The table below calculates the Black-Scholes Values and associated Time Values for the employee's stock options where Time Value is defined as Black-Scholes Value less In-The-Money Value (i.e., Black-Scholes Value = In-The-Money Value + Time Value).

Volatility: 40.0%

Annual Dividend (per share): \$0.00

Risk Free Rate: 3.5%

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FMV	\$20.00			Vested		Unvested		Total	
Grant ID	Option Type	Expiration Date	Strike Price	Time value	BSV	Time Value	BSV	Time value	BSV
1 ISO 97	ISO	01/01/07	\$13.00	63,200	343,200	0	0	63,200	343,200
2 ISO 98	ISO	01/01/08	\$15.00	81,778	206,778	0	0	81,778	206,778
3 NQ 00	NQSO	01/01/10	\$41.80	137,286	137,286	0	0	137,286	137,286
4 NQ 02	NQSO	01/01/12	\$19.65	274,675	285,175	183,117	190,117	457,792	475,292
5 NQ 04	NQSO	01/01/14	\$20.11	0	0	424,134	424,134	424,134	424,134
Grand Total				556,939	972,439	607,250	614,250	1,164,190	1,586,690

Forfeit Value™ of All Options

Finally, the Profile reports the Forfeit Value™ of the employee's stock options. Forfeit Value™ is defined as the sum of the remaining Time Value in the employee's vested holdings and the total Black-Scholes Value of the unvested holdings. The sum of these two (the Forfeit Value™) represent the current estimated value the employee would potentially forfeit if he or she were to leave the company. This is provided to the employee as an aggregate value:

Your FORFEIT VALUE™ is: **\$1,171,190**