02-021

Restoring the Link Between Pay and Performance: Evaluating the Costs of Relative-Performance-Based (Indexed) Options

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The author thanks Viral Acharya and participants at NYU's finance seminar for helpful comments, Andrew Kim for excellent research assistance and Harvard Business School's Division of Research for financial support. Some of this paper is a revision of earlier work, "Executive Compensation Using Relative-Performance-Based Options: Evaluating the Structure and Costs of Indexed Options," HBS Working Paper 01-021. Email: lmeulbroek@hbs.edu

Abstract

Conventional stock options, say their critics, do not adequately discriminate between strong and weak managers because their value fluctuates with the performance of the overall market. Such critics propose replacing conventional stock options with options whose payoff depends on firm performance relative to some market or industry benchmark. While these relative-performance-benchmarked options (also referred to as "indexed" options) offer the benefits that accrue from a tighter link between managers' pay and their performance, they also have costs. This paper compares the "deadweight costs" of relative-performance-benchmarked options to those of conventional options. By "deadweight cost," I mean the gap between the firm's cost of granting the option and the value of that option to less-than-fully-diversified managers. This gap arises because managers compelled to hold stock or options to align incentives cannot fully diversify their portfolios, and must therefore bear more risk than would well-diversified investors. The less-than-fully-diversified managers will therefore always value their stock and option-based compensation at less than its market value. I estimate the cost of this lost diversification, and find that, perhaps surprisingly, the gap between the firm's cost (the market value) and the manager's private value of an option is 57% *greater* for relative-performance-based options than for conventional options. The relative-performance based options have larger deadweight costs because, by design, they strip away the manager's exposure to all systematic risk, leaving her with a portfolio with an expected return no better than the risk-free rate. One practical implication of this insight is that firms implementing a relative-performance-based compensation system should *not* boost the number of options awarded over the number that they would have otherwise awarded in a conventional stock option plan, even though indexed options have a lower market value than conventional options. Instead, firms should increase the cash component of managers' pay, which has the effect of decreasing the deadweight losses of the compensation plan while maintaining or even improving its power to align incentives.

I. Introduction

One unintended consequence of stock and option-based compensation is that in a strong stock market, it has the potential to indiscriminately reward both strong and weak managers alike. In such a market, stock prices tend to increase, even for firms underperforming their competitors. The sense that managers with less-than-stellar performances are reaping enormous payoffs has led reformers to suggest options whose payoff is linked to some sort of market or industry-based index (also called “indexed options”). [1] This paper investigates the true costs of relative-performance-benchmarked options. While their incentive-alignment benefits have been widely-discussed, their deadweight costs have not, a gap this paper attempts to address.

Deadweight costs arise in any stock or option-based compensation plan because equity-based compensation drives a wedge between the firm’s cost of awarding compensation (i.e. its market value), and the value placed on that compensation by managers. To align incentives, managers must be exposed to firm-specific risk. This exposure to firm-specific risk reduces managers’ ability to diversify their portfolios. Loss of diversification is costly; it leaves managers exposed to the firm’s full risk, when expected returns “compensate” them only for the systematic portion of that risk. Managers will therefore always value their equity-linked compensation at less than its market value. The greater the amount of the manger’s wealth invested in the firm, the greater the lost-diversification cost imposed on that manager.

In practice, the costs associated with the manager’s loss of diversification can be large and substantial. In earlier work, Meulbroek (2001b), I have estimated that the private value that managers place on conventional executive stock options is roughly half of their market value in rapidly-growing entrepreneurially-based firms, such as Internet-based firms. Even for less-volatile NYSE firms, the deadweight loss associated with stock options is 30% of their market value. In this paper, I explore whether the lost-

[1] See, for example Akhigbe and Madura (1996), Barr (1999), Garvey and Milbourn (2001), Johnson (1999), Johnson and Tian (2000), Kay (1999), Nalbantian (1993), Oyer (2000), Rappaport (1999), Reingold (2000), Schizer (2001b).

diversification costs associated with a relative-performance-benchmarked portfolio (i.e. “indexed”) option plan are greater or less than the lost-diversification costs associated with a conventional option plan.

Perhaps surprisingly, I find that the deadweight costs associated with a relative-performance-benchmarked option *exceed* those associated with a conventional option plan. For the set of firms tracked by Value Line, the “efficiency” of the option on the market and industry-adjusted performance-benchmarked portfolio is 21% lower than the efficiency level of a conventional option. Efficiency drops because benchmarking, by design, isolates firm-specific performance, removing some or all of the systematic component of firm returns from a manager’s compensation. As a consequence, performance-benchmarked portfolio options remove the component of firm returns correlated with the market, that is, the exact component that provides some degree of “diversification” to the manager. I use this insight to investigate the best way to implement a performance-benchmarked “indexed option” compensation plan, ultimately concluding that the performance-benchmarked option compensation plan should be supplemented with a cash grant, rather than by an increase in the number of options awarded relative to a conventional option plan, as many indexed option advocates recommend.[2]

The paper proceeds as follows. Section II further describes the motivation behind relative performance compensation, the extent to which it is used in practice. Section III Section IV outlines a method to measure the deadweight costs associated with a performance-benchmarked option, and then estimates those costs for NYSE, Amex, and Nasdaq firms, comparing them to the costs associated with conventional options. Section V concludes.

[2] See, for example, Rappaport (1999) or Reingold (2000) for arguments in favor of an indexed option adopter awarding a greater number of indexed options than would be awarded under a conventional plan.

II. Paying Managers for their Relative Performance

Relative-performance-based compensation rewards managers only for that portion of performance under their control. By filtering out performance that derives from factors outside managers control, such as industry-wide or market-wide gains or losses, relative-performance-based compensations tightens the link between managerial efforts and compensation. The strength of that connection is critical, for if the value of managers' compensation is unrelated to their efforts and abilities, they have little incentive to work hard. The problem with conventional stock options is that the link between managerial effort and ability and firm performance can be a weak one. If managers perform poorly, the value of their options can still increase if the overall market increases, and if managers perform well, the value of their options can still decrease if the market declines. In other words, conventional options reward the manager not only for firm-specific performance, but also for market-related and industry-related gains.

The seldom-retiring Warren Buffet plangently condemns conventional stock options, noting that "… [stock options] are wildly capricious in their distribution of rewards, inefficient as motivators, and inordinately expensive for shareholders."[3] Academic research, too, has noted the problems with traditional stock options: Gibbons and Murphy (1990), for example, suggest that compensation contracts based upon firm performance, not adjusting for industry or market performance, "…subject executives to vagaries of the stock and product markets that are clearly beyond management control."[4] Holmstrom (1982) argues that relative-performance-based compensation provides a stronger link between managers' effort and productivity to observable firm performance by allowing principals to extract better information about managerial effort and performance.[5] Such observations have renewed the call for compensation based upon relative performance.[6]

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[3] Cairncross (1999)
[4] Gibbons and Murphy (1990) p. 31-S
[5] See Murphy (1998) for a description of the framework supporting performance-based compensation generally, and relative-performance-based compensation more specifically.
[6] Note that relative-performance-based compensation is not the same as "competitive benchmarking," which involves the use of peer groups to determine compensation. Relative-performance-based compensation compares the *performance* of a company to the performance of its peers, and then compensates managers based upon that relative performance. Competitive benchmarking compares the

Compensation based upon relative performance can be either an explicit part of a manager's compensation contract, or implicit in the sense that the relation of a manager's compensation to her relative performance is not contractually-specified, but the manager's realized compensation is related to her actual performance relative to the market and/or industry. Murphy (1998) describes and analyzes much of the literature exploring whether companies' compensation schemes reflect implicit relative performance compensation. He reports that such implicit compensation schemes exist, but probably do not predominate. Gibbons and Murphy (1990), for example, report that firms do implicitly compensate their CEO's based upon relative performance. They find that the salary and bonus of CEOs appeared to be positively and significantly related to firm performance, but negatively and significantly related to market and industry performance.[7] Antle and Smith (1986) provide limited evidence that firms compensate managers based upon relative performance, and Himmelberg and Hubbard (2000) observe relative performance evaluation compensation among smaller firms with "less-highly skilled" CEOs. Bertrand and Mullainathan (1999) report that CEOs are paid for market-wide and industry movements (what they term "luck"), but the better-governed firms compensate their CEOs less for such movements than other firms. Garvey and Milbourn (2001) find that younger and less wealthy managers are the ones that receive compensation based upon relative performance. Sloan (1993)'s work also supports the hypothesis that firms base CEO compensation, at least in part, on earnings, as way to help filter market-wide movements from compensation. Other researchers, however, find less evidence of implicit relative performance-based compensation. For instance, Aggarwal and Samwick (1999), investigating pay-performance sensitivities, uncover little evidence

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compensation of the firm's managers to the compensation of managers in peer firms and then bases themangers compensation on its relation to the compensation of managers in those peer firms. Competitive benchmarking can have perverse effects on incentives, as Bizjak, Lemmon and Naveen (2000) note. They report that CEOs who are paid below the median of their peers receive raises that average twice the raises awarded to CEOs who fall below the median of their peers (both in dollars and in percentage terms).

[7] Gibbons and Murphy (1990) suggest that relative performance-based compensation (implicit or explicit) should be limited to top managers, such as CEOs, because "basing pay on relative performance generates incentives to sabotage the measured performance of co-workers (or any other reference group), to collude with co-workers and shirk, and to apply for jobs with inept co-workers." Continuing on, however, they also state that these reasons are less important for CEOs who "…tend to have limited interaction with CEOs in rival firms, [so] sabotage and collusive searching seem unlikely."

that compensation contracts reward relative performance, as do Janakiraman, Lambert and Larcker (1992).

Even if some amount of implicit relative-performance-based compensation exists, contracts which explicitly base compensation on relative performance, such as options indexed to a pre-specified industry or market benchmark, are rare. Level 3 Communications, a telecommunications company, is currently the only U.S. firm that has implemented an indexed option program. [8] This scarcity is puzzling, because indexed options have received support from both practitioners and academics (see, for example, Akhigbe and Madura (1996), Barr (1999), Garvey and Milbourn (2001), Johnson (1999), Johnson and Tian (2000), Kay (1999), Nalbantian (1993), Rappaport (1999), Reingold (2000)).

One possible explanation for the rarity of indexed options programs is that managers do not need the firm to do what they can do themselves, namely hedge market risk. Managers could limit their exposure to market risk, for example, by shorting S&P 500 futures, thereby offsetting the systematic risk inherent in their positions in company stock. While a theoretical possibility, in practice few managers appear to engage in such transactions, perhaps because of the liquidity risk induced by this strategy. That is, managers would have to mark-to-market their S&P 500 positions daily, and post additional margin in case of a market increase, but they would not be able to use their holdings in company stock or options to meet the margin call. Other ways that managers might hedge their risk are through equity swaps (see Bolster, Chance and Rich (1986)), but changes in the tax code have made such swaps considerably less attractive, or through zero-cost collars (sell a call, buy a put – see Bettis, Bizjak and Lemmon (1999)), although both of these strategies eliminate the managers' exposure to *all* risk, including the exposure to firm-specific risk, the very exposure needed to create the incentive-alignment in the first place.[9] Schizer (2000) notes that hedging of stock option positions

[8] See Meulbroek (2001c). See also Murphy (1998) for a detailed discussion of the paucity of indexed option or relative performance plans more generally.
[9] Bettis, Bizjak and Lemmon (1999) report that zero-cost collars do exist, but appear to be relatively rare, at least among senior managers (officers and directors) who report their transactions in company stock (and

can be difficult for managers as many firms prevent executive stock options from being pledged as collateral. Because such practical considerations will curtail managerial hedging of conventional options, or at least increase its cost, it may be more efficient for the firm to simply issue options that already have the market component removed.

Oyer (2000) offers another explanation for the scarcity of indexed options. He reasons that when firms use conventional stock options not for their ability to align incentives, but for their power to retain managers, conventional, rather than market-adjusted, stock options may be particularly effective. Specifically, if managers' outside employment opportunities are positively correlated with the market, then conventional stock options are a managerial retention device that automatically adjusts to the company's changing needs for retention. When the market is high, managers' outside opportunities are also great, and therefore their deferred compensation needs to be correspondingly large in order for adequate retention. Conversely, in a bear market, managers have fewer outside opportunities, so the amount of deferred compensation required to retain them decreases just as the value of the conventional options does. Under this scenario, indexed options are rare because conventional options better fulfill the retention function.

Schizer (2001a) provides a tax-based explanation for the rarity of indexed options. He points out that a managers' compensation is tax deductible only if under $1 million unless that compensation is performance-based. Because the IRS treats conventional options as performance-based compensation, when in fact their value depends upon market and industry factors that have nothing to do with their performance, conventional options enable the firm to deduct more than $1 million worth of non-performance-based compensation. Of course, this explanation implies that managers are content to have at least some portion of their compensation vary along with the market; managers' individual preferences toward market risk will determine whether the tax advantage to the firm outweighs the cost to the firm of exposing managers to market risk.

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by extension, derivates of company stock) to the SEC. However, as Bettis, Bizjak and Lemmon (2000) suggest, financial intermediaries might be writing zero-cost collars to managers who are not required to

Managers themselves point to the inferior accounting treatment of indexed options (the value of the options are deducted from the firm's earnings, whereas conventional options are not) as a hurdle impeding widespread adoption, but acknowledge that this explanation is at best incomplete since the tax treatment of the two options is identical and their value must be disclosed in the footnotes to the proxy statement in any case. [10] Rappaport (1999) discusses the unfavorable accounting treatment of indexed options, suggesting that such treatment is a misplaced concern: "bad accounting policy should not be allowed to dictate compensation."

Another source of managerial reluctance, and perhaps a more compelling one, has been the long-running bull market. Managers who perceived the probability of a market downturn as low, or at least as not imminent, were probably eager to capture the potentially huge rewards conferred by the bull market, especially when they perceived the probability of a downturn in the stock market as being low. Of course, one would suspect that recent market performance might have dampened their demand for conventional options, and perhaps increased their interest in indexed options. Relative-performance-based compensation *does* have the advantage that it protects managers during market downswings. Under traditional stock option plans, adverse market performance results in vastly reduced compensation for managers. Relative-performance based compensation protects managers against such market downturns; even if the market declines, managers can still be well-compensated if they outperform their market or industry benchmark.[11] Whether managers will be satisfied with the reduced exposure to market risk associated with indexed options is unclear, although it is unlikely that firms would be willing to entirely give up the incentive-alignment benefits produced by

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report their transactions to the SEC.

[10] Rappaport (1999) discusses the unfavorable accounting treatment of indexed options, suggesting that such treatment is a misplaced concern: "bad accounting policy should not be allowed to dictate compensation."

[11] Even under conventional plans, managers have some degree of protection against falling markets. When options move too far out-of-the-money, firms sometimes either re-strike the options, or issue new options with lower strike prices. See, for example, Acharya, John and Sundaram (2000), Saly (1994), Brenner, Sundaram and Yermack (2000), Carter and Lynch (2001), Chance, Kumar and Todd (2000), and Callaghan, Saly and Subramaniam (2000).

equity-linked compensation. That being the case, indexed options might be a good compromise that maintain proper incentive-alignment while reducing managers' exposure to market risk.

Shareholders have called for some form of performance indexing, a demand that has intensified in the wake of recent stock performance. As prices have declined, managers' existing options have moved out-of-the-money. Many firms have responded to the underwater options by repricing the options (lowering the exercise price of the managers' existing options), accelerating the grant date of the next round of options, giving employees the opportunity to exchange their old options for new at-the-money options (the exchange ratio need not be one-to-one), or issuing a supplemental grant of options, either canceling the underwater options, or leaving them outstanding. By using relative-performanced-based options, firms could avoid the appearance of self-dealing that accompanies these actions.[12]

This paper explores the implications of adopting a relative-performance-based option plan, specifically focusing on its costs. As we will see below, this analysis provides some guidance on how to implement such a plan, should a firm choose to do so.

III. The Efficiency of a Relative-Performance-Based Compensation System

A. *The structure of the relative-performance-benchmarked option*

This paper adopts the indexed option structure proposed in Meulbroek (2001a), where the underlying asset is a portfolio consisting of the firm's stock hedged against market or industry movements. The value of this portfolio is initially set to the firm's stock price, but then either increases by the percentage that the firm outperforms its market- or industry-benchmark or decreases by the percentage that the firm underperforms its market- or industry-benchmark (I refer to the portfolio as a *Performance-Benchmarked Portfolio*). The indexed option is therefore an option on this portfolio benchmarked to the firm's relative performance. The exercise price of this option remains fixed and, following standard practice, equals the firm's stock price at the time the option is awarded.[13]

The market-adjusted performance-benchmarked portfolio is long the stock and short the market, constructed to have a zero-beta (i.e. it removes all systematic risk). Specifically, the portfolio for stock j, P_j, is long fraction 1.0 in stock *j*, short fraction β_j in the market (where β_j represents firm j's systematic risk), and is long fraction β_j in the riskless asset, as displayed in **Figure 1.**

Establishing the Market-Adjusted Portfolio at time t=0		
Asset	**Long Position**	**Short Position**
Stock	V_j	
Market		$-\beta_j V_j$
Riskless Asset	$\beta_j V_j$	
Cost of Long or Short Position	$V_j + \beta_j V_j$	$-\beta_j V_j$
Total Portfolio Value	$\boldsymbol{V_j}$	

Figure 1: Initial market-adjusted portfolio

This construction creates a portfolio hedged against market movements, with an expected return of the risk-free rate (r_f), a volatility of $\sigma_j\sqrt{\left(1-\rho_{jm}^2\right)}$ (where $\sigma_j \equiv$ firm *j*'s

[12] There are, of course, valid reasons for repricing out-of-the-money options, one of which is that underwater options provide managers with poor incentives. Jin and Meulbroek (2001) show that in many instances out-of-the-money options can still provide strong incentives for managers to increase firm value.
[13] We use an indexed option structured along these lines because the indexed option design that has an exercise price tied to a market or industry index remains highly sensitive to market and/or industry movements, and therefore does *not* remove the effect of the benchmark index from the option's value. Meulbroek (2001a) shows why the variable exercise structure does not work, and proposes an alternative structure that does achieve the desired effect of rewarding managers *only* for performance that is not due to overall gains in the market or industry. Consequently, we use the alternative design proposed in that paper as a basis for the analysis presented in this paper.

volatility and $\rho_{jm} \equiv$ correlation between firm *j* returns and market returns), and an initial cost of V_j (firm j's stock price).

I also construct a second relative-performance benchmarked portfolio which removes *both* industry and market risk, implementing this benchmarking by going long the stock, and short both the market, and the industry "ex-market" (that is, the industry after the market component has been removed). Specifically, the market- and industry-adjusted portfolio has fraction 1 in stock j, fraction β_j short in the market portfolio, fraction $\frac{\gamma_j \sigma_j \eta_{ji}}{\gamma_i \sigma_i}$ short in the industry (ex-market) portfolio, and $\left[\frac{\gamma_j \sigma_j \eta_{ji}}{\gamma_i \sigma_i} + \beta_j\right]$ in the riskless asset, where $\gamma_j \equiv \sqrt{1-\rho_{jm}^2}$ and $\gamma_i \equiv \sqrt{1-\rho_{im}^2}$, $\sigma_i \equiv$ industry *i*'s volatility, $\rho_{im} \equiv$ correlation between industry *i* returns and market returns, and $\eta_{ji} \equiv$ correlation between industry *i's* returns and firm *j's* "ex-market" returns.

Figure 2 displays the market- and industry-adjusted performance-benchmarked portfolio strategy.

Establishing the Market-and Industry-Adjusted Portfolio at time t=0		
Asset	**Long Position**	**Short Position**
Stock	V_j	
Market		$-\beta_j V_j$
Industry (ex-market)		$-\dfrac{\gamma_j \sigma_j \eta_{ji}}{\gamma_i \sigma_i} V_j$
Riskless Asset	$\left[\dfrac{\gamma_j \sigma_j \eta_{ji}}{\gamma_i \sigma_i} + \beta_j\right] V_j$	
Cost of Long or Short Position	$V_j + \left[\dfrac{\gamma_j \sigma_j \eta_{ji}}{\gamma_i \sigma_i} + \beta_j\right] V_j$	$-\beta_j V_j - \dfrac{\gamma_j \sigma_j \eta_{ji}}{\gamma_i \sigma_i} V_j$
Total Portfolio Value	$\boldsymbol{V_j}$	

Figure 2: Initial market- and industry-adjusted portfolio

Again, the expected return on the market- and industry-adjusted performance-benchmarked portfolio is the risk-free rate; its standard deviation is $\sigma_j \sqrt{\left(1-\rho_{jm}^2\right)\left(1-\eta_{ji}^2\right)}$, and its cost is V_j (the stock price of firm j). For the remainder of the paper, I will use the terms "option on the performance-benchmarked portfolio" and "indexed option" interchangeably.

B. *The efficiency of options on the performance-benchmarked portfolio*

Are performance-benchmarked indexed options an "efficient" way to pay managers? Put differently, how large is the difference between the firm's cost to provide the options (the market value of those options), and the private value that managers place on those options? The gap between the firm's cost of options and the manager's private value for those options is a deadweight loss to the firm: all other things equal (i.e. the incentive and retention effects produced by the compensation system), the firm should minimize this gap.[14]

While it can certainly be minimized, this gap between firm's cost of equity-based compensation and the private value that managers place on that compensation cannot be eliminated, as it is inherent in any compensation system that seeks to more closely align the interests of managers with shareholders. Properly aligning incentives *requires* that the firm's managers be exposed to firm-specific risks, and this forced concentrated exposure compels managers to hold less-than-fully-diversified investment portfolios. [15] Because undiversified managers are exposed to the firm's total risk, but rewarded (through expected returns) for only the systematic portion of that risk, managers will value stock or option-based compensation at less than its market value. The firm, then, always faces a tradeoff between the benefits attained through incentive alignment and the deadweight cost of paying managers in a currency that is worth less to them than its cost to the firm.[16] The cost is "deadweight" in the sense that firms could issue equity or options in the market, reaping their full value to a diversified investor, but the firm instead issues the equity and options to its managers, who place a lower value on it. The deadweight costs increase with both firm volatility and with the percentage of a manager's personal wealth tied up in the firm.

This cost due to lost diversification cannot be eliminated without destroying incentive alignment, meaning that it is a *structural* cost associated with incentive-based

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[14] The wedge between the firm's cost and the manager's private value is widely-recognized in the principal-agent literature. See, for example, Murphy (1998), Carpenter (1998),and Detemple and Sundaresan (1999). Meulbroek (2001b) explores how different types of risk (i.e. systematic versus idiosyncratic) impose different costs on the manager: the manager is "compensated" through market returns for systematic risk, but not compensated for holding idiosyncratic risk. Other factors, beyond the scope of this paper, can contribute to the costs borne by the firm when awarding executive stock options. One example of such a cost is the additional agency costs that may arise when managers alter the firm's investment profile in non-value creating ways in order to lower their total level of risk. Carpenter (2000) formally models this problem.

[15] One might even argue that managers' wealth is not fully-diversified even before considering the composition of their securities portfolios as at least some of their human capital may be specific to their employer.

[16] I call this gap between managers' private value and the firm's cost a "deadweight cost" to distinguish it from the market value of the firm's compensation, which is the usual definition of "cost" in the executive compensation literature.

compensation. Individual preferences can also cause managers to value their equity-based compensation at less than its market value. For example, the *level* of overall risk faced (as opposed to its composition) by the manager may be higher or lower than the manager would choose if not compelled to hold the firm's stock or options. If the manager's preferences were known (i.e. the manager's specific utility function and the parameters for that function were known), we could measure this individual preference-based cost using the "certainty-equivalent" approach adopted in the prior compensation literature.[17] But, identifying individual utility functions is difficult and certainly impractical when constructing a broad-based compensation plan that covers many employees. Moreover, financial engineering has the potential to reduce or eliminate the costs that arise from individual preferences.[18] Therefore the approach adopted in this paper is to focus on the cost generated solely by the manager's loss in diversification, a cost that is both shared by all managers and cannot be eliminated or reduced either through financial engineering or employee self-selection into jobs with compensation packages best tailored to their preferences.[19]

Meulbroek (2001b) presents a technique to measure the lost diversification cost associated with stock and conventional options. In that paper, I find that the wedge between firm cost and employee benefit of both stock and conventional option awards can be quite large. Undiversified managers of the average NYSE firm, for example, value

[17] For examples of this individual utility-based technique, see Hall and Murphy (2000a), Hall and Murphy (2000b), Huddart (1994), or Lambert, Larcker and Verrecchia (1991). If one wanted to explicitly incorporate costs of lost diversification, the models used in those papers would have to be modified to incorporate more than one risky asset, along the lines of Jin (2000). Even then, using a specific functional form of a manager's utility function to calculate a certainty-equivalent value conflates the effect of managerial preferences about the functional form of the compensation plan with the effect due to lost diversification. For example, a manager holding a stock perfectly correlated with the market will effectively be fully-diversified. The Sharpe ratio method used in this paper tells us that the efficiency of such equity-based compensation is 100%, that is, the manager will value the perfectly-correlated stock at its full market value. Yet, the utility-function approach tells us that the manager values this stock at less than its market value, simply because the risk exposure created by holding that stock is unlikely to be the optimal risk exposure for that particular manager.

[18] Indeed, indexed options themselves are an example of a financial instrument designed to lower the manager's total risk exposure while maintaining an equivalent degree of incentive alignment

[19] To measure the *full* cost to managers imposed by any given compensation system, the Sharpe ratio method presented here could be combined with the certainty-equivalent method used in prior research, such as the multi-asset model from Jin (2000), or a modification of the technique used in Carpenter (1998) or Hall and Murphy (2000a).

their (conventional) options at 70% of the cost of these options to the firm. The gap is larger for Internet-based firms, where the value placed on the conventional options by an undiversified manager represents an average of 53% of the cost of these options to the Internet-based firm. The large magnitude of this deadweight cost for conventional options warrants an examination of the deadweight costs of the performance-benchmarked option portfolios described above. The efficiency method developed here for these indexed portfolios follows a methodology similar to Meulbroek (2001b).

C. A technique to estimate the loss-of-diversification cost for stock- and option-based compensation indexed for market and/or industry movements

To estimate this loss-of-diversification cost, we calculate the expected return a manager would require in order to be indifferent between holding the market- (or market- and industry-adjusted) performance-benchmarked portfolios, and holding an efficiently-diversified portfolio levered to a volatility level that equals that of the performance-benchmarked indexed portfolios. Of course, this method produces a lower-bound estimate of the actual cost from the manager's concentrated exposure because it does not account for that manager's individual preferences regarding the level or pattern of risk exposure she faces. [20] The risk-return profile required by a manager to make him or her indifferent between holding the market and holding the performance-benchmarked indexed portfolio is imbedded in the market's Sharpe ratio. Therefore, the performance-benchmarked portfolio's volatility level, along with the market's Sharpe ratio allows one to extract the minimum return an undiversified manager would require in compensation for accepting the diversification constraint. The analysis below shows how to translate this required return premium demanded by the undiversified manager into the private value that such a manager places on the performance-benchmarked indexed stock

[20] The description of this method as an upper-bound abstracts from the possibility of "re-pricing" the option in an executive's favor (in an effort to re-align managerial incentive levels, firms will sometimes lower the exercise price of out-of-the-money options). The method does, however, explicitly incorporate the notion of a vesting schedule, which is sometimes referred to as feature which reduces the firm's cost of issuing executive stock options. One additional caveat to the "upper bound" characterization: it assumes that the manager has limited opportunity to take risk reduction actions without the help of the firm. Such measures might include limiting their exposure to market risk by shorting S&P 500 futures, thereby offsetting the systematic risk inherent in their positions in company stock. As mentioned earlier, few managers appear to engage in such transactions, perhaps because of the liquidity risk induced by this strategy.

portfolio that constitutes his or her investment portfolio.

The strength of the Sharpe ratio technique used here is that it measures the common cost imposed on all managers by firm-specific risk, and by so doing isolates the one type of risk that is essential to properly aligning incentives. The Sharpe ratio method, however, does not incorporate the additional cost associated with individual managers' preference, and therefore our estimate of the manager's private value is likely to be an upper-bound estimate of the value of the specific compensation plan to each individual manager. An exact estimate of the manager's private value of his/her compensation would subtract an additional manager-specific discount to account for the lack of a compensation plan custom-tailored to the manager's.[21]

The assumption that CAPM holds instantaneously in a continuous-time model yields mean-variance behavior.[22] Interpreted in the context of this paper, mean-variance behavior implies that even people with high risk tolerances, such as entrepreneurs, prefer the higher expected return produced by a leveraged fully-diversified portfolio to the lower expected-return from an equally risky but less-than-fully-diversified portfolio.

Notation:

Let $e^{r_f} \equiv (1+R_f)$ where R_f represents the riskless arithmetic return, and r_f is therefore its continuously-compounded equivalent.

$e^{r_j} \equiv$ (1 + yearly expected rate-of-return of security *j* under CAPM pricing)

$e^{r_i} \equiv$ (1+ yearly expected rate-of-return for industry *i* under CAPM pricing)

$(r_m - r_f) \equiv$ market risk premium (continuously-compounded)

$r_m \equiv$ expected market return (continuously-compounded)

$\sigma_m \equiv$ market volatility

[21] If one wanted to evaluate this *additional* cost of the sub-optimality of the option as the contingent-claim used to create firm-specific exposure, one could use the multi-asset model from Jin (2000), or a modification of the technique used in Carpenter (1998) or Hall and Murphy (2000a).

[22] This assumption is not critical in the sense that the same method presented here could be adapted to incorporate any asset-pricing model (of course, the numerical estimates will change, but the technique will not).

$\beta_j \equiv$ firm *j*'s beta from CAPM

$\sigma_j \equiv$ firm *j*'s volatility

$\sigma_i \equiv$ industry *i*'s volatility

$\beta_i \equiv$ industry *i*'s beta relative to the market

$\rho_{jm} \equiv$ correlation between firm *j* returns and market returns

$\rho_{im} \equiv$ correlation between industry *i* returns and market returns

$\eta_{ji} \equiv$ correlation between industry *i's* returns and firm *j's* "ex-market" returns

$e^{r_{indexed\ port\ j}} \equiv$ (1 + yearly expected rate-of-return of a performance-benchmarked portfolio of security *j* under CAPM pricing)

$e^{r^u_{indexed\ port\ j}} \equiv$ (1 + yearly expected rate of return on the performance-benchmarked indexed portfolio based upon stock *j* required by an *undiversified* mean-variance optimizing investor to make that investor indifferent between holding only the indexed portfolio, and holding a market portfolio with a volatility equal to that of the indexed portfolio)

$s_j \equiv r^u_{indexed\ port\ j} - r_f \equiv$ the instantaneous spread between the expected return, required by an undiversified investor holding the performance-benchmarked indexed portfolio consisting of stock j (and short the market or industry), $r^u_{indexed\ port\ j}$, relative to the CAPM-based expected return for those indexed portfolios, r_f.

We assume that CAPM in continuous-time obtains[23], so

$$r_j = r_f + \beta_j \left(r_m - r_f \right) \tag{1}$$

[23] This assumption is consistent with the underlying assumption of the Black-Scholes-Merton option-pricing model, which we use later to value the executive stock options. Unlike the original single-period discrete-time version of the CAPM, the continuous-time version of the CAPM and its implied mean-variance optimizing behavior is consistent with limited-liability, lognormally-distributed asset prices, and concave expected utility functions. See Merton (1992) and Black and Scholes (1973). In the Black-Scholes model, and in continuous-time portfolio theory, the security market line relation is expressed in "instantaneous" expected-rates-of-return (i.e. exponential, continuous-compounding). Use of the CAPM in this derivation is not essential. Any asset-pricing model could be substituted.

$$r_i = r_f + \beta_i \left(r_m - r_f \right) \qquad (2)$$

What kind of return would the undiversified investor require as compensation for his/her exposure to the total risk of these performance-benchmarked indexed portfolios? If an undiversified investor had the market portfolio as an alternative investment opportunity, and were a mean-variance efficient investor, he/she would expect an excess return/risk ratio as good as the market's risk-return ratio in order to be indifferent between holding the market portfolio and the performance-benchmarked "stock j" indexed portfolio. To calculate the excess return commensurate with the risk level of this "stock j indexed portfolio", using the market's risk-return ratio as a benchmark, we equate Sharpe ratios and solve for $r^{u}_{indexed\ port\ j}$:

$$\frac{r_m - r_f}{\sigma_m} = \frac{r^{u}_{indexed\ port\ j} - r_f}{\sigma_{indexed\ port\ j}} \quad \Rightarrow \quad r^{u}_{indexed\ port\ j} = r_f + \left[\frac{\sigma_{indexed\ port\ j}}{\sigma_m} \right] \left(r_m - r_f \right) \qquad (3)$$

So s_j, the return premium, must then equal

$$s_j = \left(\left[\frac{\sigma_{indexed\ port\ j}}{\sigma_m} \right] \right) \left(r_m - r_f \right)$$

where $\sigma_{indexed\ port\ j}$ depends upon the type of performance-benchmarked indexing used to form the portfolio. For the two portfolios presented above:

$$\sigma_{market-adjusted\ port\ j} = \sigma_j \sqrt{\left(1 - \rho^2_{jm}\right)}$$

$$\sigma_{market\ and\ industry\ adjusted\ port\ j} = \sigma_j \sqrt{\left(1 - \rho^2_{jm}\right)\left(1 - \eta^2_{ji}\right)}$$

Figure 3 displays the estimation of the required rate of return graphically.

Compensating the Manager for Total Risk of the Indexed Portfolio

__Hold sigma (risk) fixed:__ What return does manager need to make him/her indifferent between holding the indexed portfolio (with stock j) and holding the market portfolio?

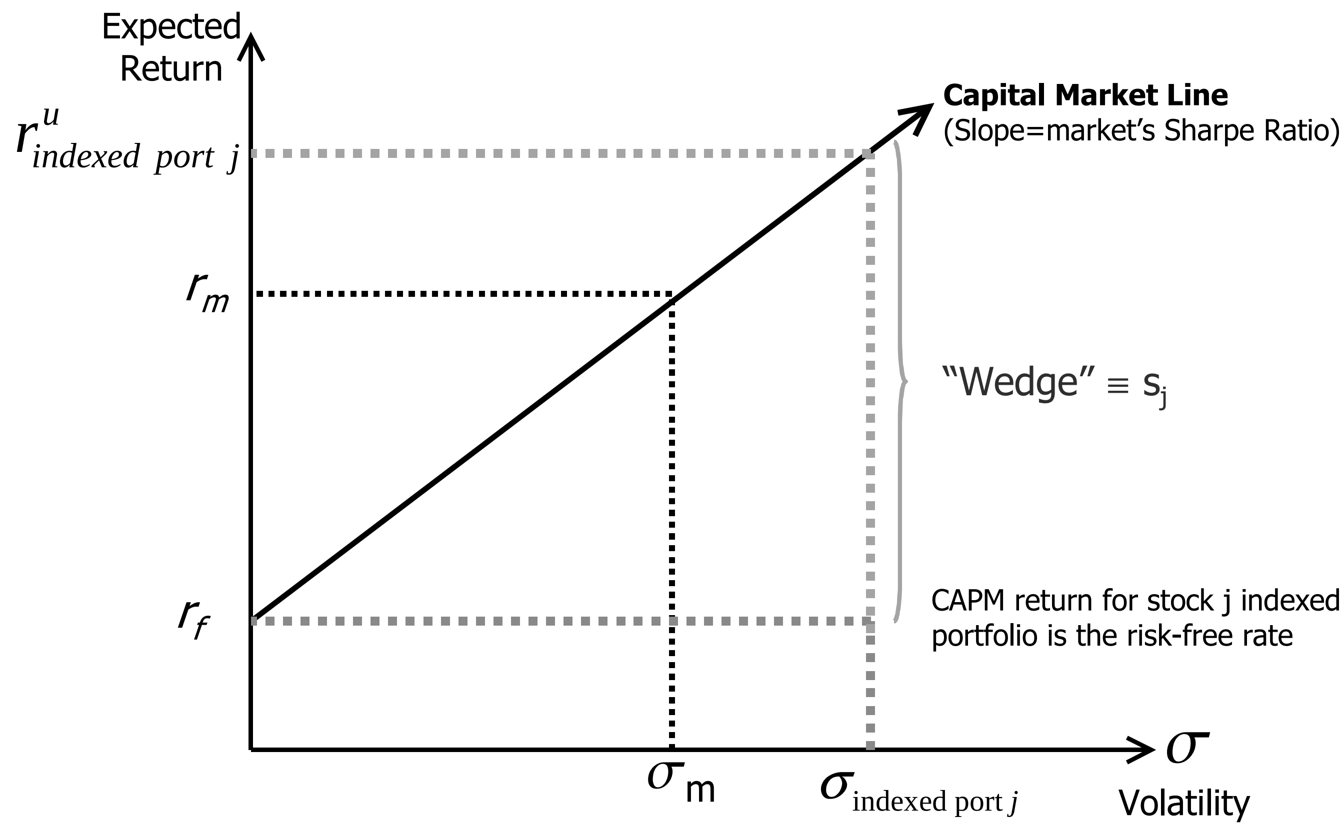

Figure 3: Return Required to Compensate for Manager's Loss of Diversification

To transform this s_j into the value of performance-benchmarked indexed portfolio j to an undiversified investor, we use the following additional notation:

$V_j(t)$ ≡ the value of performance-benchmarked indexed portfolio *j* time *t* (the market price), which equals $P_j(t)$ or $P_j^*(t)$ depending upon whether the portfolio is hedged against the market and/or the industry.

d_j ≡ firm *j*'s proportional payout rate, continuously-paid.

T ≡ date at which the undiversified investor is free to sell the stock (typically the vesting date)

$V_j^u(t)$ ≡ $G(V_j(t), \tau, d_j, s_j)$, the private value placed on the performance-benchmarked indexed portfolio of stock *j* by investor forced to hold that undiversified portfolio until date *T*, where $\tau \equiv T - t$.

In the analysis below, we assume for analytical simplicity that $d_j = 0$, that is, the firm does not pay dividends for all $t \leq T$.

By definition, we know that the discounted expected future value of the stock *j* indexed portfolio is firm *j* at time *T* equals today's stock price (recall that the performance-benchmarked indexed portfolios are constructed to have betas of zero, so the CAPM required-rate-of-return on these portfolios hedged against the market and/or the industry is the risk-free rate).

$$V_j(t) \quad = \quad e^{-r_f \tau} \, E_t\{V_j(T)\} \tag{4}$$

where E_t is the conditional expectation of the value of the shares of *j* at *T*, conditional on the information available at time *t*. And similarly, by definition of $r^u_{indexed\ port\ j}$, we know that the expected future value of the performance-benchmarked indexed portfolio to the undiversified investor discounted by $r^u_{indexed\ port\ j}$ is the value of the firm today to that investor.

$$V^u_j(t) \quad = \quad e^{r^u_{indexed\ port\ j}} \, E_t\{V^u_j(T)\} \tag{5}$$

But, at date T, the undiversified investor is free to sell his/her shares in the open market, so therefore, at date T for every outcome, the value of the stock to the undiversified investor will equal the market value of the firm:

$$V_j^u(T) = V_j(T)$$

and hence this statement must hold expectationally as well:

$$E_t\left\{V_j^u(T)\right\} = E_t\left\{V_j(T)\right\} \tag{6}$$

Substituting (6) into (4) and (5), we have

$$\begin{aligned} V_j^u(t) &= e^{r^u_{indexed\ port\ j}} E_t\left\{V_j(T)\right\} \\ &= e^{r^u_{indexed\ port\ j}} \cdot e^{-r_f \tau} \cdot V_j(t) \\ &= e^{-s_j \tau} V_j(t) \end{aligned} \tag{7}$$

$$\Rightarrow \varepsilon_{indexed\ port\ j} = \frac{V_j^u(t)}{V_j(t)} = e^{-s_j \tau} \tag{8}$$

The "efficiency" of stock j indexed performance-benchmarked portfolio compensation to an undiversified investor, $\varepsilon_{indexed\ port\ j}$, is the ratio of the performance-benchmarked indexed portfolio's value to an undiversified employee relative to the cost of that compensation to the firm, V_j. See Figure 4.

To sum up, the explicit expressions for the efficiency of the performance-benchmarked indexed portfolios are:

$$\varepsilon_{market-adjusted\ port\ j} = e^{-\left[\frac{\sigma_j}{\sigma_m}\right]\sqrt{\left(1-\rho^2_{jm}\right)}\left[r_m - r_f\right]\tau}$$

$$\varepsilon_{market-\ and\ industry-adjusted\ port\ j} = e^{-\left[\frac{\sigma_j}{\sigma_m}\right]\sqrt{\left(1-\rho^2_{jm}\right)\left(1-\eta^2_{ji}\right)}\left[r_m - r_f\right]\tau}$$

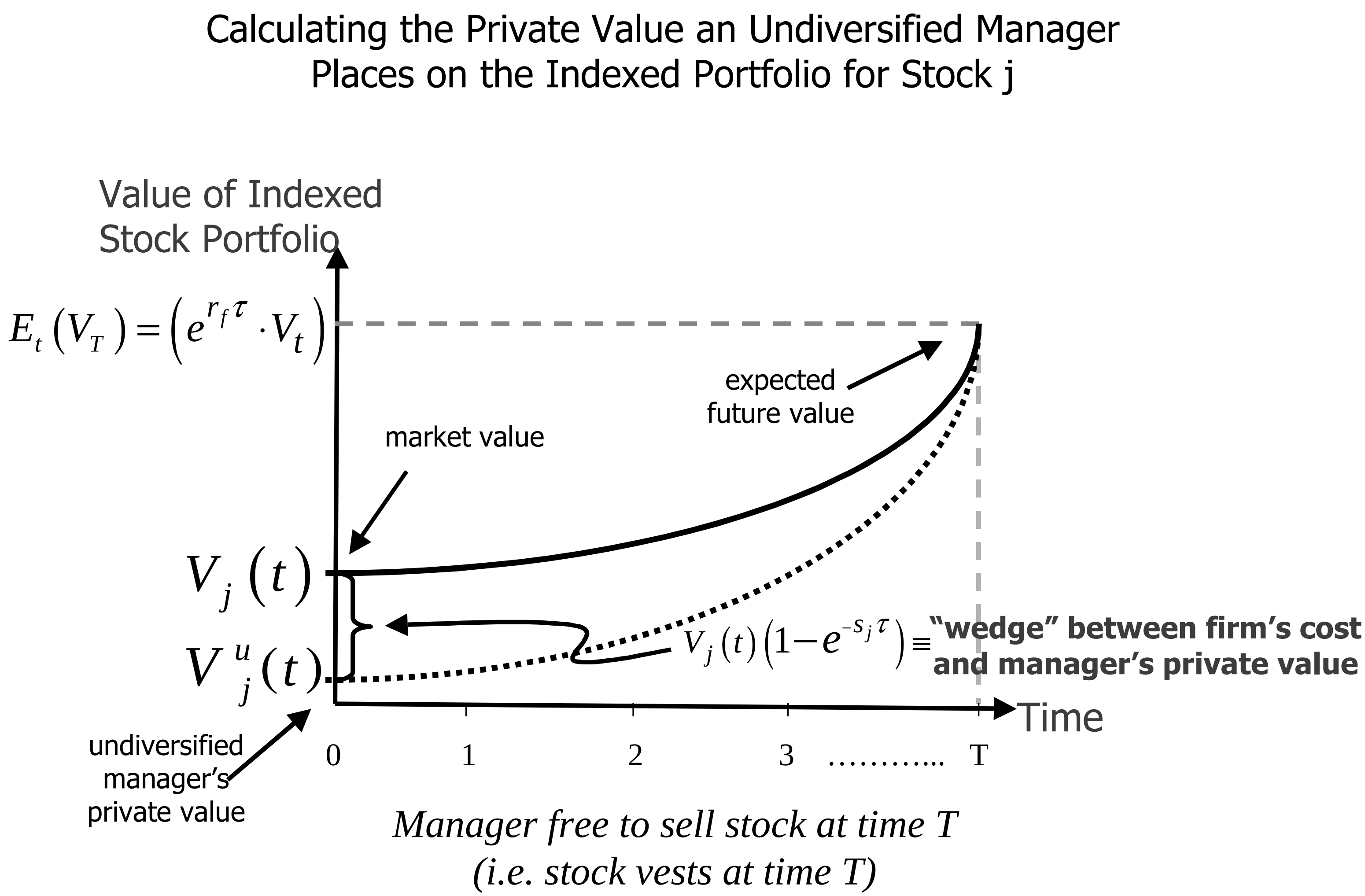

Figure 4: The Manager's Private Value for the Indexed Portfolio

These equations show that the return premium required by the undiversified investor, s_j, is a function of ρ_{jm}, η_{ji}, σ_j, and τ (time period over which the stock vests), as well as σ_m and the market expected return. The return premium s_j is biggest (i.e. the efficiency is the lowest) when σ_j is large relative to σ_m, and when ρ_{jm} and η_{ji} are low.

The derivation of the lack-of-diversification discount for the *option* on the performance-benchmarked portfolio parallels that of the lack-of-diversification discount for the performance-benchmarked portfolio presented above, but is more complex because both the expected return and the standard deviation of the option on the indexed portfolio change at every point in time. To find the lack-of-diversification discount for the performance-benchmarked indexed option, we assume that the employee will be indifferent between concentrated-versus-efficiently-diversified exposures if he or she is presented with the same (instantaneous) Sharpe ratio in either case (just as we did for the derivation for the discount on the indexed portfolio). More specifically, we equate the instantaneous Sharpe ratio of the market to the instantaneous Sharpe ratio of the option to solve for the instantaneous expected return required to compensate the undiversified manager. The formal derivation, found in Meulbroek (2001b), shows that the pricing of an option that at every point in time provides an instantaneous Sharpe-ratio equal to the instantaneous Sharpe ratio on the market portfolio is exactly the Black-Scholes-Merton option-pricing formula on a non-dividend paying stock where we replace the market price of the performance-benchmarked indexed portfolio, V_j, by its discounted private value, V_j^u, as indicated below, where Φ represents the efficiency of the option and $f(\bullet)$ represents the Black-Scholes-Merton option-pricing formula. Applying this technique to indexed options yields:

$$\Phi \equiv Efficiency\ \ of\ \ Option\ \ Compensation = \frac{f\,(V_j^u, T-t, \sigma_{indexed\ portfolio\ j}, r_f, X = V_j)}{f\,(V_j, T-t, \sigma_{indexed\ portfolio\ j}, r_f, X = V_j)} \qquad (9)$$

This method again produces a lower-bound on the undiversified investor's discount. This lower-bound results from the willingness of some employees to give up an additional amount in expected return terms to change their total level of risk or to pursue a dynamic risk strategy that differs from that of an option.

Note that the efficiency of an option (Φ) will always be less than the efficiency of the underlying stock (ε) as

$$\Phi = \frac{F(V_j^u, X)}{F(V_j, X)} < \frac{e^{-s\tau} F(V_j, X)}{F(V_j, X)} = e^{-s\tau} = \varepsilon$$

The dynamics of option efficiency, however, are similar to those for stock efficiency. As the expected rate of return premium increases, option efficiency decreases, and as vesting periods increase, option efficiency decreases. Changes in the required expected rate of return premium have a larger effect on the option efficiency than do changes in the vesting period. And, as the time until option maturity increases, efficiency increases, but only slightly.

D. *The loss-of-diversification cost of market- and industry-adjusted performance-benchmarked portfolio options versus conventional options*

The overall volatility of the performance-benchmarked indexed portfolios will be less than the volatility of the firm's equity alone, because the indexed portfolios remove either market volatility or market and industry volatility. Therefore, the manager compensated with performance-benchmarked indexed stock or options bears *less* total risk than a manager compensated with the firm's stock or conventional options. Yet somewhat surprisingly, the loss-of-diversification cost for indexed options *exceeds* that of the loss-of-diversification cost associated with conventional options. To see this, note that the premium required to compensate an undiversified investor for holding the firm j's *stock* (s_j) is: [24]

$$s_j = \left(1 - \rho_{j,m}\right)\left[\sigma_j\right]\left[\frac{r_m - r_f}{\sigma_m}\right]$$

[24] See Meulbroek (2001b).

and the premium required to compensate an undiversified investor for holding a *portfolio* of firm j's stock indexed to the market, ($s_j^{market-adjusted}$), is:

$$s_j^{market-adjusted} = \sqrt{1-\rho_{j,m}^2}\left[\sigma_j\right]\left[\frac{r_m - r_f}{\sigma_m}\right]$$

and the premium required to compensate an undiversified investor for holding a portfolio of firm j's stock indexed to *both* the market and industry ($s_j^{market\ and\ industry\ adjusted}$), is:

$$s_j^{market\ and\ industry\ adjusted} = \sqrt{\left(1-\rho_{jm}^2\right)\left(1-\eta_{ji}^2\right)}\left[\sigma_j\right]\left[\frac{r_m - r_f}{\sigma_m}\right]$$

If the correlation between the firm returns and the market returns is positive ($0 < \rho_{jm} < 1$), then

$$\sqrt{1-\rho_{j,m}^2} > \left(1-\rho_{j,m}\right) \Rightarrow s_j^{market-adjusted} > s_j$$

and

$$\sqrt{\left(1-\rho_{jm}^2\right)\left(1-\eta_{ji}^2\right)} > \left(1-\rho_{j,m}\right) \Rightarrow s_j^{market\ and\ industry\ adjusted} > s_j$$

The intuition behind this result is that the loss-in-diversification cost arises from the amount of non-diversifiable (firm-specific) risk that the manager is required to hold. Because the market-adjusted portfolio removes (by definition) the systematic risk associated with the firm's stock, the only type of risk that remains is the firm-specific risk, which is exactly the type of risk that is costly for the manager to bear. Moreover, the expected return from the market-adjusted portfolio is the risk-free rate. Figure 5 illustrates this process.

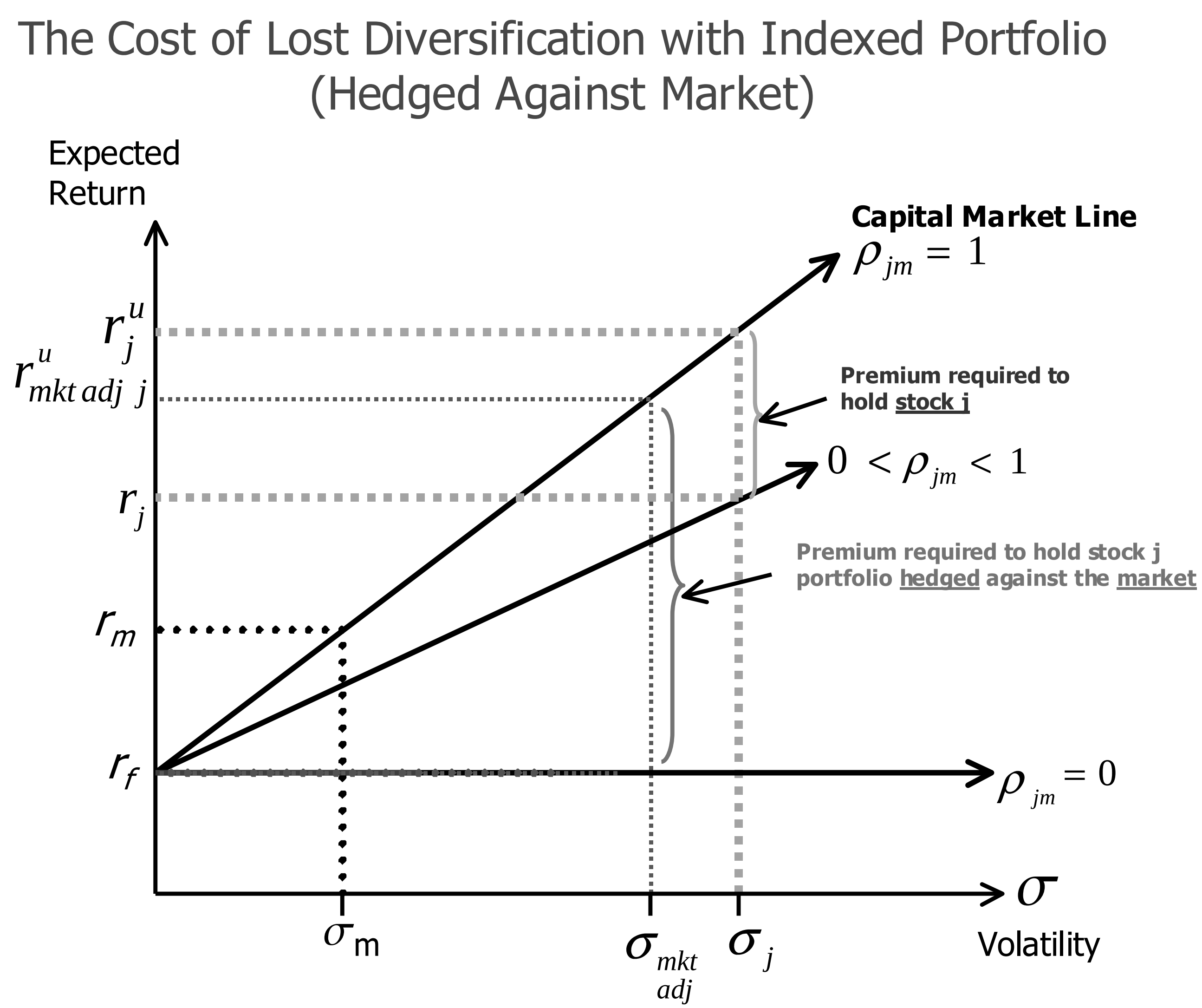

Figure 5: The Cost of Lost Diversification for Market-Adjusted Portfolio

So, as long as the correlation between firm returns and market returns is positive (as one would generally expect), the efficiency of a performance-benchmarked, or indexed, option is less than the efficiency of a conventional option. In other words, managers will place a higher discount from market value for performance-benchmarked options than they would for conventional options. While this gap between managers private value and the market value is larger for performance-benchmarked options, it may *still* be optimal for the firm to compensate managers with such options. After all, the cost estimates derived above do *not* reflect the benefits associated with equity-based compensation. And of course, one important benefit associated with equity-based compensation is incentive alignment. Because performance-benchmarked portfolio options expose the manager to a "purer" risk, that is, a risk over which the manager has control, they may indeed generate greater incentive alignment benefits. But, the costs derived above do suggest that the incentive alignment benefits of performance-benchmarked portfolio options must be higher than those associated with conventional options, or their use is not justified.

E. The additional benefit created by removing industry effects from equity-based compensation

The analysis above shows how the removal of systematic risk from the manager's equity-based compensation has the somewhat unsettling effect of decreasing compensation efficiency. The same is *not* true when the marginal influence of industry risk is removed. That is, by ridding the manager's portfolio of industry ex-market effects, the firm can unambiguously increase efficiency relative to the market-adjusted portfolio. To see this, consider that the market-adjusted portfolio has no systematic risk, and therefore has a market equilibrium expected return of the risk-free rate. Removing the marginal effect of industry movements from the market-adjusted portfolio reduces the volatility of the portfolio without reducing its expected return, which remains at the risk-free rate (assuming, once again, that the correlation between the firm returns and the market returns is positive ($0 < \rho_{jm} < 1$). Figure 6 illustrates this concept.

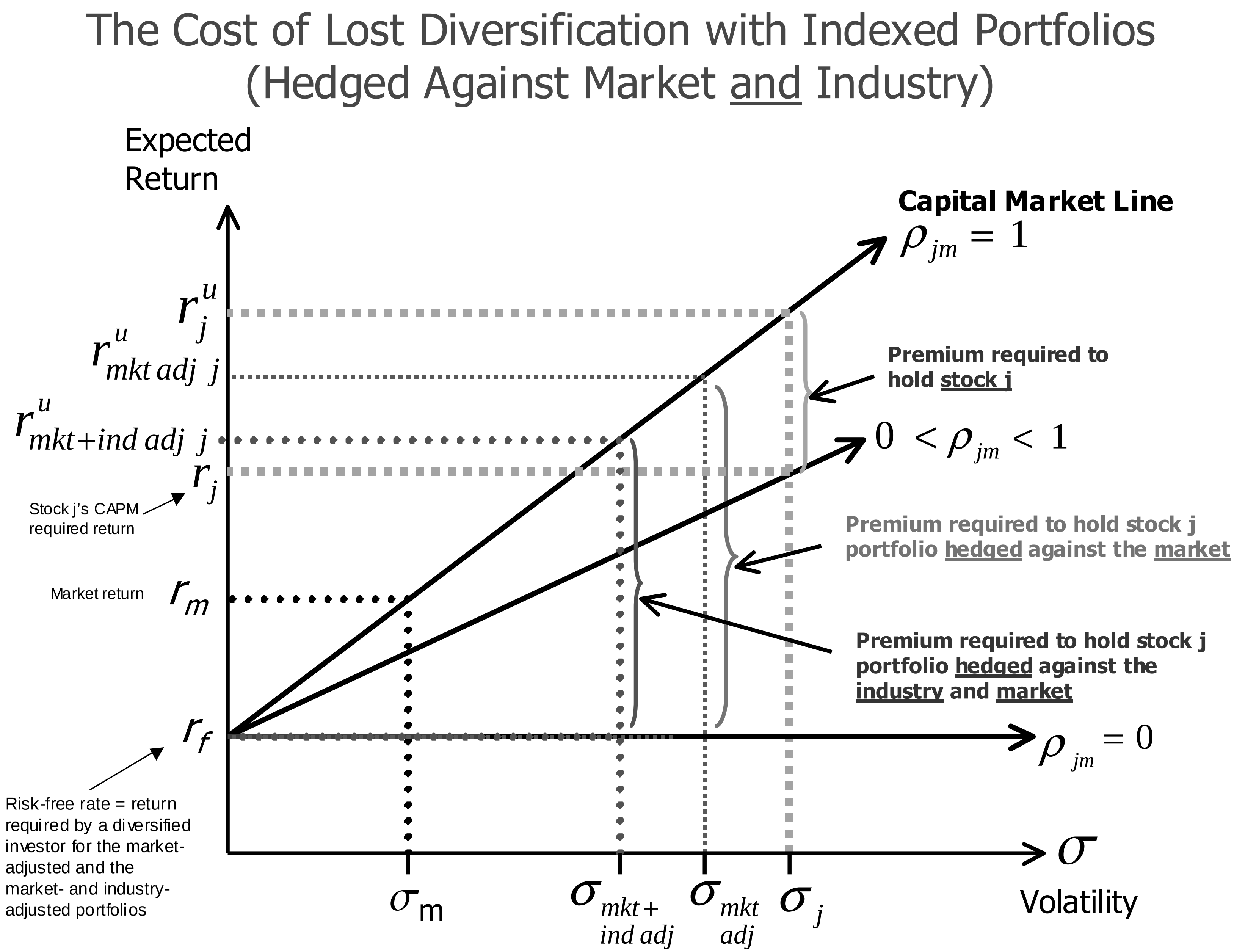

Figure 6: Cost of Lost Diversification for Portfolio Hedged Against Market and Industry

F. The loss-of-diversification cost of indexed options for the <u>partially</u>-diversified manager

Of course, the efficiency measures outlined above assume that the manager is compelled to hold *all* of her wealth in equity or options of the firm and is therefore completely undiversified. In reality, managers may hold some (or indeed most) of their wealth outside of the company. How does this ability of the manager to partially-diversify affect efficiency levels? Under partial diversification, the volatility faced by the manager will be a mix of the performance-benchmarked portfolio's volatility and the volatility of the manager's other holdings. Applying the efficiency metric for a partially-diversified investor from Meulbroek (2001b) to the case at hand shows that an investor having weight *w* invested in the stock j performance-benchmarked portfolio and (1-*w*) in the market portfolio faces a volatility level of σ_p (the standard deviation of the combined market plus stock j performance-benchmarked portfolio) where

$$\sigma_p = \sqrt{w^2\sigma^2_{indexed\ portfolio} + (1-w)^2\sigma_m^2 + 2w(1-w)\sigma_{indexed\ portfolio,\ m}}$$

$$= \sigma_m \sqrt{w^2\left(\frac{\sigma_{indexed\ portfolio}}{\sigma_m}\right)^2 + (1-w)^2}$$

Therefore the stock efficiency under partial diversification, ε^*, is:

$$\varepsilon^* = \frac{V_j^*(t)}{V_j(t)} = e^{-(r_j^* - r_j)\tau} \quad \text{, where } r_j^* - r_j = \left[\frac{1}{w}\left[\frac{\sigma_p - \sigma_m}{\sigma_m}\right]\right] (r_m - r_f)$$

with the corresponding option efficiency paralleling the earlier derivation. Figure 7 displays the efficiency levels for a hypothetical firm with a volatility and market correlation equal to the average of all Value Line firms, specifically illustrating the efficiencies of a market-adjusted indexed portfolio and an option on that portfolio for managers with various degrees of portfolio diversification. The calculations use a three-year vesting period, meaning that the manager will be free to sell the stock or option in three years.[25] We can see that, as expected, the ability to partially diversify improves efficiency, but perhaps not as much as one might initially suspect. For example, the efficiency of a market-adjusted equity portfolio for this hypothetical firm is 70% for a manager who has no wealth outside the firm, increasing to 82% for a manager with 50% of her wealth outside the firm. The efficiency of the market-adjusted indexed option is 61% for a completely undiversifed manager, improving to 76% for a manager with 50% of her wealth outside the firm.

In Section IV, below, we will apply the technique developed here for estimating the efficiency of options on the performance-benchmarked portfolios for a partially-diversified investor in a somewhat different context. In that section we will estimate the combined efficiency of an option on the performance-benchmarked portfolio supplemented by a cash grant. The cash grant is a supplement with a magnitude equal to the difference between the market value of a conventional option to the market value of the option on the performance-benchmarked portfolio. In that context, an cash paid the manager is interpreted as an increase in the manager's ability to diversify, just as wealth held outside the firm allows a manager to diversify.

[25] Specifically, the 1998 year-end volatility averages 52% for Value Line firms, the market volatility is 27%, and the average firm-market correlation is 48%. As a consequence, the average volatility of a market-indexed portfolio is 45%.

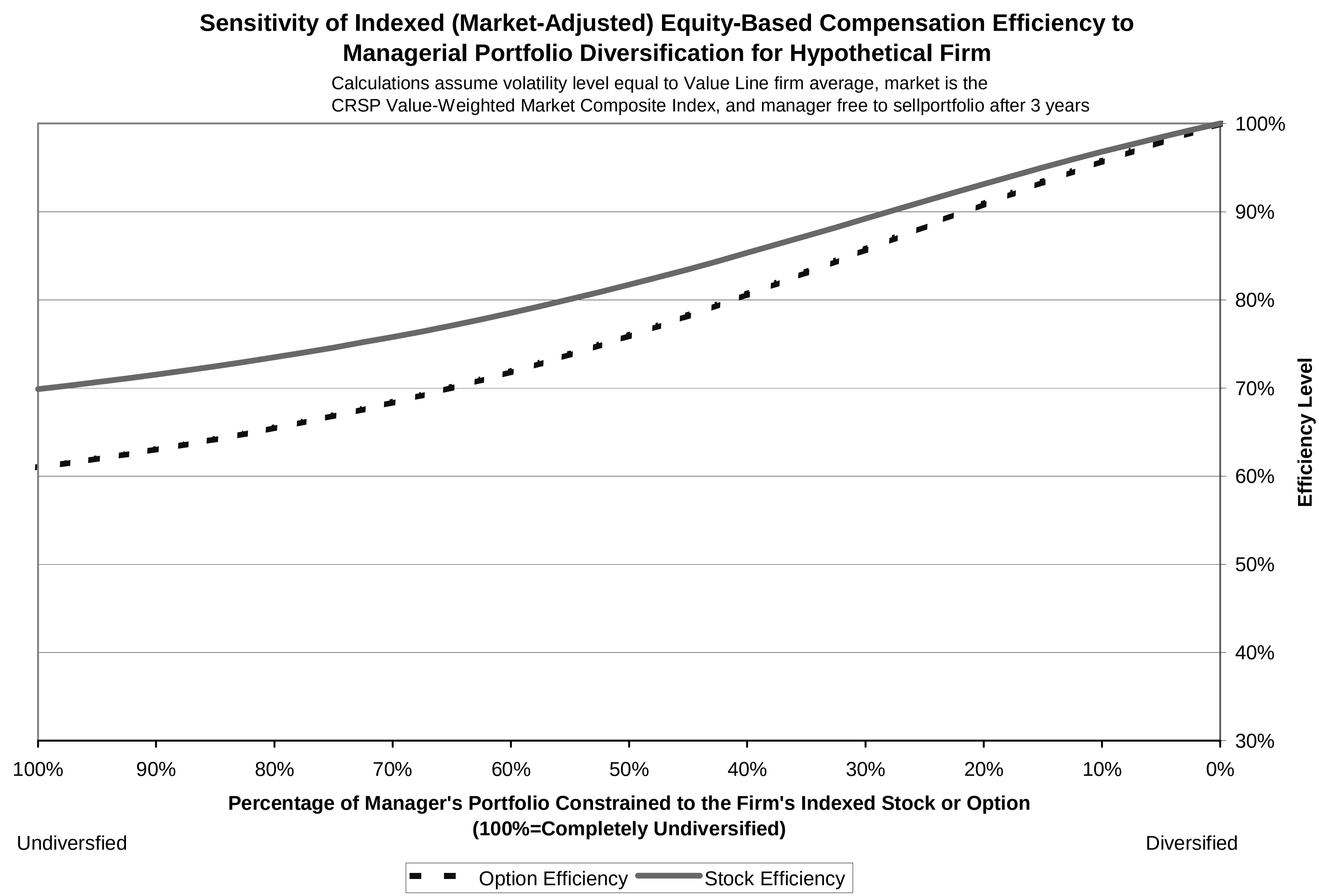

Figure 7: The Effect of Partial Diversification on Efficiency for Market-Adjusted Portfolio

G. Implications of the relative efficiency analysis for structuring indexed portfolio option compensation plans

Indexed options, that is, options on performance-benchmarked portfolios, will, of course, have a lower market value than conventional options, simply because they have a lower overall volatility level. As a consequence, many proponents of indexed options have suggested that the number of options granted to a manager will therefore have to be adjusted upwards if an indexed option compensation plan is adopted, in order to equate the manager's pay under each system.[26] While this argument is intuitively appealing, our analysis above suggests that a better structure exists. Instead of equating compensation levels across the two types of plans by issuing additional *options* on the indexed portfolios, a more efficient structure is to supplement the indexed portfolio option grant with a "market-value-equivalent" amount of *cash* compensation, that is, the amount required to bring the manager's total compensation level up to the market value of a conventional option. Cash is perfectly efficient: it leaves the manager free to invest in the market portfolio (or anything else). The market-value-equivalent cash supplement therefore increases the efficiency of the option on the indexed portfolio because it allows the manager to diversify her holdings a bit, boosting efficiency. As a consequence, the cash supplement plus indexed portfolio option package strictly dominates, in an efficiency sense, the policy of boosting the number of indexed portfolio options to equate the market value of the indexed portfolio options with that of a conventional option

Indeed, the firm may want to increase the proportion of cash even *beyond* the market-value-equivalent level needed to equate the value of the option on the performance-benchmarked portfolio (plus cash) to the value of a conventional option. In any compensation plan, the firm is forced to balance the incentive alignment benefits of equity-linked compensation with the loss-of-diversification costs associated with that compensation. A performance-benchmarked portfolio option plan allows the firm to shift that balance towards cash without sacrificing incentive-alignment. To see this, assume for

[26] Recall that the goal of an indexed option compensation is to create better incentive alignment, restoring the link between pay and performance by rewarding managers only for that portion of performance under managers' control. If sole goal were to decrease managers' compensation, firms could simply decrease the

the moment that the firm has currently found the optimal balance between awarding conventional options and other, non-equity based compensation. Performance-benchmarked portfolio options (indexed portfolio options) are designed to limit managers' risk exposures to those the managers can control. If we think that this selected exposure provides better incentive-alignment than the conventional option, then the number of indexed portfolio options can actually be *reduced* relative to the firm's current conventional option grants. With the superior incentive-alignment attributed to indexed portfolio options, the firm could afford to shift its cash-option mix more towards cash. The gains from this strategy relative to a option compensation plan that relies solely on relative-performance-benchmarked options, if any, will depend upon the relative efficiency of the options on the performance-benchmarked options and conventional options, explored in the next section.

IV. An Empirical Analysis of Conventional and Indexed Portfolio Option Efficiency

To better understand how economically significant the efficiency loss created by performance-benchmarking (indexing) is, we investigate the efficiency of indexed portfolio and conventional options (both with and without the cash supplement described above). This analysis should provide some guidance on how to best implement a relative-performance-based compensation plan

Our empirical investigation begins by calculating stock and option efficiency metrics for all firms listed in Value Line's *Investment Survey* as of December 31, 1998. We also examine separately the results for a sample of Internet-based firms defined by the Hambrecht & Quist (H&Q) *Internet Index*.[27] The H&Q *Internet Index* is used because Value Line's coverage of internet-based firms is limited to six firms during the period over which we conduct our examination. Internet-based firms are perhaps of particular interest because much of managers' compensation in these firms is equity-based, and

number of conventional options granted to managers, rather than go through the trouble of switching to an indexed option system.

[27] The H&Q *Internet Index* comprises a sub-sample of Internet-based firms, and is not confined to H&Q clients. The *Internet Index* is widely-cited and viewed as a reliable reflection of Internet-based activity.

such managers are likely to have a substantial fraction of their wealth invested in these companies. As a consequence, compensation plans that reduce volatility, such as the indexed portfolio plans discussed here, might be especially valuable to these managers.

Value Line's industry classifications are widely-held to be more accurate than industries formed using SIC codes. The database of firms and their industry classifications used in this paper are described in Stafford (2001); we have updated that database through year-end 1998.[28] The Stafford-Andrade Value Line data lists all firms and industry assignments collected from fourth quarter editions of Value Line, excluding foreign industries (e.g. "Japanese Diversified" or "Canadian Energy"), ADR's, REIT's, investment funds, and firms with industry classifications of "unassigned" or "recent additions" that are not subsequently assigned to an industry by Value Line. The database uses Value Line's industry classifications, with a few exceptions. For example, industries that differ merely by geographic classifications (e.g., "Utilities (East)" and "Utilities (West)") are merged into one classification; industries where the product lines seem particularly similar (e.g., "Auto Parts (OEM)" and "Auto Parts (Replacement)") are also combined into one category. In total, our sample consists of 1496 Value Line firms classified into 56 industries.

To calculate efficiency levels as described in III(C), we need estimates of β and σ for each firm as inputs. To estimate a firm's β, we use the market model, incorporating the last 150 trading days of returns data prior to December 31, 1998, and using CRSP's value-weighted market composite index. We use these same 150 trading days of returns data to estimate each individual firm's volatility, σ_j, as well as the market's volatility, σ_m, calculated from CRSP's value-weighted market composite index.[29] We assume a risk-premium of 7.5% (7.2% continuously-compounded), the historical average amount by which the value-weighted market index exceeds the long-term government bond rate (beginning in 1926). Continuously-compounded daily excess returns (net of daily riskless rates) are used in all calculations. The Value Line industry components over the six

[28] The author thanks Gregor Andrade and Erik Stafford for use of this database.

month period ending December 31, 1998 are used to create both value-weighted and equal-weighted daily industry returns.

Table 1 displays the characteristics of firms in our sample. Panel A shows that the mean beta for Value Line firms is 0.90, with an annual volatility level of 52%, and the mean firm size (market equity value) is $7.5 billion. Panel B shows that the mean beta and volatility for H&Q Internet based firms is higher than the average Value Line firm (beta = 2.00 and annual volatility = 117%). As a consequence, for a three-year vesting period, the mean efficiency of stock compensation for Value Line firms is 81% (higher than the 63% of H&Q firms), and the efficiency of conventional stock options is 76% (versus 61% for H&Q firms). Table 2 further details some of the information from Table 1 by showing the industry-level figures corresponding to Table 1's summary statistics. We can see from Table 2 that industry-level volatility (volatility calculated using the return of the Value Line industry index) ranges from a low of 16% for the Utility industry, to a high of 57% for Oil Field Services and Equipment,[30] and averaging 32% across all industries. Notice too that the correlation between firm returns and market returns averages 0.48 over all Value Line firms, with a maximum value of 0.70 firm Bank and Thrifts, and a minimum of 0.31 for Utilities.

The correlations give us a preliminary sense of how effective performance-benchmarking (indexing) to the market and or industry might be. The square of the correlation is the R^2 from the CAPM regression model, which indicates how much of the firm's volatility is explained by market movements. From Table 2, the mean R^2 across industries is 23% (the mean R^2 across individual firms is also 23%). The majority of volatility in returns is therefore non-systematic. Similarly, one can look to the last column of Table 2 to see how industry-level indexing might affect volatility. This column displays the correlation coefficient between the firm's ex-market returns and its ex-market industry returns. These correlation coefficients calculations remove the effect of market movements, and show us

[29] In cases where 150 days of data are not available, we require a minimum of 64 observations (3 months) of daily returns for volatility estimation.

[30] Value Lines inchoate Internet industry index has a higher volatility of 79%, but Value Line includes only six firms in this industry, prompting our use of the H&Q Internet Index.

how much correlation remains between the firm and its industry after such an adjustment. The larger the correlation coefficient, the greater the marginal decrease in volatility that can be achieved from removing industry effects from the manager's portfolio. Table 2 illustrates that the average firm returns have a correlation of 0.28 with its industry, meaning that the R^2 from a regression of ex-market firm returns and ex-market industry returns is 0.08. Therefore, 8% of the volatility remaining after stripping out market effects from firm returns is due to industry movements. Together, these numbers suggest that much of a stock's volatility is not industry or market related, meaning that the manager will still bear significant firm-specific risk even if options are performance-benchmarked, that is, indexed.

Table 3 turns to the efficiency of stock and option compensation using three types of relative-performance-benchmarked portfolios – a portfolio hedged against market movements, a portfolio hedged against industry movements, and a portfolio hedged against both industry and market movements. Hedging out market movements drops the manager's stock portfolio from a 52% annual volatility to 45% annual volatility. Taking out non-market industry effects drops the volatility to 42%. The column labeled "Efficiency of Stock or Indexed Portfolio) displays the efficiency that results from the combined volatility decrease and shift in the composition (systematic versus idiosyncratic) of that volatility. The efficiency of a stock-based portfolio declines from the 81% associated with a grant of the firm's stock, to 72% for the market- and industry-adjusted stock portfolio. In other words, the private value that a manager places on her stock compensation is 81% of its market value when the firm's stock is used. When the manager is compensated using the market- and industry-adjusted portfolio, the private value that a manager places on that portfolio is 72% of its market value. The decline in efficiency is somewhat greater for option-based compensation, which moves from an efficiency level of 76% for a conventional option, versus 63% for an option on a market- and industry-adjusted performance-benchmarked portfolio.

If we stopped the analysis here, the conventional option, with its higher efficiency level, would seem to dominate the option on the performance-benchmarked (indexed) portfolio.

Of course, this conclusion ignores several advantages of indexed options not considered in the efficiency-based cost calculations. First, the indexed option may better motivate the manager simply because more of the volatility of her stock and option holdings is now under her control. Second, an indexed option costs less (meaning it has a lower market value) than a conventional option. This lower cost means that a firm could supplement its indexed option grant with a *cash* grant, in order to bring the combined value of the indexed option and the cash up to the level of a conventional option. Because cash is 100% efficient from the manager's standpoint (i.e. she can invest cash as she sees fit), this combination will have a higher efficiency than that of the indexed option alone. Indeed, it is conceivable that this extra cash could boost the efficiency of the indexed option-cash combination higher than the efficiency level of the conventional option.

To better understand the efficiency of this market-value-equivalent portfolio of indexed portfolio option plus cash, one first needs to know how large the cash grant will be. The larger the cash grant, the larger the efficiency gains. The last column in Table 3 shows how large a cash grant is needed to equate compensation value across the two different types of option programs: conventional and performance-benchmarked (indexed) portfolios. The mean ratio of the market value of the option on the market-adjusted portfolio to the market value of the conventional option is 93%, and the mean ratio of the market- and industry-adjusted option to the conventional option is 91%. Thus, in the case of the market-adjusted option, the firm gives the manager cash equivalent to 7% of the conventional option's value, combined with that option on the market-adjusted portfolio, or in the case of the option on the market- and industry-adjusted portfolio, cash equivalent to 9% of the conventional option's value, combined with that option on the market- and industry-adjusted portfolio, to form the *market-value-equivalent* portfolios.

Table 4 displays efficiency levels for conventional and indexed portfolio options (similar to those in Table 3), but on an industry-by-industry basis. The table reveals that industries such as Utilities, Natural Gas, Bank and Thrifts have efficiency levels for market-adjusted options on the high end of the spectrum, while Internet-based firms, Educational Services, Medical Services and Oilfield Services and Equipment have efficiencies on the lower end. Examining the efficiency levels of the market- and industry-adjusted option portfolio yields much the same story. Holding cost of compensation constant between the performance-benchmarked option plus cash and the conventional option, the market- and industry-adjusted indexed option could be supplemented by an amount of cash ranging from 6% of the conventional option for H&Q Internet-based firms, to 29% of the conventional option's value (Coal and Alternate Energy), averaging 11% across all industries. So, even after considering the marginal contribution of removing industry effects, the majority of the value from the market-value-equivalent market- and industry-adjusted option plus cash package comes from the indexed portfolio option, not from cash.

Tables 3 and 4 tell us that the amount of the cash grant required to bring the cost of the performance-benchmarked option up to the value of the conventional option will be small. Is this relatively small cash grant enough to boost the combined cash plus performance-benchmarked option efficiency level above that of the conventional option? Table 5 addresses this question. It displays the efficiency level of conventional options, the efficiency level of the indexed option, and, using the market value ratios from Table 4, the efficiency level the indexed option plus cash grant. In Table 5, Panel A, can see that the mean efficiency level of the conventional option for Value Line firms is 76% versus 63% for the market- and industry-adjusted option, before considering the added cash. Mixing in cash averaging 9% of the conventional option's value boosts the efficiency of the indexed portfolio option itself to 65%, and the indexed portfolio option plus cash combination to 68%. The numbers for the other indexed portfolios (market-adjusted or industry-adjusted) are similar. The conclusions for the set of Internet-based firms parallel those of the Value Line firms: the conventional option efficiency has a mean value of 59%, and the market- and industry-adjusted indexed option efficiency moves from its value of 43% to an efficiency level of 48% when the cash supplement is added. Even with the addition of the market-value-equivalent cash, market and/or industry indexing is less efficient (managers place a lower private value on it relative to its market value) than conventional option grants. Note that these efficiency levels would be lower still if the value difference between an indexed option and a conventional option were paid to the manager in the form of *more* indexed options, rather than in cash (i.e. that 9% value difference would consist of indexed options, rather than cash), as advised by many of the proponents of indexed options.

V. Conclusions

Recent market volatility has strengthened the call for indexed options, that is, options whose payoff is linked to some sort of market or industry-based index. Such options hold the potential to propitiate critics of conventional stock options, critics who view the Brobdingnagian fortunes amassed by many managers during the bull-market as the result of luck, not ability or effort. Indexed options compensation, assert its proponents, tightens the link between managerial efforts and compensation by removing overall stock market gains (or losses), or perhaps industry-level gains (or losses) from managers' compensation. While managers have seemed reluctant to adopt compensation indexed to market or industry benchmarks (only one U.S. firm, Level 3 Communications, currently has an indexed option plan), the recent derailment of the long-running bull market may draw more managerial support for indexing in the future.

In this paper, I compare the deadweight costs of the options on the performance-benchmarked (or indexed) portfolio to the costs of conventional stock options. Deadweight costs arise in any equity-linked compensation plan: equity-linked compensation exposes managers to firm-specific risk, inevitably creating some loss in the managers' ability to hold diversified portfolios. Constrained in their ability to diversify, managers are exposed to the firm's total volatility, rather than the smaller systematic portion faced by the well-diversified investor. As a consequence, the stock's expected returns are too low to fully compensate managers for the risk they must bear, leading them to value their stock and options at less than their market value. This gap between the cost of equity-linked compensation to the firm (its market value) and the value placed on that compensation to undiversified managers, is a deadweight cost to the firm. To determine the optimal proportion of equity-based compensation, the firm must balance the deadweight loss-of-diversification costs against the incentive-alignment benefits produced by that compensation.

Perhaps surprisingly, the deadweight cost of an option on a performance-benchmarked portfolio is *greater* than the deadweight cost of a conventional option. When the option on the performance-benchmarked portfolio factors out the effect of systematic risk, it eliminates the very type of risk that provides the holder of a conventional option with a type of "implicit" diversification. A manager holding a conventional option will bear both systematic and non-systematic risk, and will be compensated through the stock's expected return for the systematic portion of that risk. A manager holding an option on a performance-benchmarked portfolio bears "only" non-systematic risk, and is therefore not "compensated" for any of that risk exposure, leaving the manager with an expected return of risk-free rate on the underlying asset.

To explore whether the theoretical deadweight costs of options on performance-benchmarked portfolios are economically significant, I use a method developed in this paper to empirically estimate their magnitude. I find that the firms tracked by Value Line have a mean efficiency level of 72% for the conventional stock option, meaning that an undiversified Value Line manager values that option at 72% of its market value on average. Indexing to the market and industry reduces the manager's private value of that option from 72% of market value to 63%. If this indexed (performance-benchmarked) plan is supplemented by a market-value-equivalent cash grant (i.e. the amount necessary so that together the cash plus the indexed option has a market value equal to that of a conventional option), the efficiency level increases to 68%, a level that is still twelve percent lower than the efficiency of the conventional option. And for more volatile Internet-based firms, the contrast is even more striking: the efficiency of a conventional option is 59%, and that of the market- and industry-adjusted indexed plan (supplemented by cash) is 48%, an average twenty-four percent lower than the conventional option.

This deadweight cost analysis has three practical implications, all essential to a firm adopting an indexed option plan. The first is that removing industry-level volatility unambiguously "increases" efficiency of the market-indexed portfolio. This efficiency increase occurs because the market-indexed portfolio is free of systematic risk (by construction), and the marginal effect of removing ex-market industry movements ("ex-market" means the portion industry return unrelated to market movements) from the market-indexed portfolio decreases idiosyncratic volatility without further sacrifice of expected returns. The better the match between the firm's benchmark portfolio and the factors under the managers' control, the more that the manager's exposure to unproductive (and costly) idiosyncratic volatility will decrease.

The second practical implication of the greater deadweight costs associated with a compensation plan structured around options on performance-benchmarked portfolios is that firms implementing the performance-benchmarked portfolios plan should award *fewer* indexed portfolio options than the number that they would have otherwise awarded in a conventional option plan. This practice contradicts the traditional recommendation that managers receiving performance-benchmarked options be granted a *greater* number of options than they would otherwise receive under a conventional option plan. Increasing the number of options on a performance-benchmarked portfolio, however, would only exacerbate the deadweight cost problem. Instead, to increase efficiency while bringing the value of the option on the performance-benchmarked portfolio grant up to the value of the conventional option, the firm can supplement the option on the performance-benchmarked portfolio with enough cash to equate the dollar value of the two types of option plans. The efficiency level of this market-market-value-equivalent indexed option portfolio is greater than the efficiency of the performance-benchmarked option alone. Nevertheless, as an empirical matter, the cash required to equate the two market values is too small to alter efficiency much. That is, at least for Value Line firms, the combined efficiency of the market-market-value-equivalent indexed option plan is *still* less that the efficiency of a conventional option plan.

Finally, the deadweight cost analysis suggest that firms who adopt an indexed option plan should consider increasing the cash component *above* the minimal market-market-value-equivalent amount suggested above. Why the increase to the cash component? An indexed option plan, if successfully designed, tightens the link between managerial pay and performance. With this greater degree of incentive alignment, the firm's optimal mix between cash and equity-based compensation may shift towards cash. If the incentive alignment gains from moving to a performance-benchmarked plan are large enough, the firm can produce the same degree of incentive alignment using fewer options. With this decrease in the cost to create a given degree of incentive alignment, the firm can increase the proportion of cash in the compensation package, an increase that will raise the value that managers' place on their compensation, without increasing the firm's cost by a like amount. In fact, any time that a firm can decrease the equity component of compensation, while maintaining the desired degree of incentive alignment, it has an opportunity to increase shareholder value.

In sum, compensation committees need to carefully consider the benefits offered by indexing, contrasting the benefits with the deadweight costs described in this paper. If a firm does move forward with an indexing scheme, the best performance-benchmarked portfolio will remove not only market (systematic) risk, but also as much idiosyncratic risk as possible, as long as that risk is not under managers' control. After determining the best performance-benchmarked portfolio, firms adopting such a plan need to re-evaluate the appropriate mix of cash and options in the compensation plan, considering whether they can increase the cash component while maintaining the desired degree of incentive alignment.

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TABLE 1
Characteristics of Sample Firms
Value Line Industry Survey Firms and H&Q Internet-Based Firms: December 31, 1998

The Panel A dataset consists of 1496 Value Line firms classified into 56 industry classifications as of 12/31/98. Foreign firms and industries are not included in the analysis. The Panel B dataset consists of 53 H&Q Internet firms as of 12/31/98. Continuously-compounded daily excess returns (net of daily riskless rates) are used in all calculations. The market return is the continuously-compounded value-weighted daily NYSE/AMEX/NASDAQ Composite returns (net of daily riskless rates). A minimum of 64 observations (3 months) of daily returns are required for beta and volatility estimation. "Equity Value of the Firm" is measured as of 12/31/98. "Return Premium (s_j)" is the return premium on a stock required by an undiversified manager to compensate for the higher level of risk. "Equity Efficiency" is the ratio of the value of the stock to the undiversified manager to the value of the stock to the diversified investor. "Option Efficiency" is the ratio of the value of the option on the stock to the undiversified manager to the value of the option on the stock to the diversified investor. The vesting period of the stock is 3 years and the time to expiration of options are 3 and 10 years labeled respectively. "n" represents the number of firms.

Panel A: Value Line Firms

	Beta (β_j)	Volatility (σ_j)	Equity Value of Firm ($mm)	Sharpe Ratio ($(r_j - r_f)/\sigma_j$)
mean	0.90	0.52	7,509	0.127
median	0.87	0.48	1,517	0.127
std dev	0.40	0.20	22,919	0.039
n	1,496	1,496	1,496	1,496

	Return Premium (s_j)	Equity Efficiency (V_j^u/V_j)	Option Efficiency	
			3 Year Maturity	10 Year Maturity
mean	0.073	0.81	0.67	0.76
median	0.064	0.83	0.67	0.77
std dev	0.041	0.09	0.09	0.08
n	1,496	1,496	1,496	1,496

TABLE 1 (cont.)
Characteristics of Sample Firms
Value Line Industry Survey Firms and H&Q Internet-Based Firms: December 31, 1998

The Panel A dataset consists of 1496 Value Line firms classified into 56 industry classifications as of 12/31/98. Foreign firms and industries are not included in the analysis. The Panel B dataset consists of 53 H&Q Internet firms as of 12/31/98. Continuously-compounded daily excess returns (net of daily riskless rates) are used in all calculations. The market return is the continuously-compounded value-weighted daily NYSE/AMEX/NASDAQ Composite returns (net of daily riskless rates). A minimum of 64 observations (3 months) of daily returns are required for beta and volatility estimation. "Equity Value of the Firm" is measured as of 12/31/98. "Return Premium (s_j)" is the return premium on a stock required by an undiversified manager to compensate for the higher level of risk. "Equity Efficiency" is the ratio of the value of the stock to the undiversified manager to the value of the stock to the diversified investor. "Option Efficiency" is the ratio of the value of the option on the stock to the undiversified manager to the value of the option on the stock to the diversified investor. The vesting period of the stock is 3 years and the time to expiration of options are 3 and 10 years labeled respectively. "n" represents the number of firms.

Panel B: Hambrecht & Quist Internet-Based Firms

	Beta (β_j)	Volatility (σ_j)	Equity Value of Firm ($mm)	Sharpe Ratio ($(r_j - r_f)/\sigma_j$)
mean	2.00	1.17	14,128	0.130
median	2.06	1.19	1,216	0.128
std dev	0.47	0.33	51,129	0.033
n	53	53	53	53

	Return Premium (s_j)	Equity Efficiency (V_j^u/V_j)	Option Efficiency	
			3 Year Maturity	10 Year Maturity
mean	0.166	0.62	0.56	0.61
median	0.159	0.62	0.56	0.61
std dev	0.074	0.13	0.12	0.13
n	53	53	53	53

TABLE 2
Industry Characteristics
Value Line Industries and Hambrecht & Quist Internet-Based Industries: December 31, 1998

The dataset consists of 1496 firms tracked by Value Line and 53 firms in Hambrecht & Quist Internet-Based Index as of 12/31/98. The calculations use daily continuously-compounded excess return (net of risk-free rate) over the six month period ending 12/31/98. If six months of data is not available, we use the available data, as long as that data covers at least three months. CRSP's Value-Weighted Composite Index is used for the market return. "Equity Value" is measured as of 12/31/98. "Beta" is a firm-level beta calculated using the market model with excess returns. "Firm Volatility" is the annualized volatility of daily returns. "Industry Volatility" is the annualized volatility of daily returns for a value-weighted industry index comprised of all firms within the specified Value Line Industry. "Firm-Mkt Corr." is the correlation between the firm's excess return and the industry's excess return calculated from daily data. "Firm-Ind. Corr." is the correlation between the firm's return and the "ex-market" industry return (where ex-market means that the market component of the industry return has been removed).

Panel A: Value Line Industries

Industry	Firms	Equity Value on 12/31/98 ($mm)			Beta (β_j)			Firm Volatility (σ_j)			Industry Volatility (σ_i)	Firm-Mkt Corr. (ρ_{jm})			Firm-Ind. Corr. (after taking out the mkt) (ηij)		
		MEAN	MED	STDDEV	**MEAN**	MED	STDDEV	**MEAN**	MED	STDDEV		**MEAN**	MED	STDDEV	**MEAN**	MED	STDDEV
Advertising, Publishing & Newspaper	33	**3716**	2378	3983	**0.83**	0.83	0.21	**0.41**	0.41	0.11	0.23	**0.56**	0.56	0.11	**0.29**	0.27	0.15
Aerospace & Defense	17	**5186**	1369	8498	**0.74**	0.67	0.27	**0.46**	0.43	0.12	0.30	**0.43**	0.45	0.09	**0.29**	0.30	0.22
Air Transport	14	**4014**	2071	4146	**1.26**	1.25	0.20	**0.58**	0.57	0.09	0.43	**0.59**	0.59	0.06	**0.54**	0.57	0.24
Apparel & Shoe	24	**1259**	552	1798	**0.88**	0.85	0.24	**0.61**	0.63	0.15	0.29	**0.40**	0.41	0.10	**0.26**	0.22	0.17
Auto & Truck	8	**14982**	1140	26408	**1.08**	1.08	0.19	**0.54**	0.51	0.09	0.38	**0.56**	0.54	0.10	**0.29**	0.17	0.28
Auto Parts	24	**2106**	1046	2187	**0.74**	0.70	0.25	**0.47**	0.44	0.15	0.21	**0.45**	0.44	0.15	**0.27**	0.26	0.16
Bank & Thrift	57	**14942**	6336	21215	**1.16**	1.16	0.24	**0.45**	0.43	0.09	0.36	**0.70**	0.71	0.08	**0.33**	0.33	0.20
Beverage	13	**22632**	2022	46221	**0.77**	0.85	0.30	**0.45**	0.47	0.11	0.32	**0.47**	0.49	0.16	**0.17**	0.07	0.30
Broadcasting & Cable TV	4	**9204**	4400	11418	**1.13**	1.17	0.14	**0.53**	0.53	0.09	0.36	**0.59**	0.60	0.05	**0.42**	0.34	0.37
Brokerage, Leasing & Financial Services	36	**12328**	5072	20528	**1.37**	1.42	0.35	**0.61**	0.58	0.16	0.47	**0.62**	0.63	0.09	**0.38**	0.41	0.22
Building Materials, Cement, Furniture & Homebuilding	53	**3382**	835	13218	**0.93**	0.93	0.35	**0.52**	0.51	0.16	0.37	**0.49**	0.50	0.14	**0.11**	0.09	0.17
Chemical	62	**3621**	1285	8562	**0.75**	0.76	0.22	**0.47**	0.43	0.14	0.25	**0.45**	0.45	0.12	**0.18**	0.16	0.19
Coal & Alternate Energy	2	**5304**	5304	4580	**0.94**	0.94	0.27	**0.52**	0.52	0.19	0.54	**0.50**	0.50	0.04	**0.66**	0.66	0.47
Computer	77	**17190**	3468	47556	**1.26**	1.22	0.35	**0.70**	0.68	0.18	0.38	**0.51**	0.50	0.14	**0.18**	0.14	0.20
Diversified	44	**5963**	1381	14750	**0.85**	0.85	0.25	**0.47**	0.43	0.10	0.26	**0.50**	0.52	0.13	**0.10**	0.08	0.17
Drug	37	**25760**	4052	46763	**1.05**	0.97	0.30	**0.57**	0.55	0.21	0.29	**0.52**	0.50	0.12	**0.14**	0.06	0.24
Drugstore	6	**10876**	7160	12416	**1.02**	0.99	0.29	**0.51**	0.47	0.14	0.41	**0.56**	0.58	0.17	**0.36**	0.34	0.45
Educational Services	5	**1160**	1158	738	**1.35**	1.23	0.49	**0.85**	0.64	0.51	0.44	**0.47**	0.49	0.08	**0.47**	0.41	0.21
Electrical Equipment & Home Appliance	25	**17080**	1240	66319	**0.78**	0.79	0.24	**0.43**	0.41	0.12	0.31	**0.51**	0.52	0.15	**0.04**	0.00	0.21
Electronics & Semiconductor	52	**7692**	1137	27801	**1.17**	1.24	0.39	**0.65**	0.67	0.17	0.37	**0.49**	0.50	0.13	**0.23**	0.21	0.21
Food Processing	43	**6006**	1895	9926	**0.68**	0.66	0.20	**0.44**	0.42	0.11	0.21	**0.44**	0.43	0.11	**0.20**	0.15	0.22
Food Wholesalers & Grocery Stores	20	**5696**	2279	7497	**0.68**	0.67	0.23	**0.43**	0.43	0.13	0.23	**0.44**	0.44	0.12	**0.27**	0.18	0.22
Hotel & Gaming	14	**1445**	1064	1397	**0.89**	0.94	0.20	**0.53**	0.53	0.12	0.30	**0.46**	0.47	0.09	**0.39**	0.48	0.21
Household Products	18	**12255**	1441	28612	**0.75**	0.76	0.21	**0.53**	0.43	0.23	0.31	**0.44**	0.48	0.17	**0.18**	0.14	0.27
Industrial Services (Including Environmental)	30	**2999**	1359	5002	**0.95**	0.84	0.40	**0.57**	0.56	0.20	0.31	**0.45**	0.45	0.11	**0.20**	0.16	0.18
Insurance	52	**7843**	4282	14550	**0.91**	0.93	0.29	**0.45**	0.43	0.13	0.30	**0.57**	0.58	0.13	**0.24**	0.24	0.18
Internet	6	**20387**	11498	26229	**2.17**	2.12	0.26	**1.06**	1.14	0.18	0.79	**0.57**	0.56	0.07	**0.69**	0.70	0.20
Investment	41	**499**	202	679	**0.85**	0.94	0.44	**0.38**	0.37	0.17	0.16	**0.60**	0.64	0.20	**0.36**	0.37	0.10
Machinery	42	**1654**	642	3048	**0.82**	0.84	0.29	**0.51**	0.47	0.16	0.27	**0.44**	0.45	0.11	**0.21**	0.20	0.18
Manufactured Housing & Recreational Vehicles	8	**828**	575	625	**0.75**	0.75	0.29	**0.46**	0.45	0.11	0.30	**0.44**	0.46	0.11	**0.44**	0.45	0.21

TABLE 2 (cont.)
Industry Characteristics
Value Line Industries and Hambrecht & Quist Internet-Based Industries: December 31, 1998

The dataset consists of 1496 firms tracked by Value Line and 53 firms in Hambrecht & Quist Internet-Based Index as of 12/31/98. The calculations use daily continuously-compounded excess return (net of risk-free rate) over the six month period ending 12/31/98. If six months of data is not available, we use the available data, as long as that data covers at least three months. CRSP's Value-Weighted Composite Index is used for the market return. "Equity Value" is measured as of 12/31/98. "Beta" is a firm-level beta calculated using the market model with excess returns. "Firm Volatility" is the annualized volatility of daily returns. "Industry Volatility" is the annualized volatility of daily returns for a value-weighted industry index comprised of all firms within the specified Value Line Industry. "Firm-Mkt Corr." is the correlation between the firm's excess return and the industry's excess return calculated from daily data. "Firm-Ind. Corr." is the correlation between the firm's return and the "ex-market" industry return (where ex-market means that the market component of the industry return has been removed).

Panel A (cont.): Value Line Industries

Industry	Firms	Equity Value on 12/31/98 ($mm)			Beta (β_j)			Firm Volatility (σ_j)			Industry Volatility (σ_i)	Firm-Mkt Corr. (ρ_{jm})			Firm-Ind. Corr. (after taking out the mkt) (ηij)		
		MEAN	MED	STDDEV	**MEAN**	MED	STDDEV	**MEAN**	MED	STDDEV		**MEAN**	MED	STDDEV	**MEAN**	MED	STDDEV
Maritime	5	**448**	340	390	**0.65**	0.66	0.08	**0.62**	0.50	0.28	0.29	**0.32**	0.31	0.09	**0.39**	0.40	0.31
Medical Services	23	**3537**	1196	4029	**1.05**	1.04	0.24	**0.77**	0.71	0.28	0.34	**0.41**	0.40	0.14	**0.31**	0.31	0.17
Medical Supplies	45	**7965**	1450	20230	**0.82**	0.79	0.27	**0.53**	0.48	0.21	0.25	**0.44**	0.43	0.13	**0.13**	0.07	0.20
Metal Fabricating	12	**1746**	442	4055	**0.71**	0.69	0.30	**0.48**	0.46	0.13	0.30	**0.42**	0.42	0.15	**0.19**	0.14	0.25
Metals and Mining	19	**2513**	982	3395	**0.60**	0.69	0.42	**0.59**	0.54	0.19	0.35	**0.34**	0.36	0.25	**0.55**	0.55	0.22
Natural Gas	43	**2141**	984	3553	**0.56**	0.52	0.27	**0.35**	0.32	0.14	0.21	**0.44**	0.46	0.11	**0.27**	0.24	0.19
Office Equip. & Supplies	21	**4336**	959	9177	**0.95**	0.93	0.46	**0.65**	0.62	0.31	0.32	**0.42**	0.39	0.17	**0.14**	0.11	0.20
Oilfield Services & Equipment	20	**3296**	1382	5913	**1.28**	1.23	0.21	**0.77**	0.76	0.14	0.57	**0.46**	0.46	0.07	**0.78**	0.82	0.14
Packaging & Container	10	**1990**	1698	1536	**0.76**	0.80	0.16	**0.50**	0.48	0.16	0.28	**0.43**	0.43	0.11	**0.34**	0.27	0.24
Paper & Forest Products	25	**3028**	1990	3357	**0.75**	0.74	0.18	**0.42**	0.40	0.08	0.29	**0.49**	0.50	0.10	**0.49**	0.60	0.25
Petroleum	41	**13515**	3373	30972	**0.77**	0.75	0.21	**0.47**	0.43	0.13	0.25	**0.46**	0.44	0.09	**0.41**	0.45	0.24
Precision Instrument	23	**1917**	476	4827	**1.00**	0.90	0.39	**0.66**	0.64	0.18	0.30	**0.42**	0.44	0.10	**0.16**	0.11	0.20
Railroad	7	**8694**	9059	4988	**0.95**	0.81	0.47	**0.46**	0.38	0.17	0.25	**0.54**	0.54	0.10	**0.47**	0.55	0.16
Recreation	30	**8626**	2242	16790	**1.11**	1.07	0.41	**0.60**	0.54	0.22	0.33	**0.52**	0.57	0.15	**0.19**	0.16	0.15
REIT's	15	**1839**	1190	1483	**0.61**	0.53	0.23	**0.33**	0.29	0.12	0.20	**0.50**	0.48	0.07	**0.49**	0.50	0.18
Restaurant	27	**3134**	590	9904	**0.84**	0.80	0.29	**0.53**	0.51	0.15	0.31	**0.44**	0.46	0.10	**0.13**	0.13	0.19
Retail (Special Lines)	55	**2177**	1001	4536	**1.17**	1.24	0.38	**0.70**	0.67	0.21	0.38	**0.46**	0.50	0.13	**0.19**	0.19	0.16
Retail Store	20	**15845**	4941	39412	**1.18**	1.23	0.27	**0.58**	0.58	0.14	0.38	**0.57**	0.60	0.15	**0.33**	0.30	0.21
Steel	17	**716**	449	882	**0.70**	0.69	0.26	**0.51**	0.50	0.19	0.27	**0.39**	0.34	0.12	**0.34**	0.37	0.20
Telecommunications	41	**24984**	4153	42081	**1.10**	1.05	0.48	**0.62**	0.57	0.25	0.26	**0.49**	0.49	0.14	**0.11**	0.02	0.27
Textile	11	**517**	386	529	**0.80**	0.82	0.27	**0.62**	0.65	0.13	0.34	**0.36**	0.36	0.11	**0.36**	0.34	0.18
Tire & Rubber	5	**2297**	1549	3179	**0.85**	0.78	0.24	**0.42**	0.36	0.15	0.29	**0.56**	0.53	0.08	**0.45**	0.32	0.31
Tobacco	6	**25059**	4487	51655	**0.62**	0.59	0.11	**0.36**	0.35	0.07	0.25	**0.46**	0.46	0.06	**0.40**	0.39	0.34
Toiletries & Cosmetics	5	**14286**	5236	22115	**0.94**	0.96	0.05	**0.45**	0.41	0.07	0.43	**0.57**	0.57	0.08	**0.40**	0.32	0.35
Trucking & Transportation Leasing	15	**765**	636	507	**0.87**	0.93	0.21	**0.59**	0.60	0.11	0.30	**0.40**	0.41	0.09	**0.38**	0.37	0.15
Utilities	88	**3961**	2626	4221	**0.28**	0.26	0.11	**0.25**	0.23	0.06	0.16	**0.31**	0.31	0.09	**0.57**	0.61	0.22
H&Q INTERNET INDEX FIRMS**	53	**14128**	1216	51129	**2.00**	2.06	0.47	**1.17**	1.19	0.33	0.47	**0.49**	0.48	0.12	**0.29**	0.27	0.15

**Not Included in Summary Statistics

TABLE 2 (cont.)
Industry Characteristics
Value Line Industries and Hambrecht & Quist Internet-Based Industries: December 31, 1998

The dataset consists of 1496 firms tracked by Value Line and 53 firms in Hambrecht & Quist Internet-Based Index as of 12/31/98. The calculations use daily continuously-compounded excess return (net of risk-free rate) over the six month period ending 12/31/98. If six months of data is not available, we use the available data, as long as that data covers at least three months. CRSP's Value-Weighted Composite Index is used for the market return. "Equity Value" is measured as of 12/31/98. "Beta" is a firm-level beta calculated using the market model with excess returns. "Firm Volatility" is the annualized volatility of daily returns. "Industry Volatility" is the annualized volatility of daily returns for a value-weighted industry index comprised of all firms within the specified Value Line Industry. "Firm-Mkt Corr." is the correlation between the firm's excess return and the industry's excess return calculated from daily data. "Firm-Ind. Corr." is the correlation between the firm's return and the "ex-market" industry return (where ex-market means that the market component of the industry return has been removed).

Panel A (cont.): Value Line Industries

Summary Statistics Across Industries and Across Firms

		# of Firms	Equity Value on 12/31/98 ($mm)	Beta (β_j)	Firm Volatility (σ_j)	Industry Volatility (σ_i)	Firm-Mkt Corr. (ρ_{jm})	Firm-Ind. Corr. (after taking out the mkt) (ηij)
Industry Summary Stats (Industries are equally-weighted)	mean	26.7	7274	0.92	0.54	0.32	0.48	0.32
	median	22.0	3987	0.86	0.52	0.30	0.46	0.30
	std dev	19.5	7060	0.28	0.13	0.10	0.08	0.16
	max	88.0	25760	2.17	1.06	0.79	0.70	0.78
	min	2.0	448	0.28	0.25	0.16	0.31	0.04

		# of Firms	Equity Value on 12/31/98 ($mm)	Beta (β_j)	Firm Volatility (σ_j)	Industry Volatility (σ_i)	Firm-Mkt Corr. (ρ_{jm})	Firm-Ind. Corr. (after taking out the mkt) (ηij)
Firm Summary Stats (Firms are equally-weighted)	mean	-	7509	0.90	0.52	-	0.48	0.28
	median	-	1517	0.87	0.48	-	0.48	0.23
	std dev	-	22919	0.40	0.20	-	0.15	0.25
	max	-	342558	2.53	1.74	-	0.92	0.99
	min	-	13	-0.48	0.12	-	-0.17	-0.25

Panel B: Hambrecht & Quist's Internet-Based Firms

Industry Sub-Category	Firms	Equity Value on 12/31/98 ($mm)			Beta (β_j)			Firm Volatility (σ_j)			Industry Volatility (σ_i)	Firm-Mkt Corr. (ρ_{jm})			Firm-Ind. Corr. (after taking out the mkt) (ηij)		
		MEAN	MED	STDEV	MEAN	MED	STDEV	MEAN	MED	STDEV		MEAN	MED	STDEV	MEAN	MED	STDEV
Commerce	18	**3098**	576	5474	**2.39**	2.09	1.20	**1.51**	1.34	0.61	0.74	**0.43**	0.42	0.10	**0.36**	0.36	0.16
Communications	12	**15142**	1444	41426	**1.95**	2.03	0.35	**1.07**	1.07	0.34	0.56	**0.53**	0.51	0.12	**0.29**	0.27	0.25
Content	13	**8574**	1556	19756	**2.44**	2.31	0.75	**1.31**	1.22	0.48	0.77	**0.53**	0.55	0.13	**0.46**	0.50	0.32
Security	4	**2904**	954	4031	**1.72**	1.65	0.36	**0.91**	0.92	0.20	0.62	**0.52**	0.54	0.09	**0.46**	0.32	0.34
Software	11	**35371**	1080	102334	**1.91**	2.14	0.49	**1.23**	1.23	0.51	0.44	**0.47**	0.46	0.15	**0.25**	0.20	0.29
All H&Q INTERNET INDEX FIRMS	53	**14128**	1216	51129	**2.00**	2.06	0.47	**1.17**	1.19	0.33	0.47	**0.49**	0.48	0.12	**0.29**	0.27	0.15

TABLE 3

Stock and Option-Based Compensation Efficiency for the Firm's Stock and the Three Performance-Benchmarked Market- and/or Industry-Adjusted

"Efficiency" is the undiversified manager's private value for equity-linked compensation divided by the market value of that compensation, assuming a three-year vesting period. "Volatility" is the annualized volatility of the firm's stock or the appropriate performance-benchmarked portfolio calculated from daily return. Option values are priced with the Black-Scholes formula assuming a ten-year maturity; CAPM is used for expected returns. "Conv. Option" is a conventional option on the firm's stock. "Performance-Benchmarked Option" is an option on the market, industry, or market and industry adjusted portfolios. Panel A data consists of 1496 firms tracked by Value Line (VL) Industry Survey (excluding foreign firms and industries), and Panel B is firms in H&Q's Internet Index, both as of 12/31/98. Calculations use daily continously-compounded excess returns (net of the risk-free rate) over the six month period ending 12/31/98. Firms with less than three months of data during this period are excluded. The market return is CRSP's Value-Weighted Composite Index. The industry return is the value-weighted average of all firms in the specified VL or H&Q industry.

Panel A: Portfolios Hedged Against Value-Weighted Market Returns and Value-Weighted Industry Returns

Portfolio Composition		Volatility	Efficiency: Stock of Firm or Performance-Benchmarked Portfolio	Efficiency: Option on Stock or Performance-Benchmarked Portfolio	Ratio of Market Value of Performance-Benchmarked Option to Conv. Option
Stock Only	**mean**	0.519	0.809	0.762	**-**
	median	0.480	0.826	0.773	-
	std dev	0.205	0.090	0.084	-
	n	1,496	1,496	1,496	-
Portfolio Hedged Against Market Returns	**mean**	0.452	0.707	0.617	**0.932**
	median	0.414	0.720	0.624	0.940
	std dev	0.196	0.100	0.073	0.045
	n	1,496	1,496	1,496	1,496
Portfolio Hedged Against Industry Returns	**mean**	0.417	0.725	0.631	**0.900**
	median	0.381	0.737	0.636	0.915
	std dev	0.182	0.105	0.079	0.071
	n	1,496	1,496	1,496	1,496
Portfolio Hedged Against Market and Industry Returns	**mean**	0.420	0.720	0.627	**0.909**
	median	0.385	0.731	0.632	0.927
	std dev	0.199	0.106	0.079	0.072
	n	1,496	1,496	1,496	1,496

TABLE 4

Industry-Level Summary Statistics for Efficiency of Compensation for Conventional Stock Option, and Option on Indexed Portfolio (Hedged Against Market Movements, Industry Movements, or Both)

"Efficiency" is the undiversified manager's private value for equity-linked compensation divided by the market value of that compensation, assuming a three-year vesting period. "Volatility" is the annualized volatility of the firm's stock or the appropriate performance-benchmarked portfolio calculated from daily return. Option values are priced with the Black-Scholes formula assuming a ten-year maturity; CAPM is used for expected returns. "Conventional Option" is a conventional option on the firm's stock. "Performance-Benchmarked Option" is an option on the market, industry, or market and industry adjusted portfolios. Panel A data consists of 1496 firms tracked by Value Line (VL) Industry Survey (excluding foreign firms and industries), and Panel B is firms in H&Q's Internet Index, both as of 12/31/98. Calculations use daily continously-compounded excess returns (net of the risk-free rate) over the six month period ending 12/31/98. Firms with less than three months of data during this period are excluded. The market return is CRSP's Value-Weighted Composite Index. The industry return is the value-weighted average of all firms in the specified VL or H&Q industry.

	Efficiency of Option on				Ratio of Market Value of Performance-Benchmarked Option to Conventional Option		
Industry	**Firm's Stock Only (Conv. Option)**	**Market-Hedged Portfolio**	**Industry-Hedged Portfolio**	**Market & Industry Hedged Port.**	**Market-Hedged Portfolio**	**Industry-Hedged Portfolio**	**Market & Industry Hedged Port.**
Advertising, Publishing & Newspaper	0.81	0.66	0.66	0.67	0.92	0.90	0.89
	(0.06)	(0.05)	(0.05)	(0.05)	(0.03)	(0.04)	(0.04)
Aerospace & Defense	0.76	0.63	0.64	0.64	0.95	0.93	0.91
	(0.04)	(0.04)	(0.04)	(0.04)	(0.02)	(0.07)	(0.06)
Air Transport	0.79	0.60	0.64	0.64	0.90	0.81	0.81
	(0.03)	(0.03)	(0.06)	(0.05)	(0.02)	(0.10)	(0.09)
Apparel & Shoe	0.71	0.57	0.58	0.58	0.96	0.94	0.93
	(0.07)	(0.05)	(0.06)	(0.06)	(0.02)	(0.04)	(0.04)
Auto & Truck	0.79	0.61	0.62	0.63	0.91	0.88	0.87
	(0.05)	(0.04)	(0.06)	(0.06)	(0.04)	(0.10)	(0.10)
Auto Parts	0.76	0.63	0.63	0.64	0.94	0.92	0.92
	(0.08)	(0.06)	(0.06)	(0.07)	(0.04)	(0.05)	(0.05)
Bank & Thrift	0.87	0.67	0.67	0.68	0.85	0.83	0.82
	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)	(0.06)	(0.06)
Beverage	0.77	0.64	0.64	0.65	0.94	0.93	0.91
	(0.07)	(0.04)	(0.06)	(0.06)	(0.04)	(0.09)	(0.08)
Broadcasting & Cable TV	0.80	0.62	0.65	0.66	0.90	0.84	0.82
	(0.04)	(0.03)	(0.10)	(0.10)	(0.02)	(0.13)	(0.12)
Brokerage, Leasing & Financial Services	0.80	0.60	0.62	0.62	0.89	0.85	0.84
	(0.06)	(0.05)	(0.05)	(0.05)	(0.04)	(0.07)	(0.07)
Building Materials, Cement, Furniture & Homebuilding	0.77	0.61	0.61	0.62	0.93	0.93	0.92
	(0.08)	(0.06)	(0.06)	(0.06)	(0.05)	(0.06)	(0.06)
Chemical	0.76	0.62	0.62	0.63	0.94	0.94	0.93
	(0.07)	(0.05)	(0.06)	(0.06)	(0.03)	(0.05)	(0.05)
Coal & Alternate Energy	0.77	0.61	0.75	0.75	0.93	0.72	0.71
	(0.06)	(0.07)	(0.12)	(0.12)	(0.01)	(0.29)	(0.27)
Computer	0.73	0.56	0.56	0.57	0.92	0.92	0.91
	(0.09)	(0.07)	(0.07)	(0.07)	(0.05)	(0.07)	(0.07)
Diversified	0.78	0.63	0.63	0.63	0.93	0.93	0.92
	(0.06)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)
Drug	0.76	0.60	0.60	0.61	0.92	0.92	0.91
	(0.09)	(0.08)	(0.08)	(0.08)	(0.04)	(0.07)	(0.06)
Drugstore	0.79	0.63	0.65	0.66	0.90	0.84	0.83
	(0.10)	(0.06)	(0.09)	(0.09)	(0.07)	(0.16)	(0.15)
Educational Services	0.67	0.52	0.55	0.55	0.95	0.88	0.88
	(0.16)	(0.14)	(0.15)	(0.15)	(0.03)	(0.09)	(0.09)

TABLE 4 (cont.)

Industry-Level Summary Statistics for Efficiency of Compensation for Conventional Stock Option, and Option on Indexed Portfolio (Hedged Against Market Movements, Industry Movements, or Both)

"Efficiency" is the undiversified manager's private value for equity-linked compensation divided by the market value of that compensation, assuming a three-year vesting period. "Volatility" is the annualized volatility of the firm's stock or the appropriate performance-benchmarked portfolio calculated from daily return. Option values are priced with the Black-Scholes formula assuming a ten-year maturity; CAPM is used for expected returns. "Conventional Option" is a conventional option on the firm's stock. "Performance-Benchmarked Option" is an option on the market, industry, or market and industry adjusted portfolios. Panel A data consists of 1496 firms tracked by Value Line (VL) Industry Survey (excluding foreign firms and industries), and Panel B is firms in H&Q's Internet Index, both as of 12/31/98. Calculations use daily continously-compounded excess returns (net of the risk-free rate) over the six month period ending 12/31/98. Firms with less than three months of data during this period are excluded. The market return is CRSP's Value-Weighted Composite Index. The industry return is the value-weighted average of all firms in the specified VL or H&Q industry.

	Efficiency of Option on				Ratio of Market Value of Performance-Benchmarked Option to Conventional Option		
Industry	**Firm's Stock Only (Conv. Option)**	**Market-Hedged Portfolio**	**Industry-Hedged Portfolio**	**Market & Industry Hedged Port.**	**Market-Hedged Portfolio**	**Industry-Hedged Portfolio**	**Market & Industry Hedged Port.**
Electrical Equipment & Home Appliance	0.79	0.64	0.65	0.65	0.93	0.94	0.92
	(0.07)	(0.05)	(0.07)	(0.07)	(0.05)	(0.06)	(0.06)
Electronics & Semiconductor	0.73	0.57	0.58	0.58	0.93	0.91	0.91
	(0.07)	(0.06)	(0.06)	(0.06)	(0.04)	(0.07)	(0.07)
Food Processing	0.76	0.63	0.64	0.64	0.95	0.94	0.93
	(0.06)	(0.05)	(0.05)	(0.05)	(0.03)	(0.05)	(0.05)
Food Wholesalers & Grocery Stores	0.77	0.64	0.65	0.65	0.95	0.93	0.92
	(0.07)	(0.05)	(0.06)	(0.06)	(0.03)	(0.06)	(0.06)
Hotel & Gaming	0.75	0.60	0.62	0.62	0.94	0.90	0.89
	(0.05)	(0.04)	(0.05)	(0.05)	(0.03)	(0.06)	(0.05)
Household Products	0.74	0.61	0.61	0.62	0.94	0.93	0.92
	(0.12)	(0.09)	(0.10)	(0.10)	(0.04)	(0.08)	(0.09)
Industrial Services (Including Environmental)	0.74	0.59	0.60	0.60	0.95	0.94	0.93
	(0.06)	(0.06)	(0.06)	(0.06)	(0.03)	(0.04)	(0.05)
Insurance	0.81	0.65	0.65	0.65	0.91	0.89	0.89
	(0.07)	(0.05)	(0.05)	(0.05)	(0.04)	(0.06)	(0.06)
Internet	0.68	0.47	0.55	0.55	0.93	0.79	0.79
	(0.07)	(0.06)	(0.10)	(0.10)	(0.04)	(0.14)	(0.14)
Investment	0.85	0.69	0.70	0.70	0.90	0.88	0.87
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.06)
Machinery	0.75	0.61	0.62	0.62	0.95	0.93	0.93
	(0.06)	(0.06)	(0.06)	(0.06)	(0.03)	(0.05)	(0.05)
Manufactured Housing & Recreational Vehicles	0.76	0.63	0.65	0.65	0.95	0.89	0.89
	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.08)	(0.08)
Maritime	0.67	0.56	0.59	0.59	0.97	0.91	0.91
	(0.11)	(0.09)	(0.11)	(0.11)	(0.02)	(0.08)	(0.08)
Medical Services	0.66	0.52	0.54	0.54	0.95	0.93	0.92
	(0.13)	(0.10)	(0.10)	(0.10)	(0.04)	(0.05)	(0.05)
Medical Supplies	0.74	0.60	0.60	0.61	0.95	0.94	0.93
	(0.09)	(0.07)	(0.08)	(0.08)	(0.04)	(0.05)	(0.05)
Metal Fabricating	0.74	0.62	0.63	0.63	0.95	0.94	0.93
	(0.08)	(0.05)	(0.08)	(0.08)	(0.03)	(0.09)	(0.09)
Metals and Mining	0.68	0.58	0.61	0.63	0.95	0.88	0.85
	(0.15)	(0.08)	(0.06)	(0.06)	(0.05)	(0.06)	(0.07)
Natural Gas	0.79	0.67	0.68	0.68	0.95	0.94	0.93
	(0.05)	(0.06)	(0.05)	(0.05)	(0.02)	(0.04)	(0.04)

TABLE 4 (cont.)

Industry-Level Summary Statistics for Efficiency of Compensation for Conventional Stock Option, and Option on Indexed Portfolio (Hedged Against Market Movements, Industry Movements, or Both)

"Efficiency" is the undiversified manager's private value for equity-linked compensation divided by the market value of that compensation, assuming a three-year vesting period. "Volatility" is the annualized volatility of the firm's stock or the appropriate performance-benchmarked portfolio calculated from daily return. Option values are priced with the Black-Scholes formula assuming a ten-year maturity; CAPM is used for expected returns. "Conventional Option" is a conventional option on the firm's stock. "Performance-Benchmarked Option" is an option on the market, industry, or market and industry adjusted portfolios. Panel A data consists of 1496 firms tracked by Value Line (VL) Industry Survey (excluding foreign firms and industries), and Panel B is firms in H&Q's Internet Index, both as of 12/31/98. Calculations use daily continously-compounded excess returns (net of the risk-free rate) over the six month period ending 12/31/98. Firms with less than three months of data during this period are excluded. The market return is CRSP's Value-Weighted Composite Index. The industry return is the value-weighted average of all firms in the specified VL or H&Q industry.

	Efficiency of Option on				Ratio of Market Value of Performance-Benchmarked Option to Conventional Option		
Industry	**Firm's Stock Only (Conv. Option)**	**Market-Hedged Portfolio**	**Industry-Hedged Portfolio**	**Market & Industry Hedged Port.**	**Market-Hedged Portfolio**	**Industry-Hedged Portfolio**	**Market & Industry Hedged Port.**
Office Equip. & Supplies	0.70	0.57	0.57	0.57	0.95	0.94	0.93
	(0.12)	(0.10)	(0.10)	(0.10)	(0.05)	(0.07)	(0.07)
Oilfield Services & Equipment	0.69	0.53	0.62	0.63	0.95	0.75	0.74
	(0.06)	(0.05)	(0.05)	(0.05)	(0.02)	(0.08)	(0.08)
Packaging & Container	0.74	0.61	0.62	0.63	0.95	0.91	0.90
	(0.08)	(0.06)	(0.06)	(0.06)	(0.03)	(0.06)	(0.07)
Paper & Forest Products	0.79	0.65	0.67	0.68	0.93	0.87	0.86
	(0.05)	(0.03)	(0.04)	(0.04)	(0.03)	(0.08)	(0.07)
Petroleum	0.77	0.63	0.64	0.65	0.94	0.90	0.89
	(0.06)	(0.05)	(0.06)	(0.06)	(0.02)	(0.06)	(0.06)
Precision Instrument	0.70	0.56	0.56	0.57	0.96	0.95	0.94
	(0.06)	(0.06)	(0.07)	(0.07)	(0.02)	(0.06)	(0.06)
Railroad	0.80	0.64	0.66	0.66	0.92	0.87	0.86
	(0.04)	(0.05)	(0.06)	(0.06)	(0.04)	(0.04)	(0.04)
Recreation	0.76	0.59	0.59	0.60	0.92	0.91	0.91
	(0.10)	(0.08)	(0.08)	(0.08)	(0.04)	(0.05)	(0.05)
REIT's	0.82	0.68	0.70	0.71	0.94	0.89	0.89
	(0.04)	(0.05)	(0.05)	(0.05)	(0.02)	(0.05)	(0.05)
Restaurant	0.74	0.60	0.60	0.61	0.95	0.95	0.93
	(0.06)	(0.05)	(0.06)	(0.07)	(0.02)	(0.06)	(0.06)
Retail (Special Lines)	0.71	0.55	0.56	0.56	0.94	0.93	0.92
	(0.09)	(0.07)	(0.07)	(0.07)	(0.04)	(0.05)	(0.05)
Retail Store	0.78	0.60	0.62	0.62	0.90	0.87	0.87
	(0.09)	(0.06)	(0.07)	(0.07)	(0.05)	(0.09)	(0.09)
Steel	0.73	0.61	0.62	0.62	0.96	0.93	0.92
	(0.08)	(0.07)	(0.07)	(0.07)	(0.03)	(0.06)	(0.06)
Telecommunications	0.74	0.58	0.58	0.59	0.93	0.94	0.91
	(0.09)	(0.08)	(0.09)	(0.09)	(0.05)	(0.05)	(0.05)
Textile	0.68	0.56	0.58	0.58	0.97	0.93	0.92
	(0.06)	(0.05)	(0.05)	(0.05)	(0.02)	(0.05)	(0.05)
Tire & Rubber	0.81	0.65	0.69	0.70	0.92	0.87	0.85
	(0.06)	(0.06)	(0.11)	(0.11)	(0.03)	(0.10)	(0.10)
Tobacco	0.79	0.66	0.70	0.71	0.95	0.91	0.90
	(0.03)	(0.03)	(0.12)	(0.11)	(0.01)	(0.08)	(0.07)
Toiletries & Cosmetics	0.81	0.64	0.68	0.70	0.91	0.86	0.82
	(0.05)	(0.03)	(0.09)	(0.09)	(0.03)	(0.16)	(0.14)

TABLE 4 (cont.)

Industry-Level Summary Statistics for Efficiency of Compensation for Conventional Stock Option, and Option on Indexed Portfolio (Hedged Against Market Movements, Industry Movements, or Both)

"Efficiency" is the undiversified manager's private value for equity-linked compensation divided by the market value of that compensation, assuming a three-year vesting period. "Volatility" is the annualized volatility of the firm's stock or the appropriate performance-benchmarked portfolio calculated from daily return. Option values are priced with the Black-Scholes formula assuming a ten-year maturity; CAPM is used for expected returns. "Conventional Option" is a conventional option on the firm's stock. "Performance-Benchmarked Option" is an option on the market, industry, or market and industry adjusted portfolios. Panel A data consists of 1496 firms tracked by Value Line (VL) Industry Survey (excluding foreign firms and industries), and Panel B is firms in H&Q's Internet Index, both as of 12/31/98. Calculations use daily continously-compounded excess returns (net of the risk-free rate) over the six month period ending 12/31/98. Firms with less than three months of data during this period are excluded. The market return is CRSP's Value-Weighted Composite Index. The industry return is the value-weighted average of all firms in the specified VL or H&Q industry.

	Efficiency of Option on				Ratio of Market Value of Performance-Benchmarked Option to Conventional Option		
Industry	**Firm's Stock Only (Conv. Option)**	**Market-Hedged Portfolio**	**Industry-Hedged Portfolio**	**Market & Industry Hedged Port.**	**Market-Hedged Portfolio**	**Industry-Hedged Portfolio**	**Market & Industry Hedged Port.**
Trucking & Transportation Leasing	0.71	0.58	0.59	0.59	0.96	0.92	0.91
	(0.05)	(0.04)	(0.04)	(0.04)	(0.02)	(0.04)	(0.05)
Utilities	0.79	0.71	0.74	0.74	0.98	0.92	0.92
	(0.03)	(0.03)	(0.05)	(0.05)	(0.01)	(0.04)	(0.03)
H&Q INTERNET INDEX FIRMS**	0.61	0.43	0.44	0.44	0.95	0.94	0.94
**Not Included in Summary Stats Below	(0.13)	(0.10)	(0.10)	(0.10)	(0.05)	(0.07)	(0.07)

	Efficiency of Option on				Ratio of Market Value of Performance-Benchmarked Option to Conventional Option		
Industry-Level Summary Statistics (Equally-weighting each industry)	**Firm's Stock Only (Conv. Option)**	**Market-Hedged Portfolio**	**Industry-Hedged Portfolio**	**Market & Industry Hedged Port.**	**Market-Hedged Portfolio**	**Industry-Hedged Portfolio**	**Market & Industry Hedged Port.**
mean	**0.76**	**0.61**	**0.63**	**0.63**	**0.93**	**0.90**	**0.89**
median	**0.76**	**0.61**	**0.62**	**0.63**	**0.94**	**0.92**	**0.91**
std dev	**0.05**	**0.04**	**0.05**	**0.05**	**0.02**	**0.05**	**0.05**
max	**0.87**	**0.71**	**0.75**	**0.75**	**0.98**	**0.95**	**0.94**
min	**0.66**	**0.47**	**0.54**	**0.54**	**0.85**	**0.72**	**0.71**

TABLE 5

The Efficiency Effect of Supplementing the Options on the Performance-Benchmarked Indexed Portfolio with Cash Amounting to the Difference in Market Value Between a Conventional Option and the Performance-Benchmarked Indexed Portfolio

"Efficiency" is the undiversified manager's private value for equity-linked compensation divided by the market value of that compensation, assuming a three-year vesting period. Option values are priced with the Black-Scholes formula assuming a ten-year maturity; CAPM is used for expected returns. "Conv. Option" is a conventional option on the firm's stock. "Performance-Benchmarked Option" is an option on the market, industry, or market and industry adjusted portfolios. "Market-Value-Equivalent Cash Supplement" is the difference between the market value of a conventional option and an option on one of these performance-benchmarked indexed portfolios. Panel A data consists of 1496 firms tracked by Value Line (VL) Industry Survey (excluding foreign firms and industries), and Panel B is firms in H&Q's Internet Index, both as of 12/31/98. Calculations use daily continously-compounded excess returns (net of the risk-free rate) over the six month period ending 12/31/98. Firms with less than three months of data during this period are excluded. The market return is CRSP's Value-Weighted Composite Index. The industry return is the value-weighted average of all firms in the specified VL or H&Q industry.

Panel A: Value Line Firms

Portfolio Composition		Firm's Stock Only (Conv. Option)	Market-Hedged Portfolio	Industry-Hedged Portfolio	Market and Industry Hedged Portfolio
Stock or	**mean**	0.809	0.707	0.725	0.720
Benchmarked Portfolio	**median**	0.826	0.720	0.737	0.731
Alone	**stddev**	0.090	0.100	0.105	0.106
Option on Stock	**mean**	0.762	0.617	0.631	0.627
or Benchmarked Portfolio	**median**	0.773	0.624	0.636	0.632
Alone	**stddev**	0.084	0.073	0.079	0.079
Market Value of Performance-Benchmarked	**mean**	1.000	0.932	0.900	0.909
Option Relative to Conventional Option	**median**	1.000	0.940	0.915	0.927
(= ω)	**stddev**	0.000	0.045	0.071	0.072
Efficiency of Option Portion of Portfolio	**mean**	0.762	0.632	0.658	0.651
When Market-Value-Equivalent Cash	**median**	0.773	0.641	0.657	0.651
Supplement of (1 - ω) Paid	**stddev**	0.084	0.080	0.096	0.096
Combined Efficiency of Performance-	**mean**	0.762	0.656	0.688	0.679
Benchmarked Option Plus Market-Value-	**median**	0.773	0.665	0.689	0.681
Equivalent Cash Supplement of (1 - ω)	**stddev**	0.084	0.084	0.101	0.102

TABLE 5 (cont.)

The Efficiency Effect of Supplementing the Options on the Performance-Benchmarked Indexed Portfolio with Cash Amounting to the Difference in Market Value Between a Conventional Option and the Performance-Benchmarked Indexed Portfolio

"Efficiency" is the undiversified manager's private value for equity-linked compensation divided by the market value of that compensation, assuming a three-year vesting period. Option values are priced with the Black-Scholes formula assuming a ten-year maturity; CAPM is used for expected returns. "Conv. Option" is a conventional option on the firm's stock. "Performance-Benchmarked Option" is an option on the market, industry, or market and industry adjusted portfolios. "Market-Value-Equivalent Cash Supplement" is the difference between the market value of a conventional option and an option on one of these performance-benchmarked indexed portfolios. Panel A data consists of 1496 firms tracked by Value Line (VL) Industry Survey (excluding foreign firms and industries), and Panel B is firms in H&Q's Internet Index, both as of 12/31/98. Calculations use daily continously-compounded excess returns (net of the risk-free rate) over the six month period ending 12/31/98. Firms with less than three months of data during this period are excluded. The market return is CRSP's Value-Weighted Composite Index. The industry return is the value-weighted average of all firms in the specified VL or H&Q industry.

Panel B: Hambrecht & Quist Internet-Based Firms

Portfolio Composition		Firm's Stock Only (Conv. Option)	Market-Hedged Portfolio	Industry-Hedged Portfolio	Market and Industry Hedged Portfolio
Stock or	**mean**	0.600	0.435	0.475	0.466
Benchmarked Portfolio	**median**	0.619	0.439	0.448	0.441
Alone	**stddev**	0.155	0.145	0.181	0.184
Option on Stock	**mean**	0.590	0.408	0.443	0.435
or Benchmarked Portfolio	**median**	0.609	0.420	0.427	0.421
Alone	**stddev**	0.148	0.120	0.154	0.156
Market Value of Performance-Benchmarked	**mean**	1.000	0.957	0.913	0.919
Option Relative to Conventional Option	**median**	1.000	0.971	0.956	0.961
(= ω)	**stddev**	0.000	0.047	0.116	0.116
Efficiency of Option Portion of Portfolio	**mean**	0.590	0.415	0.461	0.452
When Market-Value-Equivalent Cash	**median**	0.609	0.423	0.431	0.424
Supplement of (1 - ω) Paid	**stddev**	0.148	0.128	0.182	0.184
Combined Efficiency of Performance-	**mean**	0.590	0.435	0.488	0.477
Benchmarked Option Plus Market-Value-	**median**	0.609	0.441	0.457	0.450
Equivalent Cash Supplement of (1 - ω)	**stddev**	0.148	0.143	0.195	0.198