The Compensation and Incentive Components
of Executive Stock Option Value

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The Compensation and Incentive Components of Executive Stock Option Value

Little is known about the breakdown of the value of an executive stock option between compensation and incentives. We show that an adjustment to the option terms and revaluation removes the compensation element, thereby isolating the incentive element. Our estimates reveal that option compensation is about half of option value and a median of about 13 percent of total pay and 21 percent of total compensation. These results have implications for understanding compensation and incentive value and potentially give a better definition of the component of option value that should be expensed.
The Compensation and Incentive Components
Of Executive Stock Option Value

Executive stock options are awarded for two purposes, to compensate for past performance and to provide an incentive for future performance. As compensation, an executive should be indifferent between options with a given value and cash of that same amount. Indeed, determining the certainly equivalent cash value is a common approach to valuing these instruments. But cash provides little incentive as it can be immediately expended, and executives cannot be compelled to invest that cash back into the firm. Options also give the executive a stake in the future of the firm. Because executives have some control over the performance of the firm, options provide an incentive for executives to remain employed by the firm and exert their best efforts.

Given the dual nature of options, it is of considerable interest to understand what portion of an option’s value represents compensation, or payment for past performance, and what portion represents the value of incentives, which is related to future performance. On the surface one might think that an option’s value is strictly driven by future performance, but some of the firm’s future cash flows are derived from assets that were in place before the options were granted. That portion of the option’s value should be viewed as compensation. The portion of the option’s value that is driven by cash flows the executive puts in place after being granted the option represents the incentive value.

Disentangling the compensation value from the incentive value would seem to be a difficult task. Separating old cash flows from new cash flows and then determining how these cash flows convert into option value seems daunting if not impossible. We show in this paper, however, that this separation is straightforward. The terms of the option permit a dichotomy of option value between old cash flows and new cash flows. We demonstrate that as long as the option can be valued, regardless of the preferred valuation model, adjustments to the terms and a revaluation of the option permits a removal of the compensation component. This adjusted option value then represents the incentive component. We show that this approach can be modeled empirically, and we obtain estimates of the portion of the value of options that represents compensation, with the remaining portion representing incentives, for a large sample of firms.

While our primary objective is to obtain empirical estimates of the components of option value that represent compensation and incentives, our model has considerable practical application and policy implications. Given the continuing debate over the
expensing of options, we believe that if the compensation value of an option can be identified, it defines the amount that should be expensed.\(^1\) In addition, our model effectively proposes a new measure of incentive value that may better quantify incentives than does the traditional measure, the option delta.

Section I sets up the model, and Section II presents the main results for traditional options. Section III shows how a re-design of the option enables us to isolate the compensation and therefore its complement, the incentive component. Section IV presents empirical estimates of the compensation and incentive components, and Section V provides conclusions.

I. Model Structure

To separate option value into the compensation and incentive components, we develop a model that identifies how option payoffs are driven by cash flows in place before the options are granted and cash flows added after the options are granted. The latter determine the increase in shareholder wealth that occurs after the options are granted. In simple terms, we are interested in whether management, after receiving options, is then successful in finding positive net-present-value projects.

Our model is initially derived in a world of limited certainty, by which we mean that the cash flows of a firm are assumed to be known but all information about the future is not known. This framework is sufficient to illustrate many of the most important points. As Damodaran (2005) notes, “if two projects have the same net present value, firms should be indifferent between them (p. 44).” Thus, we should not care whether a project’s \(\text{NPV}\) is derived from risky cash flows discounted at a risk-adjusted rate or risk-free cash flows discounted at the risk-free rate. We incorporate uncertainty, however, in the form of allowing only for the possibility but not certainty that management will discover new projects that increase shareholder wealth. Cash flow uncertainty will introduce some complexities that, nonetheless, reveal some additional insights into the nature of the problem of separating compensation value from incentive value, but we defer that discussion until later. For now, uncertainty will strictly derive from the question of whether management is successful in finding positive net–present-value projects. This objective is what the shareholders want and why management receives the options.

A. Basic Setup

\(^1\)Accounting is structured toward recording historical performance. Compensation is a reward for past performance and would seem reasonably justified as a recorded expense. Future performance, however, is not a basis for accounting because after that future performance is realized, it would then become historical performance and would be accounted for at that time.
Consider an all-equity firm in a one-period world, starting at time 0 and ending at time 1.2 The firm has existing assets consisting of cash in the amount of \( C_0 \) and other assets invested in various projects, producing certain cash of \( C_1 \) at time 1. These risk-free cash flows are discounted at the risk-free rate, \( r - 1 \), which obviously is the company’s cost of capital.

The objective of the firm is naturally to increase shareholder wealth, which occurs if management can add projects with positive net present value. To induce managerial effort, the board offers options to management. In this model, options are granted and management then has an instant to find a positive-NPV project. We will also consider alternative uses for the cash, such as dividends and share repurchase, which can be done if desirable projects are not found. In addition, we will look at the use of outside financing to raise funds for investment. We assume that the investment opportunity set is fixed, but the board has no knowledge of these opportunities.

Initially, let us disregard the use of options and illustrate the model in a world in which management need not be incentivized to find a positive-NPV project. As noted, the firm’s existing projects generate cash of \( C_1 \) at time 1, which has a present value of \( C_1r^{-1} \). The company has cash on hand of \( C_0 \). The value of the firm before the options are granted is

\[
S_0 = C_0 + C_1r^{-1}.
\]

If management finds a positive-NPV project, \( C_0 \) is invested and creates cash flow at time 1 of \( \Delta C_1 \).3 Of course, a project with positive net present value means that \( \Delta C_1r^{-1} > C_0 \). The firm’s total cash flow at time 1 will then be \( C_1 + \Delta C_1 \). All of this cash is distributed to shareholders and the company terminates. The new stock price at time 0 will be

\[
S'_0 = C_1r^{-1} + \Delta C_1r^{-1}.
\]

Of course, \( S'_0 \) exceeds \( S_0 \) as a result of the positive value added of \( \Delta C_1r^{-1} - C_0 \). Naturally these results are just standard paradigms from the theory of finance.

**B. Options are Awarded**

To increase the likelihood that the manager will add value, let us assume that the board of directors grants the manager \( \gamma \) options where \( \gamma \) is the number of options divided by the number of outstanding shares. All results require only the restriction that the board awards fewer options than there are shares. Thus, \( \gamma < 1 \). Later we will show that this constraint is upheld in a simple principal-agent model.

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2Extension of the model to a multiperiod setting can be done by letting the time 1 cash flow also include the value of all remaining cash flows. We discuss some aspects of multiperiod analysis later.

3As with \( C_1 \), \( \Delta C_1 \) can also reflect the value of future cash flows for a multiperiod project.
To avoid some complexity that would be created by the issuance of new shares upon exercise, let us treat the options as cash-settled, which are typically called share appreciation rights. Because of this characteristic and because we liquidate the firm after all value has been distributed to shareholders, we must carefully define how the payoff of the options is determined. We assume that the option payoff will be deducted from the available cash at time 1. Hence, the payoff per option is $Max(0, C_1 + \Delta C_1 - X)$ where $X$ is the exercise price. After paying off the options, the remaining cash will be paid out to the shareholders and the firm liquidated. At this point, it should be apparent that this model is integrative, unlike many other models of stock options usage in a firm. In many models, the cost of options is not directly incorporated into the value of the firm. Moreover, the option value depends on corporate cash flows and shareholder wealth depends on corporate cash flows and option value. This circularity must be built into the model, as it characterizes reality. Also, note that we can refer to the value and cost of the option as the same. The value to management is the same as the cost to the firm. Differences arise only due to such factors as illiquidity and vesting, which are not considered here.

Now we must establish a criterion that identifies whether the option grant was successful as an incentive device. It seems natural to assume that if management is granted options for the purpose of adding value for the shareholders, then the incentive value of those options should be determined by whether management creates value for the shareholders after being granted the options. If management does not create value, the options should expire worthless. If these conditions are not met, the option cannot be considered a pure incentive device. With certainty of cash flows at time 1, the option is a pure incentive device if its value at time 0 is positive if management is successful and zero if not. Define $v_0$ to be the value of the option today, which represents the discounted expected value of the option payoff at expiration. With cash flow certainty, we see that

$$v_0 = r^{-1} \begin{cases} C_1 + \Delta C_1 - X & \text{if } C_1 + \Delta C_1 > X \\ 0 & \text{otherwise} \end{cases}$$ (3)

Because the firm is liquidated at time 1, options that settle in shares would have the same economic impact as cash-settled options. But because the stock price would be zero upon liquidation, we must carefully define the rule under which the option payoff is made. Also, note that if $C_1$ and $\Delta C_1$ reflect the value at time 1 of cash flows beyond time 1, then we assume that these projects could be liquidated.

These factors are relevant but their importance arises for reasons unrelated to the issues addressed in this paper. In addition, the one-period nature of the set-up precludes any concern over liquidity or vesting issues.

We need not make any assumptions about how the option is valued. Therefore, the question of whether the Black-Scholes-Merton model is appropriate is not important in this context.
In other words, the terminal value of the option is known as soon as the incremental cash flow $\Delta C_i$ is known. With cash flow certainty, the initial value of the option is then known. As noted, a desirable property is that $v_0$ be positive if management increases shareholder wealth and zero if not.

We also assume that management is unable to divert resources from one project to another. In other words, it can do nothing to increase the incremental cash flow at the expense of the existing cash flow. This assumption is guaranteed by the certainty associated with the existing cash flow at time 1 but is worth remembering. We also assume that the market does not react to the awarding of the options.

II. Model Results

Options are traditionally granted with the exercise price equal to the current stock price, $X = S_0$. We make that assumption and proceed with our results stated in the form of propositions.

A. The Cash is used for Capital Investment

In this section we assume that management causes the firm to invest its cash into capital projects. Let us first assume that management finds a positive net-present-value project.

PROPOSITION 1: If management finds a positive-NPV project, the option will have value.

Proof: See Appendix.

Thus, management will benefit if it finds a positive-NPV project. Clearly such a result is a necessary condition for the options to serve as an incentive.

Now let us examine the question of whether the cost (value) of the options can exceed the net present value, thereby wiping out any shareholder gains. We measure the cost of the options by their payoff at time 1.

PROPOSITION 2: The cost of the options awarded to management can exceed the value of a positive-NPV project that management finds and the firm undertakes.

Proof: See Appendix.

As the proof indicates, whether the cost exceeds the $NPV$ depends on the number of options awarded. But this maximum number of options is a function of the $NPV$ of the new project. Whether management can find a new project with positive $NPV$ and the
NPV of that new project are the uncertain state variables. Because the board of 
directors would not know before granting the options whether management would be 
successful and if so, how much value would be created, it would not be possible for it to 
be sure that it awards a sufficiently small number of options so that cost does not exceed 
NPV.

Thus, even if management is successful in finding a project with positive NPV, 
the shareholders can end up paying management more than the NPV. Hence, if options 
are awarded to incentivize management, they can fail in that purpose because 
management might find a positive-NPV project but the cost of the options can exceed 
the value created. In that case, the option serves poorly as an incentive device. As we 
will show later, this result actually means that the options serve a dual purpose. A 
portion of their value is compensation for past performance.

We now examine whether the options can have value even if the project has a 
negative net present value.

PROPOSITION 3: The option can have value even if management selects a negative-
NPV project.

Proof: See Appendix.

This result implies that if management cannot find a positive-NPV project, it can still 
benefit from a negative-NPV project. Thus, in the absence of monitoring, management 
can clearly benefit from actions that are highly detrimental to the shareholders. It is 
even possible to show that the options can have value when the project has a negative 
internal rate of return.\(^7\) Management might choose a negative-NPV for the purpose of 
empire-building. That said, however, we are not implying that management would 
automatically select a negative-NPV project. As we will show, there are several other 
choices for management that are better, though they would not capture whatever private 
benefits management might perceive as associated with empire-building. But in any 
case, these results show that options cannot serve solely as an incentive device as they 
reward management for actions that are detrimental to shareholders.

We now summarize and illustrate these results in Figure 1. First, define the 
NPV as 
\[ b = \Delta C_1 r^1 - C_0. \]
Shareholders and management benefit from all positive-NPV

\(^7\) The option has value if \( C_1 + \Delta C_1 > S_0. \) Define the IRR to be \( i - 1 \) where \( \Delta C_1 r^1 = C_0. \) Substituting this definition shows that \( i \) can be less than one meaning a negative IRR, with positive option value.
projects, that is, where \( b > 0 \). From management’s standpoint, the positive payout of the options is \( C_1 + \Delta C_1 - (C_0 + C_1r^t) > 0 \) or \( C_1 > -rC_0 - br^2/R \) where \( R = r - 1 \). Management and shareholders would find all projects with positive NPV beneficial, but there is a region in which negative NPV projects are beneficial to management.

The reason for this overinvestment problem is that the options pay off based not only on the incremental cash flow but also on the cash flow that existed before the options were awarded, \( C_1 \). Options allow management to benefit not only from any new value created but also from value that existed before the options were awarded. Hence, negative-NPV projects can be supported by value existing before the options were awarded. This result establishes Proposition 4.

**PROPOSITION 4:** If managers are incentivized with traditional options, they will receive a portion of the gains from projects that the firm had in place before the options were awarded.

*Proof:* See Appendix.

If compensation is viewed as payment for services rendered in the past, this finding suggests that options play a role as a form of compensation. If options reward management for cash flows that were put in place before the options were granted, it is reasonable to treat this reward as a form of compensation. Thus, we see that options contain both a compensation component and an incentive component.

**B. The Cash is used for Dividends**

If there are no positive-NPV projects, the obvious alternatives are to pay dividends, repurchase shares, or invest in a zero-NPV project, such as purchasing financial assets. Let us now consider these alternative uses of funds, starting with dividends. Thus, no capital investment is made, and the cash, \( C_0 \), is paid out as a dividend. We state the effect of dividends as Proposition 5.

**PROPOSITION 5:** If cash is not invested in new projects but is instead paid out as a dividend, the option will have value only if the dividend is smaller than the time value of the cash flow from the existing projects.

The proof is simple. With no capital investment, the option will have value only if \( C_1 > S_0 \), which equivalent to \( C_1 - C_1r^t > C_0 \). Thus, if a dividend is paid, the option can have value only if the left-hand side exceeds the right-hand side, the latter being the dividend. The left-hand side is the time value of the cash flow from existing projects. If the dividend \( C_0 \) is sufficiently small relative to this time value, it is possible for the
option to have value. But if not, the option will not have value. In other words, the dividend must be “small” relative to the time value of the cash flow from existing projects. Thus, management will prefer that companies pay low dividends or none at all. Empirical evidence is consistent with this finding: options seem to make management more averse to paying dividends.\(^8\)

A modification to the option that can reduce this problem is for the exercise price to be adjusted by the dividend. This feature, which is common in over-the-counter options markets, effectively makes the option dividend-protected. In this case, the strike would be set at the ex-dividend stock price of \(S_0 - C_0 = C_1 r^1\). This adjustment leads to Proposition 6.

**PROPOSITION 6:** If cash is not invested in new projects but is instead paid out as a dividend and the strike price of the option is adjusted downward by the amount of the dividend, the option will always have value.

The proof is simple and follows that of Proposition 5. Now the criterion for the option to have value is just \(C_1 > C_1 r^1\), which clearly holds. Thus, the adjustment of the option strike over-corrects for management’s aversion to dividends.\(^9\) From the shareholders’ perspective, a dividend-adjusted strike is not desirable because management benefits even though it was not successful in identifying a positive-NPV project. But if management is powerful enough to control the dividend decision, it may be in the shareholders’ interests to use an adjusted strike. Although dividend protection allows management to profit from its options when it does not find a positive-NPV project, it does at least remove the impediment to management support of dividends when positive-NPV projects are unavailable.\(^10\) In practice, however, it is not common in most countries to adjust the strikes of executive stock options for dividends.\(^11\)

**C. The Cash is used to Repurchase Shares**

\(^8\)Brown, Liang, and Weisenmer (2004) find that both before and after the 2003 dividend tax cut, companies whose executives have large option holdings are less likely to increase dividends. Also, Lambert, Lanen, and Larcker (1989) hypothesize that firms that adopt executive stock option plans will reduce dividends below what the dividends otherwise would have been. Their empirical results in a sample of about 200 firms over the 1967-1987 period are consistent with this conjecture. The reduction in dividends relative to expectations is largest for cases in which the executive has the most to gain by a reduction in dividends. In short, dividends tend to be lower the more stock options firms use. Fenn and Liang (2002) report similar results.

\(^9\)Yet another possibility is to set the strike at a level in which the option expires at-the-money if no positive-NPV project is found and a portion of the funds are invested in cash with the remainder paid out as dividends.

\(^10\)There is yet another alternative to full strike adjustment and no strike adjustment. A partial strike adjustment could be derived that would set the strike at precisely the level that the option would expire at-the-money if no new positive-NPV project is found.

\(^11\)Adjustment of the strike for dividends is evidently done in Finland. See Pasternack and Rosenberg (2003).
Now let us consider share repurchase, the first obvious alternative to dividends. We now state Proposition 7.

PROPOSITION 7: If firms offer at-the-money options and repurchase shares, management will always benefit from the options.

Proof: See Appendix.

Ignoring taxes, it is well-known that dividends and share repurchases are equivalent from the shareholders’ point of view. It is apparent, however, that in the presence of options, they are not equivalent from management’s point of view. Unless the strike is adjusted for dividends, management will clearly prefer share repurchase, a result consistent with empirical research.12

C. The Cash is used for Financial Investment

An alternative project with zero net present value is for the firm to invest its cash in financial assets with the same risk as the firm’s existing assets or investment in a merger with no synergy. We will treat these and any other type of capital investment as the same and simply examine the financial investment case.

PROPOSITION 8: If firms offer at-the-money options and invest in zero net-present-value projects, management will always benefit from the options.

The proof is easily stated. Recall that the option has value if $(C_1 + \Delta C_1 - (C_0 + C_t r^1))$ is positive and zero otherwise. With zero NPV $(\Delta C_1 = C_0 r)$, this term becomes $C_1 - C_1 r^1 + C_0 (r - 1)$, which is clearly positive, so management benefits even though it did not add value for the shareholders.

D. Summary of Uses

Table 1 summarizes the benefit to management and the benefit to the shareholders from each use of the cash. Though these expressions are complex, they include certain common terms and can be simplified greatly. For example, each of the terms for the benefit to management includes the expression $\gamma(C_1 - C_1 r^1)$, while each of the terms for the benefit to the shareholders includes the expression, $(1 - \gamma)C_1 + \gamma C_1 r^1$. Removing these common expressions makes it easier to see which method is preferred.

The preference for shareholders and management varies according to the values of $\Delta C_1$, $C_0$, and $r$. There are seven conditions that must be considered. Let us denote

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12 See Kahle (2002), Weisbenner (2000) and Jolls (1998), who find that share repurchases are more widely used by firms that use stock options and are more widely used the more stock options outstanding.
the five choices for use of the cash as CI (capital investment), D (dividends, no strike adjustment), DSA (dividends with strike adjustment), SR (share repurchase), and FI (financial investment). Table 2 shows the order of preference of management and shareholders for each use under each of nine collectively exhaustive conditions.

The first and only nexus of agreement between management and the shareholders is Condition A(i), the existence of a positive-NPV project \((C_0 < \Delta C_1 r^1)\) in which \((1 - \gamma)\Delta C_i > C_0 r\). The term \((1 - \gamma)\Delta C_i\) is the portion of the incremental cash flow retained by the shareholders (i.e., after paying out the option payoff). When what the shareholders keep exceeds the opportunity cost of cash invested, the shareholders clearly benefit, as would management. The two other positive-NPV outcomes, however, are undesirable for the shareholders. In Condition A(ii) the portion of the incremental cash flow retained by the shareholders is less than the opportunity cost of cash invested. In Condition A(iii) the portion of the incremental cash flow retained by the shareholders is less than cost of capital, adjusted by the capital that management contributes in exercising its options. Conditions A(ii) and A(iii) are clearly undesirable to the shareholders and they would prefer dividends, but management and the shareholders differ on the alternatives beyond dividends. For Condition A(ii), the second choice of shareholders would be capital investment over a strike-adjusted dividend, while for Condition A(iii) the second choice of shareholders would be a strike-adjusted dividend over capital investment. Of course, in both cases, management prefers capital investment.

All remaining cases involve zero or negative NPV. In each case, management prefers financial investment, while shareholders prefer dividends. In all such cases, the shareholders would even find strike-adjusted dividends preferable to share repurchase, which is preferable to financial investment. Management’s second choice would be share repurchase in all such cases. The only point of agreement is in Conditions F and G, in which where the incremental cash flow is negative or zero. In that case, shareholders and management rank capital investment last, for the obvious reason that neither benefits from zero or negative incremental cash flows. Note also that even though we found that management can benefit from a negative-NPV project, it should prefer financial investment or share repurchase unless it wants to engage in empire-building.\(^\text{13}\)

The cases in which no positive-NPV project is found and management prefers financial investment are consistent with Jensen’s (1986) assertion that management will

\(^{13}\) Management might possibly undertake a negative-NPV project if that project enables management to increase its power or secure an entrenched position.
often hoard cash rather than pay dividends. As he notes, this problem must be addressed by finding ways to induce management to disgorge the cash into more efficient uses. But Jensen’s claim is not focused on the fact that by hoarding cash, management benefits from its options. Indeed options have been considered as a means of getting management to engage in more capital investment. But as seen here, options might not achieve this desired result.

In this section we have examined what happens when the firm considers alternative uses of funds. We observe that options create conflicts between management and shareholders. Another possible scenario is that the firm has an inadequate supply of internal financing but access to capital markets. In the appendix we examine the cases of where external debt and equity fund the capital investment and also the case where the required outlay for capital investment is less than the available cash. None of our conclusions change.

E. On the Assumption of $\gamma < 1$ in a Principal-Agent World

These results have been derived under extremely mild assumptions. In this section we show that the only critical requirement, that $\gamma < 1$, is supported in a principal-agent world. Let us assume that, in accordance with the results in Table 2, both principal and agent agree that finding a positive-NPV project is the best result for both parties. The second best result for management is financial investment, while the second best result for the shareholders is ordinary dividends. We assume that management controls the decision of what to do with the cash so if it does not find a positive-NPV project, it will engage in financial investment. Formally, we assume that there is a probability $p(\gamma)$ that management will find a positive-NPV project with complementary probability $1 - p(\gamma)$ that management will have the firm engage in financial investment. We assume that the number of options awarded increases the likelihood of management finding a positive-NPV project but does so at a decreasing rate. Thus,

$$p'(\gamma) > 0$$

$$p''(\gamma) < 0.$$  

The value of the firm is, therefore,

$$V_0(\gamma) = \frac{p(\gamma)[(1-\gamma)C_i + \gamma C_o r^{-1} + \gamma C_o + (1-\gamma)\Delta C_i]}{+(1-p(\gamma))[(1-\gamma)C_i + \gamma C_o r^{-1} + \gamma C_o + (1-\gamma)C_o r]}$$

The board of directors maximizes the value of the firm by choosing the optimal number of options:
Differentiating, we obtain

\[
V_0(\gamma)' = r^{-1}\left\{p(\gamma)'\left[(1 - \gamma)C_1 + \gamma C_1 r^{-1} + \gamma C_0 + (1 - \gamma)\Delta C_1\right] - p(\gamma)'\left[(1 - \gamma)C_1 + \gamma C_1 r^{-1} + \gamma C_0 + (1 - \gamma)C_0 r\right] + p(\gamma)\left[-C_1 + C_1 r^{-1} + C_0 - \Delta C_1\right] + (1 - p(\gamma))\left[-C_1 + C_1 r^{-1} + C_0 - C_0 r\right]\right\}.
\]

Cancelling and rearranging gives the simplified expression

\[
V_0(\gamma)' = r^{-1}\left\{\theta + p(\gamma)\left[C_0 r - \Delta C_1\right] + p(\gamma)'\left[(1 - \gamma)\left[\Delta C_1 - C_0 r\right]\right]\right\},
\]

where \( \theta = -C_1 + C_1 r^{-1} + C_0 - \Delta C_1 \), which is negative. The solution is

\[
\gamma = 1 + \frac{\theta + p(\gamma)(C_0 r - \Delta C_1)}{p(\gamma)'(\Delta C_1 - C_0 r)}.
\]

The sign of each term assures us that \( \gamma < 1 \), and the second-order condition identifies the result as a maximum. Hence, if the board acts in the shareholders’ interests and recognizes that management will either invest the cash in a positive-NPV project and if one is not available, it will invest the cash in securities, the number of options will be less than the number of shares. Thus, our results, while quite general without modeling a principal-agent relationship, are still upheld under the mildly restrictive conditions of a reasonable principal-agent model.

III. Isolating the Compensation Component

The problems described so far arise from the fact that management shares in the benefits of projects that existed before the options were awarded. Payment for such past performance can be viewed as compensation. We show in this section that it is possible to design an option that would function strictly as an incentive device. That is, its payoff would be strictly driven by the cash flows from new projects, thereby removing any reward from projects in place before the options are granted. Such a reward should be rightly viewed as compensation.

It might first seem that we would need to define the option’s payoff as being determined by the portion of equity value deriving from the new cash flows. As a practical matter, such an option would be difficult to construct, as it would be hard to separate the component of the stock price associated with the new project’s cash flow from the component based on the existing cash flows. Since our goal is to separate the portion of an option’s value that derives from compensation from the portion that derives from incentives, we would require a way to empirically separate old cash flows...
from new, a task we regard has highly improbable. There is, however, a simple alternative that allows a clean separation of option value between performance driven by cash flows in place before the options were awarded and performance obtained from cash flows added after the options are awarded. The former is clearly compensation value, and the latter is clearly incentive value.

A. Adjusting the Exercise Price

Suppose that instead of offering options with an exercise price equal to the current stock price, the board indexes the exercise price to the firm’s cost of capital. That is, \( X = S_0 r \). From Equation (1), the strike now becomes \( C_0 r + C_t \). We formalize our results with Proposition 9.

**PROPOSITION 9:** If the exercise price is indexed to the firm’s cost of capital, the option will pay off if and only if value is created after the options are awarded. Hence, the option will function strictly as an incentive device.

The proof is as follows. Recall that the options have value if \( C_t + \Delta C_t > X \) where \( X \) is the strike, which is now set to \( S_0 r \). Then the option pays off if

\[
\begin{align*}
C_t + \Delta C_t &> S_0 r \\
C_t + \Delta C_t &> C_0 r + C_t \\
\Delta C_t r^{-1} &> C_0,
\end{align*}
\]

which is the positive-NPV condition. Thus, the option payoff is strictly determined by whether a positive-NPV project is found.

Next we show that the option value cannot exceed the NPV. We specify that the option value is less than NPV and proceed algebraically:

\[
\gamma (C_t + \Delta C_t - S_0 r) r^{-1} < \Delta C_t r^{-1} - C_0
\]

\[
\gamma < \frac{\Delta C_t r^{-1} - C_0}{C_t r^{-1} + \Delta C_t r^{-1} - S_0}
\]

\[
\gamma < \frac{\Delta C_t r^{-1} - C_0}{\Delta C_t r^{-1} - C_0}
\]

\[
\gamma < 1.
\]

Thus, our constraint that no more options are awarded than shares of stock outstanding is sufficient to ensure that the cost of the options does not exceed the NPV. In effect, positive-NPV projects result in a sharing of the NPV with management. The conventional NPV decision criterion can be safely used, though the increase in shareholder wealth is not the NPV, but instead is the NPV after deducting the cost of the managerial incentives.
Now let us consider how these options perform when management cannot find a positive-\(NPV\) project. We must be assured that management cannot benefit by any other uses of cash that do not create shareholder wealth. Suppose \(C_0\) is used to pay a dividend. Then the stock price drops to \(C_1 r^1\). The strike is still based on the cum-dividend stock price, \(S_0 = C_0 + C_1 r^1\), and, thus, is \(S_0 r = C_0 r + C_1\). The value of the option at time 1 will be \(\text{Max}(0, C_1 - (C_0 r + C_1)) = 0\). The option is then sure to expire out-of-the-money, so its value at time 0 is zero. A similar result is obtained for the case of share repurchase. For financial investment, the \(NPV\) is zero and the option expires precisely at-the-money and, therefore, with no value.

Regardless of the valuation model one uses for executive stock options, it is a simple matter to adjust the exercise price. The only additional requirement is that one know the firm’s cost of capital. Inasmuch as option values change with movements in the stock price, increments in time, and changes in volatility, the components of option value represented by compensation and incentives will also change. Figure 2 illustrates the compensation component as a percentage of total option value as it relates to moneyness and time (Panel A), volatility (Panel B), and cost of capital (Panel C) for a 10-year option issued at-the-money with a stock price of $40, a volatility of 40\%, and a risk-free rate of 5\%. For Panels A and B we also assume the cost of capital is the risk-free rate, but we vary the cost of capital in Panel C.

In Panel A, each line represents a different time to expiration. We see that for all expirations, compensation value as a percentage of option value declines exponentially with moneyness. Hence, options that are deeper in-the-money provide a much greater incentive value than compensation value. Interestingly, compensation value is greater than incentive value only for options that are very deep out-of-the-money. This result makes sense as out-of-the-money options are typically thought of as having low incentive value. With a slight exception that occurs for very deep out-of-the-money options, the compensation component of total option value declines over time. Thus, holding moneyness constant, options become more of an incentive device as they move through time. In Panel B we see that the compensation component of option value declines exponentially with volatility. Hence, more volatility options serve much more as an incentive device. This result certainly makes sense. With low volatility the uncertainty is less and the option behaves much more like compensation. In Panel C, we observe a nearly positive linear relationship between the compensation component and the cost of capital. Thus, holding all other factors constant, options will have greater value as compensation relative to incentives for firms with higher costs of capital.
B. Cost-of-Capital Indexed Options

Options in which the exercise price is indexed to the cost of capital have been mentioned previously in the literature but not explored in an analytical framework. Jensen (2001) discusses them, referring to a 1990 paper by Stewart (1990). As Jensen argues, these options are better for executives who are able to create shareholder wealth and, hence, should be desired by executives that a firm would want to retain and undesired by executives that the firm would not want.

It is easy to see that if a company issues an at-the-money option with 10 years to maturity, its management can be quite enriched, while shareholder wealth decreases. Interestingly, noted investment legend Benjamin Graham may well have recognized the problem with at-the-money options instruments in his classic work *The Intelligent Investor* in 1949.

> Excessive compensation to officers is by no means a negligible matter.  
> There are real abuses here, especially through the use of stock options at inadequate prices ... (p. 208).

Vanguard founder John Bogle (2005) also recently speaks of this problem:

> [T]he fixed-price stock option is fundamentally flawed as a method of aligning the interests of ownership and management: They are not adjusted for the cost of capital, providing a free ride even for executives who produce only humdrum returns. (p. 16)

The analysis so far has considered options only in a world of cash flow certainty. Uncertainty is captured by the question of whether management can find value-increasing projects. We now look at how cash flow uncertainty affects our analysis.

C. The Effect of Uncertainty

With uncertain cash flows, the firm continues to have current cash of $C_0$ and expected future cash of $E(C_1)$. The current value of the firm is $S_0 = C_0 + E(C_1)/k$ where $k$ is one plus the appropriate risk-adjusted discount rate. The manager can invest $C_0$ into a risky project offering an expected payoff of $E(\Delta C_1)$ so the NPV is $E(\Delta C_1)/k - C_0$. We assume the project has the same risk as the company’s current projects, though we will relax this assumption later. The cost-of-capital indexed option will have a strike of

$$X = kS_0 = k(C_0 + E(C_1)/k) = C_0 k + E(C_1).$$
When the option expires, the realized cash flows will be $C_1$ and $\Delta C_1$. Thus, the payoff of a cost-of-capital indexed option is

$$\max(0, C_1 + \Delta C_1 - X) = \max(0, C_1 + \Delta C_1 - (C_0 k + E(C_1)))$$

$$= \max(0, C_1 - E(C_1) + \Delta C_1 - C_0 k).$$

Thus, whether the option pays off depends on a combination of the performance of the existing project relative to expectations and the performance of the new project relative to its time-adjusted initial outlay. The option’s payoff can be positive if the existing projects perform well and the new project performs poorly or vice versa. Thus, it would appear that management can benefit from projects currently in place, a problem we need to avoid if the option is to be viewed strictly as an incentive device.

Uncertainty, however, illustrates another reasonable means by which incentivized management can create value: by managing existing and new projects in such a way as to produce outcomes that exceed expectations. Consider a firm with no cash and no investment opportunities. Thus, its value is simply $E(C_1)/k$. If management can cause the existing projects to pay off more than $E(C_1)$, shareholder wealth will increase. If cost-of-capital adjusted options are used, the strike price would be $E(C_1)$, and the option would pay off $\max(0, C_1 - E(C_1))$. Thus, if management is successful in causing the firm’s existing projects to beat expectations, even without the creation of new projects, shareholders will then benefit and the option should and would pay off. If not, the option should and would expire worthless. Thus, under uncertainty we see that these types of options still provide the proper incentive even if management has no cash to invest and no positive-NPV projects. Options can induce management to take actions that create more favorable payoffs from existing projects. Note, however, that if conventional options are used, the payoff will be $\max(0, C_1 - E(C_1)/k)$, and management does not need to completely beat expectations. It need only produce $C_1 > E(C_1)/k$.

As noted in the beginning of this section, if there is cash available to invest, the option payoff will be $\max(0, C_1 - E(C_1) + \Delta C_1 - C_0 k)$. In this case, management is rewarded by the sum total of its performance in managing both the existing projects and new projects. The option payoff is driven by the combined total of the value created by managing existing projects, whereby $C_1$ is benchmarked to $E(C_1)$, and the value created by identifying and managing new projects, whereby $\Delta C_1$ is benchmarked to $C_0 k$. It is entirely possible that, given limited resources, management could choose to neglect either the old or new projects in favor of the other, but this choice causes no problem. It is the performance of the total portfolio of projects that matters. Shifting resources after the option is granted is a reasonable action that should be rewarded if it creates wealth.
D. Risk Shifting

Recall that with the cost-of-capital indexed option under uncertainty, we assume that a new project accepted by management has the same risk as the existing project. This assumption is critical and if it is violated, we have introduced a third source of uncertainty. \(^{14}\) Recall that the payoff of the cost-of-capital indexed option under uncertainty is

\[
\text{Max}(0, C_1 + \Delta C_1 - X) = \text{Max}(0, C_1 - E(C_1) + \Delta C_1 - C_0 k).
\]

If the new project has risk different from that of the existing projects, then its cost of capital will not equal \(k\). Yet the option payoff treats the opportunity cost of cash invested as \(k\). Let us assume the new project has a cost of capital of \(k'\). Thus, when the options are awarded, the shareholders bear the risk that management will shift the risk of the firm. Such an action can indeed be desirable, as often options are awarded to induce management to take more risks. The cost-of-capital adjustment to the option strike, however, cannot properly reflect the new risk, because the risk is unknown when the option is awarded.

One solution to the problem is for the option contract to stipulate the risk that management can take. This solution would, however, force management to reject positive-NPV projects from restricted risk classes. A better solution is that the option be granted such that if there is a subsequent change in risk, the strike is adjusted accordingly. Let \(k'\) be the adjusted cost-of-capital, which is given as follows:

\[
k^* = \left( \frac{1}{S_0} \right) \left( E(C_1) + C_0 k' \right).
\]

Then the option payoff will be:

\[
\text{Max}(0, C_1 + \Delta C_1 - X) = \text{Max}(0, C_1 + \Delta C_1 - S_0 k^*)
\]

\[
= \text{Max}(0, C_1 + \Delta C_1 - S_0 (1 / S_0) (E(C_1) + C_0 k'))
\]

\[
= \text{Max}(0, C_1 + \Delta C_1 - (E(C_1) + C_0 k'))
\]

\[
= \text{Max}(0, C_1 - E(C_1) + \Delta C_1 - C_0 k').
\]

Here we see that the proper cost of capital is applied to the capital investment of \(C_0\). Management and the shareholders still benefit if the project in place and the new project exceed expectations.

For a standard option, risk shifting is an even greater problem. The payoff of the standard option is

\[
\text{Max}(0, C_1 - E(C_1) / k + \Delta C_1 - C_0),
\]

\(^{14}\) Recall that the first source of uncertainty is whether management will find a positive-NPV project. The second source of uncertainty is the cash flows from existing and new projects.
which means that there is no adjustment whatsoever for the cost of capital on the investment of \( C_0 \). Except for the rare case of the new project having an extremely low cost of capital, the cost-of-capital indexed option would be better, even if it were not adjusted to reflect the new cost of capital. But, of course, an adjustment for the different risk of the new project vis-à-vis the old is appropriate.

Because options are awarded to incentivize management, risk-shifting would not be unusual. Indeed we noted earlier that options are oftentimes used to induce management to take more risk. What we have seen from this model, however, is that not knowing the risk that management will take is another element of uncertainty. In standard financial theory, this risk poses no problem. As long as management uses the appropriate hurdle rate, a positive-NPV project creates value when investors become informed about the new project. But if management has been granted options to induce it to take on new projects that might have different risks, these options must be designed to either permit an adjustment for the new risk or to contractually stipulate the risk that management can take. The latter will result in underinvestment. The former approach seems feasible and appropriate.\(^{15}\)

Clearly some individual firms will have changes in risk, and these changes would need to be adjusted for in the above manner if this type of option were being used. Our concern, however, is with estimating the incentive and compensation components of option value. We need only assume that there is no net risk shifting across firms.

**E. The Compensation and Incentive Values of Stock**

Suppose that instead of options, the manager is awarded \( \gamma \) shares of stock. If he finds a positive-NPV project, the payoff will be \( \gamma(C_1 + \Delta C_1) \). If he fails to find a positive-NPV project and engages in financial investment, the payoff will be \( \gamma(C_1 + C_0r) \).

Now consider an alternative of granting management deferred compensation of the amount of \( \gamma(C_0r + C_1) \) and \( \gamma \) forward contracts requiring that he buy the stock at \( S_0r \). If he finds a positive-NPV project, the forward contract will pay off \( \gamma(C_1 + \Delta C_1 - S_0r) = \gamma(C_1 + \Delta C_1 - (C_0 + C_1r^1)r) = \gamma(\Delta C_1 - C_0r). \) Combined with the deferred cash payment, management will receive \( \gamma(C_1 + \Delta C_1) \). If he fails to find a positive-NPV project, the forward contract will pay off \( \gamma(C_0r + C_1 - S_0r) = \gamma(C_0r + C_1 - (C_0 + C_1r^1)r) = 0 \), and management will have only the deferred compensation of \( \gamma(C_0r + C_1) \). Thus, for both outcomes, the forward contract plus the deferred compensation replicate the stock. This result should not be too surprising inasmuch as forward contracts replicate cash.

\(^{15}\)Management can also shift the risk after the project is in place, in which case the option contract would need to permit an adjustment at that time as well.
generally replicate stock, but the difference here is that the uncertainty lies in whether the executive is able to create value by finding a positive-NPV project. If we add the standard element of uncertainty of cash flows, the forward contract should be struck at $S_0k$ to preserve this same quality, and deferred compensation should be $E(C_t) + C_0k$.

Consider the forward contract, a hypothetical instrument albeit rarely if ever granted to executives. As shown above, if the executive is successful in finding a positive-NPV project, the forward contract pays off $\gamma(\Delta C_1 - C_0r)$. If the executive is unable to find a positive-NPV project, the forward contract pays nothing. Thus, the forward contract is a pure incentive contract. Any positive payoff is determined completely by the NPV of the new project. If management fails to find a positive-NPV project, it does not benefit. Thus, the value of stock granted consists of a pure incentive contract valued at zero at the start and deferred compensation equal to the value of the stock. Consequently, it is not possible to break its value into these components at the start. Under cash flow certainty, during the life of the contract, the value of the incentive component will clearly be positive if a positive-NPV project has been found and zero otherwise.

Under cash flow uncertainty, however, the analysis of stock changes considerably. If we assume that shareholder expectations are not revised through time, then the incentive value of stock is positive if a positive-NPV project is found and zero otherwise. If we allow expectations to be revised, then it is possible that the incentive value can become negative.

The interpretation of a stock grant as consisting of deferred compensation and a zero-value forward contract that represents a pure incentive arrangement holds great promise for shedding new light on various issues in equity compensation. In addition, the potential that the incentive value of stock can turn negative over time raises important questions about the interpretation of equity-based incentives. These issues are important but require much greater attention than can be given within this paper. Therefore, we limit our focus to options and defer stock-related issues to a separate study.

IV. Empirical Estimates

We have demonstrated that if at-the-money options are awarded as incentives, management will benefit from cash flows in place before the options are awarded. Thus, traditional options reward management for actions taken before the options are granted. If the options were indexed to the cost of capital, however, management would benefit only when shareholders benefit. These cost-of-capital-adjusted options are virtually non-
existent, but the ability to model such an option by merely changing the exercise price offers an interesting empirical opportunity. Existing options, issued at-the-money, clearly have both compensation and incentive value. By re-valuing such options with the exercise price adjusted by the cost of capital, we obtain values that these options would have if they were strictly incentives. The difference between the value of an original-issue at-the-money option and its value if its exercise price were indexed to the cost of capital would be the compensation component of the option’s value.

To examine this issue, we select a sample of firms, estimate their costs of capital, collect information about the stock options of their top executives, and estimate the values of the options with their strikes adjusted by the cost of capital. To determine if our model is reasonable, we first test two predictions that are implied by our previous results.

We showed that executives can benefit from at-the-money options by choosing financial investment, or hoarding cash, over paying dividends. As noted earlier, empirical evidence elsewhere is consistent with the notion that options create an aversion to dividends and, hence, a preference for holding cash. Therefore, one implication of our model is that the difference in value between a cost-of-capital indexed option and an original-issue at-the-money option should be related to the firm’s cash position. In other words, the compensation component of option value should be related to the firm’s cash. We also saw earlier that executives can benefit from investments that destroy shareholder value. Although we showed that negative-NPV projects are inferior to financial investment and dividends for executives, there is no assurance that executives would not waste corporate resources investing in such projects. Indeed empire building, private benefits, and entrenchment are strong motivators for accepting such projects. When coupled with the potential that stock options can pay off for projects that reduce shareholder wealth, executives may well engage in wasteful investment, or as it is termed, overinvestment. Therefore, the difference in value between a cost-of-capital indexed option and an original-issue at-the-money option, the compensation value of the option, should be related to a measure of overinvestment.

A. Data and Methodology

We use all non-financial firms with the required data available in Compustat, CRSP, and the ExecuComp data bases. ExecuComp provides annual data from 1992-2005 on the compensation and options of the top five executives. Each observation is a

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single grant to a specific executive. Table 3 provides summary statistics. The first line refers to grant size using the Black-Scholes-Merton model on an individual-grant basis, while the second is for all grants of a firm. The median grant value is about $2.7 million. The median number of options awarded is about 235,000, suggesting an option value of $11.62. The median grant size per firm is about $3 million.

We want to relate the compensation value of options to certain firm-specific characteristics such as free cash flow, overinvestment, and certain other variables. Consequently, multiple grants of a given executive in a given year and grants of other executives of the same firm in a given year will have the same firm-specific variable measures. Therefore, we estimate the compensation value of a given option grant at the grant-executive-year level and then pool the results across all executives of a given firm in a given year. We then estimate the cost of capital for each firm following a procedure used by Vassalou and Xing (2004), and similarly by Hillegeist et al (2004) and Bharath and Shumway (2004), which is based on an application of the Merton (1974) model of corporate debt and equity as options. We then revalue the outstanding options using the Black-Scholes-Merton model with the exercise price increased by the cost of capital. This option value represents the value of the option if it were strictly an incentive. The value with the actual exercise price is the value that includes both the compensation and incentive components.

B. Estimating the Cost of Capital

Following Merton (1974), we treat the equity as a call option on the assets with value

\[ V_E = V_A N(d_1) - B e^{-rT} N(d_2) \]

\[ d_1 = \frac{\ln \left( \frac{V_A}{B} \right) + \left( r + 0.5 \times \sigma_A^2 \right) T}{\sigma_A \sqrt{T}}, \quad d_2 = d_1 - \sigma_A \sqrt{T}, \]

where \( V_E \) is the market value of equity, \( B \) is the face value of debt, \( V_A \) is the market value of the assets, \( r \) is the risk-free rate, \( T \) is the maturity of the debt, and \( \sigma_A \) is the volatility of the assets. The procedure used by Vassalou and Xing and others starts with the assumption that the debt maturity is one year. The face value of the debt is the debt due within one year plus one-half of the long-term debt, and the risk-free rate is the one-month Treasury bill rate. We take an estimate of the volatility of the market value of the stock from the previous year as a starting point for estimating \( \sigma_A \). We then estimate the value of the assets, \( V_A \), in the above equation. This procedure is repeated for every trading day of the previous year, which generates a series of values of the
assets, from which we can then estimate a volatility of the assets. We then insert this figure into the formula as the next estimate of $\sigma_A$ and repeat the procedure until the difference in consecutive estimates is less than 0.0001. Then, the mean return of the daily series of market values of the assets provides an estimate of the expected rate of return, which is our proxy for the cost of capital.

C. Free Cash Flow, Overinvestment, and Compensation Value

We estimate free cash flow and overinvestment using a procedure developed by Richardson (2006). First we estimate total investment as the sum of capital expenditures, acquisition, and research and development, less the sale of property, plant, and equipment. This figure can be decomposed into maintenance and new investment, the former of which is available on COMPUSTAT. New investment can then be decomposed into expected new investment and unexpected new investment, the latter of which is the proxy for overinvestment. We then regress total investment on the previous year’s measure of growth opportunities, leverage, cash, age of the firm, total assets, the previous year’s stock return, and the previous year’s new investment. We also incorporate two dummy variables, one that reflects each of the years 1992-2005 and one that captures the two-digit SIC industry code. Growth opportunities are measured as the value of assets in place relative to market value of equity. Total investment and cash are scaled by total assets. The value of assets in place is estimated following a procedure used by Richardson. The fitted total investment is the expected investment, and the residual is the unexpected investment, with a positive residual indicative of overinvestment. To estimate free cash flow, we need cash flow from assets in place, which is the sum of operating cash flows and research and development less maintenance expenditures and is scaled by total assets. Free cash flow is then the cash flow from assets in place net of expected new investment.

First we replicate the Richardson results. We test three versions of the model, each of which contains the same metric variables but differ with respect to year and industry dummies. Model I contains neither dummy, model II contains an industry dummy but not a year dummy, and Model III contains both dummies. The results are not notably different across models. Size is not significant when both dummy variables are used, is significant at the 5% level when only an industry dummy is used, and is not significant when neither dummy is used. R²s vary from only from 32.2% to 34.4%, figures that are similar to Richardson’s. Model III, which includes year and industry dummies, is most consistent with Richardson’s results. Hence, we use that model to
estimate expected new investment for the purpose of estimating unexpected new investment, or overinvestment.

D. Empirical Results

As noted, we measure the difference in option value using the standard option exercise price and the cost-of-capital indexed exercise price. This difference represents the compensation value of newly-issued options. We obtain option values using ExecuComp’s estimates of the risk-free rate, and we assume the option maturity is 10 years.17

If the model is valid, we should find a positive and significant relationship between free cash flow and the compensation component. Therefore, we regress free cash flow on the compensation component (scaled by market value of equity) and other firm-specific variables as noted above and year and industry dummies. The results are shown in Table 4. When all observations are used, we obtain an $R^2$ of about 16%, and the compensation component of option value is positively related to free cash flow and significant at the 5% level. When we use only those cases in which the firm has positive free cash flow, we obtain a lower $R^2$, about 9%, but the compensation component is significant at the 1% level. Thus, the compensation component of option value does appear to be positively and significantly related to free cash flow, as our model predicts, and this result is, not surprisingly, stronger when free cash flow is positive.

We now examine the relationship between the compensation component and overinvestment. Recall that, following Richardson (2006), we estimate overinvestment as the positive residual from a regression of investment on the variables previously discussed. Hence, we do not need to incorporate these variables again into the regression to explain overinvestment. We start by estimating unexpected investment and then we examine those cases of only positive unexpected investment, which defines overinvestment. Thus, we regress unexpected investment on the compensation component (scaled by market value of equity) and free cash flow. Free cash flow (FCF) is captured with two dummy variables. The first is FCF when FCF > 0 and zero otherwise. The second is FCF when FCF < 0 and zero otherwise. Splitting the variable in this manner allows us to capture an asymmetric response of overinvestment to free cash flow. Table 5 shows the results. In Model I, in which unexpected investment can

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17 Some models of executive stock option valuation assume a maturity of less than 10 years, based on the expectation of early exercise. We do not address the early exercise problem empirically because we cannot assume the same early exercise for cost-of-capital indexed options as for standard options. The former have higher exercise prices and would, therefore, almost surely be exercised later. Because our objective is to estimate a relative value, the component of option value represented by compensation, we believe that component would not differ substantially in the presence of early exercise.
be positive or negative, the $R^2$ is 4.1% and compensation variable is not significant. In Model II in which only positive unexpected investment, or overinvestment, is used, compensation value is positive and significant at the 5% level, as the model predicts, and the $R^2$ is 8.8%.$^{18}$

Thus, the empirical results confirm the principal theoretical propositions from the model.$^{19}$ The compensation values of options are positively and significantly related to free cash flow and overinvestment. These findings provide confidence that other predictions of the model are reasonable. We now look at the principle result of our interest, the value of the compensation component itself.

Table 6 contains our estimates of the value of the compensation component (COMPVAL) expressed as a percentage of various measures of interest. We express compensation value relative to salary (SAL), salary plus bonus (SPB), and total pay (TOTPAY) defined as salary, bonus, restricted stock, option value, long-term incentive payouts, and any other pay. We then refine total pay into two categories of compensation pay only. The first, TOTCOMP1, excludes the incentive value from the value of options paid and should, therefore, reflect pure compensation. TOTCOMP2 is TOTCOMP1 minus restricted stock, which can also have incentive elements. Finally, we relate compensation value to the total option value, OPTVAL, to identify the percentage of option value that is compensation.

The mean (median) option value is about 154% (55.1%) of salary, 88.6% (33.6%) of salary plus bonus, 21.7% (13.9%) of total pay, 27% (20.8%) of total compensation, 28.4% (22.1%) of total compensation less restricted stock, and 53.2% (48.5%) of total option value. The results we are most interested in are that median compensation value is about 48% of total option value. Thus, the median breakdown between compensation and incentives is close to fifty-fifty. We also find that the compensation component of option value represents a median of about 22% of total pay and about 21% of total compensation.

Figure 3 shows the year-by-year percentages. The two lines representing option compensation relative to total compensation and total pay move in almost perfect sync.

$^{18}$We also estimated the tests in Tables 4 and 5 with a simpler and naïve definition of unexpected investment, specifically that investment in year $t$ is total assets in year $t - 1$ times the ratio of investment in year $t - 1$ to assets in year $t - 2$. These results confirm our previous findings. Compensation value relative to market value is positively related to free cash flow and overinvestment.

$^{19}$It might appear that we have an endogeneity problem in that the compensation component might drive overinvestment and free cash flow rather than the other way around. We conduct Durbin-Wu-Hausman tests to examine the potential for this problem and find no evidence that the problem exists. Hence, it seems reasonable to interpret that the compensation component is associated with higher overinvestment and free cash flow. We have no reason to require that causality be identified.
They indicate the extent to which options are used as a part of the compensation and pay packages. We see a steady increase from 1992 to 2002, but a sharp decrease in 2002, which might have resulted from the scandals of Enron and other companies. Option compensation has, however, recovered and through 2005 continues to make up around 20% of the total compensation and 18% of the total pay packages. The heavy line representing option compensation relative to option value has fluctuated dramatically over the years, representing more than 80% in 1995 and as little as 8% in 2002. Holding moneyness and maturity constant, it is simple to demonstrate numerically that option compensation relative to option value will increase when volatility is lower and the cost of capital is higher. Thus, the variation in this ratio is a reflection of changes in volatility and cost of capital.

We now take a look at how option compensation is related to characteristics of a firm. Whether compensation value is high or low is a function of two factors: the extent to which a firm uses options and the relative component of option value that is represented by compensation, which is the variable we are estimating. In Table 7 we examine how firm characteristics explain option compensation value in relation to total pay and total compensation. Most of these variables are fairly standard firm-specific measures such as growth, size, age, cash, capital expenditures, leverage, and beta, as well as year and industry dummy variables. We also introduce volatility and cost of capital into the regression, which are variables that we showed earlier clearly affect the value of COMPVAL. The results using TOTCOMP1 and TOTCOMP2 are nearly identical so we report only the former.

We obtain R²'s close to 50%. Based on the significance of variables, we find that options are more widely used as compensation for larger but younger firms with high growth, high levels of cash, high levels of capital expenditures, lower volatility, and higher costs of capital. These characteristics are common for many highly successful and rapidly growing firms in the technology industry. Volatility and cost of capital, in particular, are clearly very important variables, without which the R²'s are only about 15%, but of course, these variables are important determinants of the option compensation measure. Thus, these types of firms are more prone to use options as compensation, while firms with the opposite characteristics will use options to a lesser degree as compensation.  

It might appear that we should examine the relationship between COMPVAL/OPTVAL and firm-specific variables. When we do so and include only firm-specific variables other than volatility and cost of capital, we obtain R²'s of only around 15%. When we add volatility and cost of capital, the R²’s increase to over 75%. Eliminating the firm-specific variables leaves the R²’s barely unchanged. Hence, virtually all of the variation in COMPVAL/OPTVAL is explained...
V. Conclusions

In this paper we derive a methodology for estimating estimate the component of the value of an executive stock option represented by compensation, the remainder of which is the component representing incentives. We do this by defining compensation as payment for performance achieved before the options were awarded, with incentives defined as payment for future performance. We show that traditional options, issued at-the-money, contain elements of both but that the compensation component can be isolated by indexing the exercise price to the cost-of-capital. By so doing, management benefits if and only if it creates value after the options are awarded, in which case the option conforms to the notion of a pure incentive device.

There has, of course, been extensive debate over the proper way to value executive stock options. The proposed models are diverse and range from extremely simple to relatively complex. On this issue, we take an agnostic position. Regardless of which model is appropriate, it is simple to revalue the options with the exercise price adjusted by the cost of capital. The resulting value is the incentive component. The full option value taken by using the original-issue at-the-money exercise price contains both the incentive and compensation components. With these components isolated, an important issue can now be addressed in a more informed manner.

One of the controversies in accounting has been the expensing of these options. The corporate world has opposed expensing and claimed that the values obtained by the various models overstate the values of the options and, therefore, overstate expenses. The primary basis for that position is the lack of liquidity of these options. As we show here, even if liquidity were not the issue, about half of option value represents compensation. Given that accounting is based on historical performance, perhaps it is the case that expensing stock options at full value, which includes incentive value, does give a biased view of the true expense. But regardless of accounting issues, it is important to recognize that stock options serve a dual purpose and to be aware of how much of their value derives from one purpose and how much from the other.

In addition, this research has identified a new measure of the incentive value of options. Previous research has focused on the option delta. By quantifying incentive in the forms of a value that can be expressed relative to various measures such as total compensation and total option value, new research could reveal greater insights.

\footnote{by its negative relationship with volatility and positive relationship with the cost of capital. But this result is tautological. As shown earlier, there are clear and direct mathematical relationships between COMPVAL/OPTVAL and volatility and cost of capital. Hence, the assessment of how firm-specific variables affect this relationship merely introduces variables that explain volatility and cost of capital.}
Table 1. Managerial and Shareholder Benefits from Alternative Uses of Cash

γ is the number of options awarded, \( C_0 \) is the cash flow at time 0, \( C_1 \) is the cash flow at time 1 from existing projects, \( \Delta C_1 \) is the cash flow at time 1 from the new project, and \( r \) is the cost of capital. The benefits are computed as the gain in value to the respective party less any cost or cash paid out.

<table>
<thead>
<tr>
<th></th>
<th>To Management</th>
<th>To Shareholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital investment</td>
<td>( \gamma (C_1 - C_1 r^{-1} - C_0 + \Delta C_1) )</td>
<td>( (1 - \gamma)C_1 + \gamma C_1 r^{-1} + \gamma C_0 + (1 - \gamma)\Delta C_1 )</td>
</tr>
<tr>
<td>Dividend</td>
<td>( \gamma (C_1 - C_1 r^{-1} - C_0) )</td>
<td>( (1 - \gamma)C_1 + \gamma C_1 r^{-1} + C_0 r + \gamma C_0 )</td>
</tr>
<tr>
<td>Strike-adjusted</td>
<td>( \gamma (C_1 - C_1 r^{-1}) )</td>
<td>( (1 - \gamma)C_1 + \gamma C_1 r^{-1} + C_0 r )</td>
</tr>
<tr>
<td>dividend</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share repurchase</td>
<td>( \gamma (C_1 - C_1 r^{-1} - C_0 + C_0 r) )</td>
<td>( (1 - \gamma)C_1 + \gamma C_1 r^{-1} + \gamma C_0 + (1 - \gamma)C_0 r )</td>
</tr>
<tr>
<td>Financial</td>
<td>( \gamma (C_1 - C_1 r^{-1} - C_0 + C_0 r) )</td>
<td>( (1 - \gamma)C_1 + \gamma C_1 r^{-1} + \gamma C_0 + (1 - \gamma)C_0 r )</td>
</tr>
<tr>
<td>investment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2. Order of Preference of Management and Shareholders for Each Use of Funds When Stock Options are Awarded

$\gamma$ is the number of options awarded, $C_0$ is the cash flow at time 0, $C_1$ is the cash flow at time 1 from existing projects, $\Delta C_1$ is the cash flow at time 1 from the new project, and $r$ is the cost of capital. CI is capital investment, FI is financial investment, which is investing in a zero-NPV project or correctly priced securities or assets, SR is share repurchased, D is dividends, and DSA is dividends with the strike reduced by the amount of the dividend.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Order of Preference for Management</th>
<th>Order of Preference for Shareholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. $C_0 &lt; \Delta C_1 r^1$</td>
<td>CI $\succ$ FI $\sim$ SR $\succ$ DSA $\succ$ D</td>
<td>CI $\succ$ D $\succ$ DSA $\succ$ SR $\sim$ FI</td>
</tr>
<tr>
<td>(i) $(1 - \gamma)\Delta C_1 &gt; C_0 r$</td>
<td></td>
<td>CI $\succ$ D $\succ$ DSA $\succ$ SR $\sim$ FI</td>
</tr>
<tr>
<td>(ii) $C_0 r - \gamma C_0 &lt; (1 - \gamma)\Delta C_1 &lt; C_0 r$</td>
<td></td>
<td>D $\succ$ CI $\succ$ DSA $\succ$ SR $\sim$ FI</td>
</tr>
<tr>
<td>(iii) $C_0 r - \gamma C_0 &gt; (1 - \gamma)\Delta C_1$</td>
<td></td>
<td>D $\succ$ DSA $\succ$ CI $\succ$ SR $\sim$ FI</td>
</tr>
<tr>
<td>B. $C_0 &gt; \Delta C_1$</td>
<td>FI $\sim$ SR $\succ$ DSA $\succ$ CI $\succ$ D</td>
<td>D $\succ$ DSA $\succ$ SR $\sim$ FI $\succ$ CI</td>
</tr>
<tr>
<td>C. $C_0 = \Delta C_1$</td>
<td>FI $\sim$ SR $\succ$ DSA $\sim$ CI $\succ$ D</td>
<td>D $\succ$ DSA $\succ$ SR $\sim$ FI $\succ$ CI</td>
</tr>
<tr>
<td>D. $\Delta C_1 r^1 &lt; C_0 &lt; \Delta C_1$</td>
<td>FI $\sim$ SR $\succ$ CI $\succ$ DSA $\succ$ D</td>
<td>D $\succ$ DSA $\succ$ SR $\sim$ FI $\succ$ CI</td>
</tr>
<tr>
<td>E. $C_0 = \Delta C_1 r^1$</td>
<td>FI $\sim$ SR $\sim$ CI $\sim$ DSA $\succ$ D</td>
<td>D $\succ$ DSA $\sim$ SR $\sim$ FI $\sim$ CI</td>
</tr>
<tr>
<td>F. $\Delta C_1 = 0$</td>
<td>FI $\sim$ SR $\succ$ DSA $\succ$ D $\sim$ CI</td>
<td>D $\succ$ DSA $\succ$ SR $\sim$ FI $\succ$ CI</td>
</tr>
<tr>
<td>G. $\Delta C_1 &lt; 0$</td>
<td>FI $\sim$ SR $\succ$ DSA $\succ$ D $\succ$ CI</td>
<td>D $\succ$ DSA $\succ$ SR $\sim$ FI $\succ$ CI</td>
</tr>
</tbody>
</table>
Table 3. Summary Statistics

Grant size is the aggregate value of all options granted to the top executives of a firm within one year. These options are valued by using S&P’s Black Scholes methodology or the company. The number of options is the total stock options granted to top executives of a firm within one year. The volatility is the stock return volatility in ExecuComp, which is calculated over previous 60 months. Moneyness is calculated by using (exercise price-current stock price)/current stock price and the value of zero means at-the-money, positive means in-the-money, and negative means out-of-the-money. Maturity is the number of years between the source date in ExecuComp and the expiration date. The data range is from 1992 to 2005 and there are 4,687 firm-years.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Median</th>
<th>Std. Dev.</th>
<th>P(10th)</th>
<th>P(90th)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grant size ($000)</td>
<td>9,753.55</td>
<td>2,733.06</td>
<td>31,895.92</td>
<td>424.38</td>
<td>19,079.48</td>
</tr>
<tr>
<td>Grant size - firm ($000)</td>
<td>11,794.92</td>
<td>3,031.09</td>
<td>112,100.6</td>
<td>479.53</td>
<td>20,951.87</td>
</tr>
<tr>
<td>Number of options (000)</td>
<td>476.21</td>
<td>235</td>
<td>882.81</td>
<td>50</td>
<td>1,045</td>
</tr>
<tr>
<td>Volatility</td>
<td>0.4847</td>
<td>0.431</td>
<td>0.2509</td>
<td>0.244</td>
<td>0.785</td>
</tr>
<tr>
<td>Moneyness</td>
<td>0.0038</td>
<td>0</td>
<td>0.0719</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Maturity (years)</td>
<td>8.55</td>
<td>8.92</td>
<td>2.22</td>
<td>5.83</td>
<td>9.67</td>
</tr>
</tbody>
</table>
### Table 4. Regression of Free Cash Flow on the Compensation Component of Option Value

The dependent variable is free cash flow. The data range is from 1992 to 2005 and all sample firms have data available in CRSP, Compustat, and ExecuComp databases. COMPVAL is the difference of option value between traditional and cost-of-capital indexed option multiplied by the number of options granted. MV is the beginning balance of the market value of total equity. INVNew is the total new investment, CF_{AIP} is the cash flow generated from assets in place, and CASH is the balance of cash and short term investment. V/P is the measure of growth opportunities, which is the ratio of the value of assets in place to the market value of equity. LEV is the ratio of book value of short- and long-term debt to total assets, AGE is the log of the number of years the firm has been listed in CRSP, SIZE is the log of total assets, and SR is the annual stock return defined as the log of the ratio of current market value of equity to its value of the previous year. TA is the book value of total assets in millions. INV_{New}, CF_{AIP}, and CASH are scaled by total assets. Year dummies reflect each of the years 1992-2005, and the industry dummies capture two-digit SIC codes. There are 4,687 firm-years in the final sample and 2,536 firm-years with positive free cash flow, FCF>0. The numbers in parentheses are t-statistics based on heteroskedasticity-consistent standard errors. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model I</th>
<th>Model II</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPVAL/MV</td>
<td>0.481</td>
<td>0.553</td>
</tr>
<tr>
<td></td>
<td>(2.26)**</td>
<td>(2.80)***</td>
</tr>
<tr>
<td>V/P_{t-1}</td>
<td>0.018</td>
<td>-0.015</td>
</tr>
<tr>
<td></td>
<td>(2.41)**</td>
<td>(-3.84)***</td>
</tr>
<tr>
<td>LEV_{t-1}</td>
<td>-0.079</td>
<td>0.009</td>
</tr>
<tr>
<td></td>
<td>(-4.40)***</td>
<td>(0.55)</td>
</tr>
<tr>
<td>CASH_{t-1}</td>
<td>-0.113</td>
<td>0.032</td>
</tr>
<tr>
<td></td>
<td>(-9.19)***</td>
<td>(2.39)***</td>
</tr>
<tr>
<td>AGE_{t-1}</td>
<td>0.002</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
<td>(0.92)</td>
<td>(-0.46)</td>
</tr>
<tr>
<td>SIZE_{t-1}</td>
<td>0.009</td>
<td>-0.002</td>
</tr>
<tr>
<td></td>
<td>(6.82)***</td>
<td>(-2.09)***</td>
</tr>
<tr>
<td>SR_{t-1}</td>
<td>0.013</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>(2.91)***</td>
<td>(1.47)*</td>
</tr>
<tr>
<td>INV_{New,t-1}</td>
<td>-0.170</td>
<td>0.054</td>
</tr>
<tr>
<td></td>
<td>(-7.69)***</td>
<td>(2.37)***</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.032</td>
<td>0.069</td>
</tr>
<tr>
<td></td>
<td>(-2.24)**</td>
<td>(7.61)***</td>
</tr>
<tr>
<td>Adjusted R^{2}</td>
<td>0.159</td>
<td>0.089</td>
</tr>
</tbody>
</table>
Table 5. Regression of Unexpected Investment on the Compensation Component of Option Value

The dependent variable is overinvestment. The data range is from 1992 to 2005 and all sample firms have data available in CRSP, Compustat, and ExecuComp databases. COMPVAL is the difference of option value between traditional and cost-of-capital indexed option multiplied by the number of options granted. MV is the market value of equity at the end of the previous year. FCF>0 is free cash flow when it is positive and zero otherwise. FCF<0 is free cash flow when it is negative and zero otherwise. Year dummies reflect each of the years 1992-2005, and the industry dummies capture two-digit SIC codes. There are 4,687 firm-years in the final sample and 1928 firm-years with positive overinvestment. The numbers in parentheses are t-statistics based on heteroskedasticity-consistent standard errors. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model I</th>
<th>Model II Unexpected Investment &gt;0 (Overinvestment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPVAL/MV</td>
<td>0.161 (0.91)</td>
<td>0.783 (2.13)**</td>
</tr>
<tr>
<td>FCF&gt;0</td>
<td>0.249 (5.24)**</td>
<td>0.173 (2.78)**</td>
</tr>
<tr>
<td>FCF&lt;0</td>
<td>0.090 (1.88)*</td>
<td>-0.175 (-2.13)**</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.007 (-1.26)</td>
<td>0.028 (3.51)**</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.041</td>
<td>0.088</td>
</tr>
</tbody>
</table>
Table 6. Difference in Value between At-the-Money Options and Cost-of-Capital Options

COMPVAL is the difference of option value between traditional and cost-of-capital indexed option multiplied by the number of options granted. We measure the percentage of difference with respect to different valuables. SAL is the dollar value of the base salary, SPB is the dollar value of the base salary plus bonus, and TOTPAY is the total compensation including base salary, bonus, restricted stock, Black-Scholes-Merton value of stock options, long-term incentive payouts, and all other total. TOTCOMP1 is TOTPAY – Black-Scholes-Merton value of stock options + COMPVAL. TOTCOMP2 is TOTCOMP1 – restricted stock. OPTVAL is the stock options valued using S&P’s Black-Scholes-Merton methodology.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Median</th>
<th>Std. Dev.</th>
<th>P(10th)</th>
<th>P(90th)</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPVAL/SAL</td>
<td>1.5397</td>
<td>0.5508</td>
<td>5.1436</td>
<td>0.0694</td>
<td>3.2755</td>
</tr>
<tr>
<td>COMPVAL/SPB</td>
<td>0.8866</td>
<td>0.3364</td>
<td>2.4402</td>
<td>0.0476</td>
<td>1.9369</td>
</tr>
<tr>
<td>COMPVAL/TOTPAY</td>
<td>0.2166</td>
<td>0.1388</td>
<td>0.2171</td>
<td>0.0208</td>
<td>0.5258</td>
</tr>
<tr>
<td>COMPVAL/TOTCOMP1</td>
<td>0.2704</td>
<td>0.2079</td>
<td>0.2228</td>
<td>0.0370</td>
<td>0.6141</td>
</tr>
<tr>
<td>COMPVAL/TOTCOMP2</td>
<td>0.2837</td>
<td>0.2213</td>
<td>0.2255</td>
<td>0.0416</td>
<td>0.6330</td>
</tr>
<tr>
<td>COMPVAL/OPTVAL</td>
<td>0.5323</td>
<td>0.4847</td>
<td>0.3669</td>
<td>0.0620</td>
<td>0.9995</td>
</tr>
</tbody>
</table>
Table 7. Regression Analysis of the Relationship between the Compensation Component of Option Value and Firm-Specific Characteristics

The dependent variable is option value difference relative to different variables. The data range is from 1992 to 2005 and all sample firms have data available in CRSP, Compustat, and ExecuComp databases. COMPVAL is the difference of option value between traditional and cost-of-capital indexed option multiplied by the number of options granted. TOTPAY is the total compensation including base salary, bonus, restricted stock, Black-Scholes-Merton value of stock options, long-term incentive payouts, and all other total. TOTCOMP1 is TOTPAY – Black-Schoels-Merton value of stock options + COMPVAL. V/P is the measure of growth opportunities, which is the ratio of the value of assets in place to the market value of equity. SIZE is the log of total assets and CASH is the balance of cash and short term investment. CAPEXP is the capital expenditure, R&D is the expense of research and development, LEV is the ratio of book value of short- and long-term debt to total assets, AGE is the log of the number of years the firm has been listed in CRSP, BETA is the historical beta estimated by using previous sixty monthly returns, and VOL is the stock return volatility in ExecuComp. CASH, CAPEXP, and R&D are scaled by total assets. Cost of Capital is the cost of capital estimate for each firm. Year dummies reflect each of the years 1992-2005, and the industry dummies capture two-digit SIC codes. There are 4,687 firm-years in the final sample. The numbers in parentheses reflect each of the years 1992-2005, and the industry dummies capture two-digit SIC codes. There are 4,687 firm-years in the final sample. The numbers in parentheses are t-statistics based on heteroskedasticity-consistent standard errors. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

<table>
<thead>
<tr>
<th>Variable</th>
<th>COMPVAL/TOTPAY</th>
<th>COMPVAL/TOTCOMP1</th>
</tr>
</thead>
<tbody>
<tr>
<td>V/P_{t-1}</td>
<td>-0.0542</td>
<td>-0.0861</td>
</tr>
<tr>
<td>SIZE_{t-1}</td>
<td>0.0111</td>
<td>0.0211</td>
</tr>
<tr>
<td>CASH_{t-1}</td>
<td>0.1198</td>
<td>0.1559</td>
</tr>
<tr>
<td>CAPEXP_{t-1}</td>
<td>0.1048</td>
<td>0.1853</td>
</tr>
<tr>
<td>R&amp;D_{t-1}</td>
<td>-0.0851</td>
<td>-0.0319</td>
</tr>
<tr>
<td>LEV_{t-1}</td>
<td>-0.0100</td>
<td>-0.0259</td>
</tr>
<tr>
<td>AGE_{t-1}</td>
<td>-0.0165</td>
<td>-0.0263</td>
</tr>
<tr>
<td>BETA_{t-1}</td>
<td>0.0043</td>
<td>0.0030</td>
</tr>
<tr>
<td>VOL_{t-1}</td>
<td>-0.2583</td>
<td>-0.1934</td>
</tr>
<tr>
<td>Cost of Capital</td>
<td>0.5911</td>
<td>0.5373</td>
</tr>
<tr>
<td>Constant</td>
<td>0.1291</td>
<td>0.1269</td>
</tr>
<tr>
<td>Adjusted R^2</td>
<td>0.497</td>
<td>0.457</td>
</tr>
</tbody>
</table>
Figure 1. Management and Shareholders’ Decision Rule

This figure illustrates the relationship between NPV and the cash flow in place, \( C_1 \). It shows that when cash flow in place is sufficiently large, management can benefit from negative-NPV projects as well as from positive-NPV projects.

\[
S_0 = 0 \\
-rC_n \\
-C_nRr^{-1} \\
\]
Figure 2. The Relationship Between the Compensation Component of Option Value and Moneyness and Time to Expiration (Panel A), Volatility (Panel B), and Cost of Capital (C)

This example assumes an original-issue at-the-money option with a stock price of $40, a time to expiration of 10 years, a volatility of 40%, and a risk-free rate of 5%.

(A) Relationship of Compensation Component of Option Value to Moneyness

![Graph showing the relationship between compensation value/option value and moneyness with time to expiration as a parameter.](image)
(Figure 2 continued)

(B) Relationship of Compensation Component of Option Value to Volatility
(Figure 2 continued)

(C) Relationship of Compensation Component of Option Value to Cost of Capital

[Diagram showing the relationship between Compensation Value/Option Value and Cost of Capital]
Figure 3. Year-by-Year Median Compensation Component of Option Value Relative to Total Pay and Option Value

COMPVAL is the difference in option value between traditional at-the-money and cost-of-capital indexed options multiplied by the number of options granted and represents the compensation value of the option. TOTPAY is includes base salary, bonus, restricted stock, Black-Scholes-Merton value of stock options, long-term incentive payouts, and all other total. TOTCOMP1 is TOTPAY – Black-Scholes-Merton value of stock options + COMPVAL. OPTVAL is the value of the stock options using S&P’s Black-Scholes-Merton methodology.
Appendix: Proofs of Propositions and Other Results

Proof of Proposition 1:

A sufficient condition for the options to have value at time 0 is that the option be exercised at time 1 for certain, that is, \( C_1 + \Delta C_1 > S_0 \). If \( NPV \) is positive, we have \( \Delta C_1 r^1 > C_0 \). Since \( S_0 = C_0 + C_1 r^1 \), it follows that

\[
\Delta C_1 r^1 > S_0 - C_1 r^1 \\
\Rightarrow \Delta C_1 r^1 + C_1 r^1 > S_0.
\]

Because the terms on the left-hand side are discounted, clearly their undiscounted values exceed the right-hand side, \( S_0 \). Thus, \( C_1 + \Delta C_1 > S_0 \), so we know that the option will have value if management is successful in finding a positive-\( NPV \) project.

Proof of Proposition 2:

Assuming exercise, the cost of the options is \( \gamma (C_1 + \Delta C_1 - S_0) r^1 \), while net present value is, of course, \( \Delta C_1 r^1 - C_0 \). The condition in which the option cost exceeds the \( NPV \) is

\[
\gamma (C_1 + \Delta C_1 - S_0) r^1 > \Delta C_1 r^1 - C_0 \\
\Rightarrow \gamma (C_1 + \Delta C_1 - S_0) > \Delta C_1 - C_0 r \\
\Rightarrow \gamma > \frac{\Delta C_1 - C_0 r}{C_1 + \Delta C_1 - S_0}.
\]

Since \( \gamma \) is constrained to a value of between 0 and 1, we need only demonstrate that the right-hand side of the inequality is less than 1:

\[
\frac{\Delta C_1 - C_0 r}{C_1 + \Delta C_1 - S_0} < 1 \\
\Rightarrow \Delta C_1 - C_0 r < C_1 + \Delta C_1 - (C_0 + C_1 r^{-1}) \\
\Rightarrow \Delta C_1 - C_0 r < C_1 + \Delta C_1 - C_0 - C_1 r^{-1} \\
\Rightarrow C_0 - C_0 r < C_1 - C_1 r^{-1}.
\]

The left-hand side is clearly negative, while the right-hand side is clearly positive. Thus, the critical ratio is less than 1. So the value of the options can exceed the \( NPV \) if \( \gamma \) exceeds the indicated ratio above, which itself is less than 1. Also, note that the maximum number of options for cost to not exceed \( NPV \) is a function of \( NPV \). Thus, it is not possible for the board to set \( \gamma \) such that the cost is guaranteed to not exceed \( NPV \).

Proof of Proposition 3:

It is a simple matter to rearrange the formula for the value of the options:
The first term in parentheses is clearly positive. The second term can be positive even if the \( NPV \) is negative. In other words, the undiscounted cash flow can exceed the initial outlay, even though the discounted cash flow does not exceed the initial outlay.

**Proof of Proposition 4:**

Proposition 2 stated that the value of the options at expiration is
\[
(C_1 - C_1 r^{-1}) + (\Delta C_1 - C_0) > 0
\]

The payoffs from projects that existed before awarding the options are represented by the \( C_1 \) cash flow. Hence, management receives a portion of these cash flows, even though they would have occurred even had management not been awarded the options.

**Proof of Proposition 7**

For simplicity assume a single share outstanding at the start. The available cash, \( C_0 \), is sufficient to purchase a fraction, \( C_0 / (C_0 + C_1 r^1) \), of the shares. The stock price after repurchase will be \( C_1 r^1 / (1 - (C_0 / (C_0 + C_1 r^1))) = C_0 + C_1 r^1 \), the same price as before the repurchase. The option value is \( (C_1 / (1 - C_0 / (C_0 + C_1 r^1)) - (C_0 + C_1 r^1)) r^1 \) if positive and zero otherwise. With rearrangement of this equation, we find that the option value is positive if \( C_1 - C_1 r^1 > C_0 - C_0 r \). The left-hand side is positive and the right-hand side is negative. Thus, this statement is always true, so options will always have value if the funds are used to repurchase shares.

**The Use of External Debt Financing**

If the firm has an inadequate supply of cash on hand to undertake new projects, it can issue new debt or equity. Let us assume that the firm has no cash on hand and its value is comprised solely of the shareholders’ claim on the future cash, \( C_1 r^1 \). Now let it raise \( D_0 \) in cash by issuing debt with face value of \( D_0 \). The value of the firm with debt financing will then be \( V_0 = D_0 + C_1 r^1 \), and the current stock price will be \( S_0 = V_0 - D_0 = C_1 r^1 \), the same value prior to the new issue of debt. After taking into account the
NPV of the new project with debt financing, the new stock price becomes  
\[ S_0' = \Delta C_1 r^1 + C_1 r^1 - D_0. \]

The payoff of the option with debt financing is  
\[ \text{Max}(0, C_1 + \Delta C_1 - rD_0 - C_1 r^1). \]

This expression is positive if  
\[ (\Delta C_1 - rD_0) + (C_1 - C_1 r^1) > 0. \]

The second term in parentheses is clearly positive. Positive NPV is defined as  
\[ \Delta C_1 r^1 > D_0, \]

which clearly is equivalent to the first condition in parentheses. Thus, the option payoff is positive with positive NPV.

The cost of the options is  
\[ \gamma (C_1 + \Delta C_1 - rD_0 - C_0 r^1) r^1 \]

Below we see that this cost can be higher than the NPV of the new project. First we note that:

\[ \gamma \left( C_1 + \Delta C_1 - rD_0 - C_1 r^1 \right) r^{-1} > \Delta C_1 r^{-1} - D_0 \]

\[ \gamma \left( C_1 + \Delta C_1 - rD_0 - C_1 r^1 \right) > \Delta C_1 - rD_0 \]

\[ \gamma > \frac{\Delta C_1 - rD_0}{C_1 + \Delta C_1 - rD_0 - C_1 r^{-1}}. \]

To show the cost is higher than the NPV, we need only show that the ratio on the right hand side is less than one.

\[ \Delta C_1 - rD_0 < C_1 + \Delta C_1 - rD_0 - C_0 r^{-1} \]

\[ 0 < C_1 - C_1 r^{-1}. \]

With \( r \) positive, the cost of the options can be higher than the NPV of the new project.

We showed that the option payoff is positive if  
\[ (\Delta C_1 - rD_0) + (C_1 - C_1 r^1) > 0. \]

With negative-NPV the first term in parentheses is negative, but it can be outweighed by the second term in parentheses. Note also that managers clearly share in value created by projects in place before the options are awarded.

If there is no positive-NPV project and debt is issued to pay out a dividend, then it will be difficult for managers to obtain a positive option payoff. The option payoff is positive if

\[ C_1 - rD_0 > C_1 r^{-1} \]

\[ C_1 - C_1 r^{-1} > rD_0. \]

It will be difficult to meet this condition. The time value on the firm’s existing cash flow would have to exceed the principal and interest on the debt. When the strike price is adjusted by the dividend payout, it is easier for management to obtain a positive payoff, as shown below:

\[ C_1 - rD_0 > C_1 r^{-1} - D_0 \]

\[ C_1 - C_1 r^{-1} > rD_0 - D_0. \]

This condition is more easily met than in the case of no strike adjustment.
If the manager decides to repurchase some shares by using debt financing, the result will be the same as the dividend payout case without adjustment. With $D_0$, the firm can purchase a fraction $D_0/C_1r^1$, of the shares. The stock price after repurchase will be $[C_1 - rD_0/r^1]/[1 - D_0/C_1r^1] = C_1r^1$, the same price as before the repurchase. The option payoff is $(C_1 - rD_0 - S_0) = (C_1 - rD_0 - C_1r^1)$ if positive and zero otherwise. The expression on the right-hand side is the same as the dividend case without adjustment of the strike price, and, therefore, would be unlikely to be positive.

**The Use of External Equity Financing**

Now let us consider the case that the new project is financed by issuing $\theta_0$ of new equity. The new equity will result in the issue of $\theta_0/S_0$ new shares making the total number of shares be $(\theta_0 + S_0)/S_0$. The stock price remains at $S_0 = C_1r^1$. A positive option payoff is the condition

$$\Delta C_1 + C_1 > \left[\frac{S_0 + \theta_0}{S_0}\right]S_0$$

Multiplying both sides by $(\theta_0 + S_0)/S_0$ and substituting $C_1r^1$ for $S_0$ gives

$$\Delta C_1 + C_1 > \left[\frac{S_0 + \theta_0}{S_0}\right]S_0$$

$$\Delta C_1 - \theta_0 + C_1 - C_1r^1 > 0$$

With positive $NPV$, $\Delta C_1 - \theta_0 > 0$. Thus, positive $NPV$ is sufficient for the option payoff to be positive. It is also apparent from the above equation that the option payoff can be positive with negative $NPV$. For example, it is possible that $\Delta C_1r^1 < \theta_0$ but $\Delta C_1 > \theta_0$, giving a positive option payoff. The cost of the options exceeds $NPV$ if the following condition holds:

$$\gamma \left(\frac{C_1 + \Delta C_1}{(\theta_0 + S_0)/S_0} - S_0\right)r^{-1} > \Delta C_1r^{-1} - \theta_0$$

$$\gamma > \frac{\Delta C_1 - r\theta_0}{C_1 + \Delta C_1 - S_0}$$

Since $\gamma$ can be as large as one, we need only prove that the ratio on the right-hand side can be less than one. Define $\alpha = S_0/(\theta_0 + S_0)$. The proof is as follows.
\[
\frac{\Delta C_i - \theta_0 r}{C_i + \Delta C_i} - \frac{\theta_0 r}{(\theta_0 + S_0)/S_0 - S_0} < 1
\]

\[
\Delta C_i - \theta_0 r < \frac{C_i + \Delta C_i}{(\theta_0 + S_0)/S_0 - S_0}
\]

\[
\Delta C_i - \theta_0 r < (C_i + \Delta C_i)\alpha - C_i r^{-1}
\]

\[
\Delta C_i(1 - \alpha) - \theta_0 r - C_i(\alpha - r^{-1}) < 0
\]

It can be shown that \(\alpha\) can exceed \(r^{-1}\). This result occurs if \(\theta_0/S_0\) is greater than the cost of capital, \(r - 1\). The expression \(\Delta C_i(1 - \alpha) - \theta_0 r\) can be negative, even with positive net present value.\(^{21}\) So the overall expression can be negative, thereby admitting a critical \(\gamma\) of less than 1, which permits cost to exceed net present value. It is apparent that as in the other cases, part of the option’s payoff comes from the projects that the firm had in place before the options were awarded.

The case that the firm uses equity financing to pay out dividends or repurchase shares does not have economic meaning here. Therefore, we do not analyze these cases.

**Capital Investment is less than the Available Cash**

We assume that the firm invests \(\rho C_0\) and has \((1 - \rho)C_0\) available for dividends, share repurchase, or financial investment. The incremental cash flow is \(\Delta C_i\) and the capital investment is \(\rho C_0\).

If the firm pays dividends, the cash flow at time 1 is \(C_1 + \Delta C_i\). We assume the standard contract in which there is no dividend adjustment of the strike. Thus, the option payoff is determined by \(Max(0, C_1 + \Delta C_1 - (C_0 + C_i r^1))\). This value is positive if \(C_1 - C_i r^1 + \Delta C_i - C_0\). We have seen this expression before and clearly the option has value for any positive \(NPV\) project. In addition, we could have \(NPV < 0\) (such as \(\Delta C_i = C_0\)) and the option will still have positive value. In general, \(NPV < 0\) occurs as \(\Delta C_i < \rho C_0\). We can certainly have \(\Delta C_i \geq C_0\) if \(\Delta C_i/C_0 \geq \rho\), which is sufficient but not necessary for managers to gain with negative \(NPV\).

If the firm invests \((1 - \rho)C_0\) in financial investment, the option payoff is determined by \(Max(0, C_1 + \Delta C_1 + (1 - \rho)C_0 r - (C_0 + C_i r^1))\). This value is positive if \(C_1 - C_i r^1 + \Delta C_i + (1 - \rho)C_0 r - C_0 > 0\), which can obviously occur. If \(NPV\) is negative, then let us rewrite this expression as \((C_1 - C_i r^1) + (\Delta C_i - \rho C_0 r) + C_0(r - 1)\). The

\(^{21}\)With positive net present value, \(\Delta C_i - \theta_0 r > 0\), but multiplication of \(\Delta C_i\) by \(1 - \alpha\) can make the whole expression negative.
second term in parentheses represents the negative \( NPV \) but the first and third terms are positive so clearly negative \( NPV \) does not rule out a gain for management.

If the firm invests \((1 - \rho)C_0\) in share repurchase, it buys back \(\frac{(1 - \rho)C_0}{(C_0 + C_1r^1)}\) shares, leaving \(1 - \frac{((1 - \rho)C_0)/(C_0 + C_1r^1)}{\text{shares}}\). The value of the firm at time 1 will be \(C_1 + \Delta C_i\) so the option payoff will be \(\text{Max}(0, \frac{C_1 + \Delta C_i}{(C_1r^1 + \rho C_0)/(C_0 + C_1r^1)}) - (C_0 + C_1r^1)\). This expression is positive with a positive \( NPV \), but it can also be positive with negative \( NPV \).
References


