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## **OPTION VERSUS EQUITY COMPENSATION: THE EFFECT OF INVESTMENT POLICY, DIVIDENDS AND BANKRUPTCY**

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### **KEYWORDS**

Executive compensation, investment policy, dividends and bankruptcy.

### **ABSTRACT**

This study models the sensitivity of option versus equity compensation to changes in a firm's investment risk, dividends and bankruptcy costs. Optimal executive compensation is determined by the Nash equilibrium of a two-player game in which the executive chooses the investment, financing and payout policies of the firm, while the shareholders set compensation policy. The model indicates that firms with higher investment risk and higher costs of bankruptcy will use relatively more equity compensation, while firms paying a higher dividend will use relatively more option compensation.

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## **1. INTRODUCTION**

Equity holders delegate most business decisions, including the investment and payout policies of the firm, to executives, while retaining for themselves control over the compensation of those executives. To motivate executives effectively, equity holders must introduce forms of variable compensation, e.g., equity participation and options. This study examines the use and efficacy of these forms of compensation to motivate executives employed by firms with different features, i.e., different levels of investment risk, optimal dividends and bankruptcy costs.<sup>1</sup> While the literature on executive compensation has burgeoned in recent years, there has been little attention to how compensation varies between different types of firms. Some empirical studies have looked at compensation within specific industries, e.g., utilities (Joskow *et al.*, 1996), banking (Barro and Barro, 1990), pharmaceuticals (Offstein and Gnyawali, 2005), and technology (Makriet *et al.*, 2006), but comparative studies have not been done. This deficiency is particularly egregious from the theoretical perspective, where models of executive compensation have wholly neglected firm differences. This study hopes to rectify this gap. In particular, the model finds that firms with higher investment risk and higher costs of bankruptcy will use relatively more equity compensation, while firms paying a higher dividend will use relatively more option compensation.

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<sup>1</sup> (Schrenk, 2007a) applies this approach to examine how optimal compensation responds to different macroeconomic environments.

## **2. THE MODEL**

The model<sup>2</sup> represents the interaction of two agents: equity holders and executives. Equity holders are well diversified, while executives are risk-averse and receive all of their wealth from their human capital 'invested' in the firm. Executives and equity holders interact within the context of the firm. Executives are delegated control over the investment, financing and payout policies of the firm and set these to maximize the utility of their own compensation. Executives are compensated through two contingent claims: option compensation, a European call upon the value of equity (contingent upon the terminal value of the equity); and, second, equity compensation, a dividend cash flow and a capital gains cash flow. But to model the risk-averse executive, we must further introduce a non-linearity in the form of a utility function with the risk-averse characteristics described below. The value of compensation to the executive is the non-linear, discounted utility of these two contingent claims. Equity holders retain control over the compensation policy. Executives set policies to maximize the utility of their compensation; equity holders set executive compensation to maximize the value of their equity claim.

The approach develops a discrete model using a binomial tree structure to represent the value processes of the firm and the securities valued upon it. Executives, under a given compensation structure, will choose the optimal corporate policies (from a discrete set of possibilities) maximizing their own utility.

The executive-equity holder conflict is modeled as game between these two agents. If executive action were contractible, then equity holders could always reach the first-best value-maximizing solution. Unfortunately this is not possible, so equity holders must make decisions within an incomplete contracts environment. Equity holders do not have the specialized knowledge required to set optimal investment, financing and payout policies, but they do know the utility functions, risk preferences, etc. of executives and can therefore (with certainty) determine how executives will set the policies of the firm given a specific compensation package. Thus, equity holders must select the compensation plan which is the best response to the predictable decisions of executives under a set of exogenous parameters. Optimal compensation is the Nash equilibrium between the compensation policy (set by equity holders) and the investment, financing and payout policies (set by executives).

### **2.1. The Firm**

The firm begins with an initial equity endowment, and executives, by implementing different policies, may alter firm value. In investment policy, the firm has the opportunity to accept a finite number of risky, positive net present value projects. The executive selects the aggregate level of risk by choosing the volatility, modeled by the standard deviation, of total investment. Second, the level of debt issued by the firm is represented by the coupon paid to debt holders. Finally, there is also an exogenous benefit to a positive dividend payout (independent of the investment policy). As with investment risk and financing, there is an optimal dividend payout that maximizes the unlevered firm value with respect to the dividend payout. While we do not endogenize this function, there is ample evidence of a positive benefit to the payout of dividends due to informational and agency problems.<sup>3</sup> Once firm policies have been established, firm value follows a geometric Brownian motion.

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<sup>2</sup> The details of the model are more fully developed in (Schrenk, 2007b).

<sup>3</sup> Cf. (Lease et al., 1999) for a broad perspective.

We assume that the equity and bonds are issued by the firm in a complete market and thus use the no arbitrage framework of (Leland, 1994) to determine values for the firm's equity and debt: a fundamental differential equation eliminates the stochastic component through a replicating portfolio and determines the value of all instruments or claims deriving from that security. A formula for valuing each instrument is derived by specifying appropriate boundary conditions with the resulting specifications for the levered firm and the value of the equity.

## 2.2. The Agents

The model has two agents: the executive and equity holders. Executives receive only their compensation from the firm. All executive cash flows are consumed; executives do not save and do not hold independent portfolios (and therefore cannot hedge the risk of variable compensation<sup>4</sup>). Further, the executive is risk-averse, that is the executive's utility function, is twice differentiable, additive and time independent, i.e., a standard von Neumann-Morgenstein utility function.<sup>5</sup> We use a simple negative exponential utility function, satisfying the general conditions ( $u' > 0$ ,  $u'' < 0$ ) for a risk-averse utility function (when  $\beta > 0$ ) with  $\beta = 0.25$ . By contrast, equity holders are diversified and only concerned with the expected value. Their utility is thus monotonically increasing in the level of their wealth, so we need not specify an explicit utility function for equity holders. Instead, we may proxy equity holder utility by their monetary payouts.

While there is, in practice, a great range of forms of variable compensation, we consider the two most common. First, executives may receive compensation in the form of equity participation in the firm, i.e., a restricted equity plan. That is, conditional upon the solvency of the firm, executives receive dividend cash flows throughout their tenure, but obtain capital gains only at a terminal date. Second, executives may receive option compensation in the form of European call options that can be exercised at the termination date.<sup>6</sup> These forms of compensation differ in two ways: they have different effects on the behavior of executives, and they have different compensation costs to equity holders.<sup>7</sup> In general, these two factors will have opposing effects, i.e., compensation that more readily aligns executive-equity holders interests are also the most costly to grant, since risk-averse executives discount its value more severely.<sup>8</sup> The core trade off in the model is between the efficacy of compensation in motivating executives to implement optimal corporate policies (through its effect on their utility) and the cost of that compensation to equity holders.

The option and equity compensation is initially expressed as a proportion of unlevered firm value: thus, a 1% equity position is a restricted equity grant equal to 1% of the value of the unlevered firm, and a 2% option position is a European call on 2% of the value of the unlevered firm with an exercise price equal to the initial value of the firm and an expiration date equal to the terminal period. After the compensation is awarded, executives select the capital structure maximizing

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<sup>4</sup>(Ofek and Yermack, 1999) show that managers may 'unwind' positions if they can sell shares which they already own.

<sup>5</sup>This environment is an application of the more general model developed in (Mirrlees, 1976), (Holmström, 1979), and (Grossman and Hart, 1983).

<sup>6</sup>These characteristics are consistent with what managers typically receive (Murphy, 1998).

<sup>7</sup>I distinguish between two types of costs to which the equity holders are exposed: first, the compensation costs (introduced here) derived from the compensation paid to the manager, and, second, the incentive costs (discussed below) that are the opportunity costs of not setting corporate policies optimally.

<sup>8</sup>The lower valuation by executive can be considerable: (Meulbroek, 2000) estimates that the value of option compensation to executives in the case of Internet firms to be only 53% of the total cost to the firm.

utility. Since the grant of an equity stake to executives is restricted and the options cannot be exercised early, we assume that executives neither participate in the equity repurchase nor exercise options prior to the terminal date, and their equity and option proportions are adjusted for any change in the leverage of the firm.

Each agent has choice variable(s) corresponding to the areas of corporate policy under their sway. Executives have control over investment, financing and payout policies: they may choose the level of aggregate investment risk (as measured by the standard deviation of aggregate investment), the level of debt issued by the firm (as represented by the coupon paid to debt holders), and the payout to equity holders (in the form of the dividend yield). Equity holders select the level and mix of compensation paid executives: equity participation in the firm and options on the equity of the firm.

The objective function that must be constructed from these elements is complex, but in general form it follows the traditional agency model,<sup>9</sup> except that it is not slacking, but sub-optimal policies that equity holders seek to ameliorate. The goal of the executive is to set optimal investment, financing and dividend policies to maximize their own utility. Equity holders seek to maximize their equity gain. Unfortunately, a closed form solution to this stochastic control problem is not possible. As an alternative approach, we use a numerical solution for a simplified, discrete analogy to this problem.

### **2.3. Incentive Costs versus Compensation Costs**

The loss due to a lack of congruence between the objectives of principals (equity holders) and agents (executives) is typically described as an agency cost. To develop our analysis further, we distinguish between the opportunity costs associated with sub-optimal corporate policies and the loss due to a need to compensate the executive. The former are designated 'incentive costs' and are associated with an inability to induce the executive to set policies first-best policies; the latter are called 'compensation costs' and result from the payment of compensation to executives. Optimal compensation design is a trade off between the resolution of incentive costs and the cost of compensation. In some scenarios, if the executive can be induced to set first-best corporate policies, it will be possible to eliminate all incentive costs, so the agency cost will only be the compensation cost. In other situations, however, due to conflicting risk preferences of equity holders and executives, it will not be possible to avoid incentive costs; the compensation necessary to motivate a risk-averse manager to enact first-best policies may be greater than the gain from eliminating all incentive costs, so that second-best solutions are all that may be obtained.

### **2.4. Model Structure**

We construct (for a given set of parameters) a binomial tree of the price paths of the unlevered firm. At each node, we can then price equity using the Leland equity formula to obtain a binomial tree of levered equity values (Leland (1994)). The utility received by the executive at each node is the value of the utility function for the total compensation received at that node. Since there is a time value to utility, executives discount the utility at each node by the intertemporal discount rate of utility. Utility is assumed to be independent and additive, so the aggregate utility of a

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<sup>9</sup>Cf. (Campbell, 1995) for the general agency model.

compensation structure is the sum of the weighted<sup>10</sup> discounted utility at each node. We utilize a grid search to find the corporate policies that maximize executive utility for a specified compensation structure.

To explore the implications of this model we use a benchmark set of parameters:<sup>11</sup> The firm's initial equity endowment is \$1,000.00. The risk free rate of interest is assumed to be 5% and the corporate marginal tax rate 40%; the former is a typical value for that rate over a long-term economic horizon, later approximates the marginal tax rate for a large corporation. Following general practice, option compensation is awarded at-the-money, and it has a five-year expiration date. The cost of bankruptcy is 10%.

### 3. THE RESULTS OF THE MODEL

We examine the sensitivity of optimal compensation to variations among individual firms, since we know that executive compensation is sensitive to industry differences.<sup>12</sup> We capture the dissimilarity among firms with three exogenous parameters: First, firms have investment opportunities with varying degrees of optimal risk. Second, firms have divergent optimal dividend yields. And, finally, firms face disparate costs of bankruptcy. As these parameters fluctuate, so too must optimal compensation design.

In analyzing these sensitivities, it is useful to differentiate two ways in which changes in exogenous parameters may affect optimal compensation: 1) by altering the value of the firm's securities (upon which compensation is based) and 2) by altering the incentives for executives setting the policies of the firm. @@@The former are *direct* effects on the value of the equity issued by the firm and of derivative securities written upon that equity. Changes in the value of these securities in turn affect the cost of compensation. The latter are *indirect* effects: changes in exogenous parameters may cause executives to alter corporate policies and changes in corporate policies also influence the cost of compensation. The comparative statics results will be the net outcome of direct effects on the instruments of compensation as well as indirect effects upon compensation mediated through changes in corporate policies.

#### 3.1. Investment Risk

The investment opportunities available to firms are modeled by an investment risk function, which is concave in the aggregate investment risk. The maximum value added to the firm from undertaking investment risk is constant, but the level of risk capturing that value varies. The maximum of that function specifies the optimal level of investment risk, i.e., the level of risk that will *ceteris paribus* maximize firm value. Figure 1 shows how the two forms of compensation respond as the optimal level of investment risk is increased:

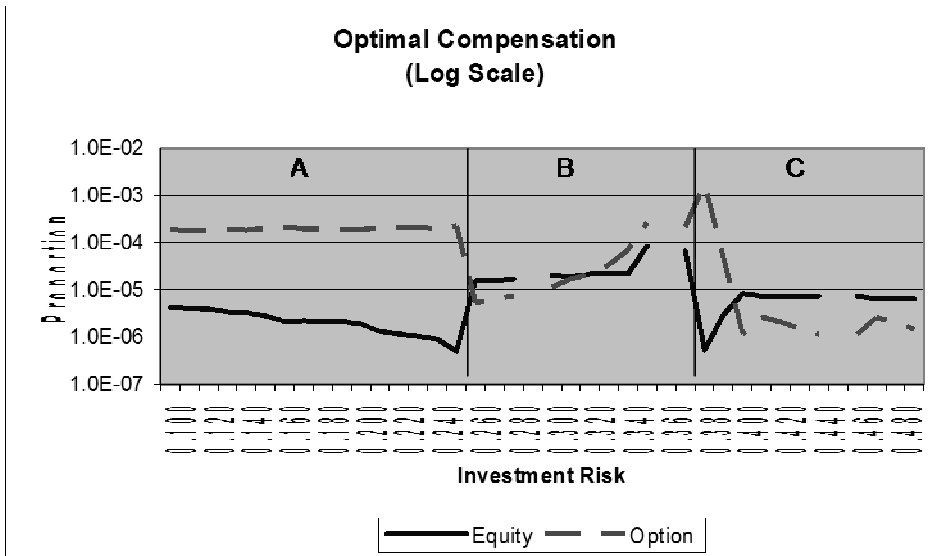
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<sup>10</sup>For simplicity, we use the pseudo probabilities as weights.

<sup>11</sup> While many typical values are used in the benchmark, this is not to imply that the model is in any way 'calibrated' to real market conditions.

<sup>12</sup> For example, on utilities, cf. (Joskow *et al.*, 1996) and on banking, cf. (Barro and Barro, 1990)

**Figure 1: Optimal Compensation as a Log Function of the Optimal Investment Risk.<sup>13</sup>**

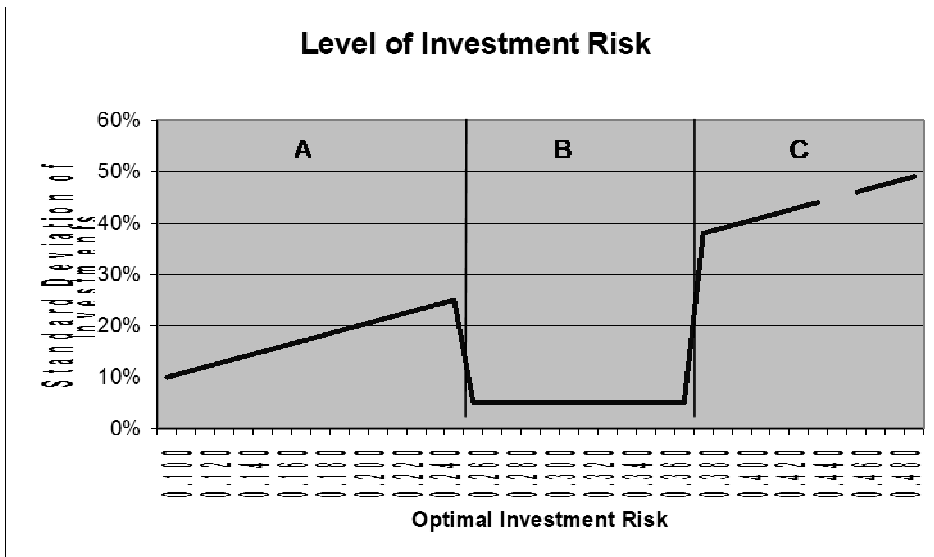


Since the maximum of the function is the first-best risk level from the perspective of equity holders, as the maximum increases, the optimal compensation design must motivate executives to undertake increasing risky investment. Because executives are risk-averse, the composition of the optimal compensation design shifts as higher levels of risk must be achieved. The optimal solution must balance the executive’s utility from the higher cash flows of variable compensation with the disutility of the higher volatility.

At lower levels of optimal investment risk (Region A), option compensation provides more effective motivation for the executive to undertake risky investment. Figure 1, however, shows that this relationship is not constant over different levels of investment risk. Instead as the optimal level of risk rises, there is a shift from option to equity compensation. Figure 2 shows the effect of increasing the optimal investment risk on the level of risk actually selected by the executive:

<sup>13</sup> Gaps indicate values for which there were difficulties in obtaining a numerical solution

**Figure 2: Actual Investment Risk as a Function of the Optimal Investment Risk.**



When the optimal risk level is sufficiently low, option compensation is used to motivate risky investment. As the target increases, however, it is no longer possible to use option compensation since the disutility of its volatility is excessive, and a first-best investment policy cannot be attained (Region B); here sub-optimal investment levels are set with the consequent incentive costs. Once the optimal investment risk is sufficiently high, a level is reached at which the first-best solution is again possible (Region C), but now that solution is reached by compensating the executive more with equity than options.

The first shift (from Region A to Region B) is easily explained as an incentive cost spawned by the risk-aversion of the executive: the higher optimal investment risk increases the risk of the first-best investment policy, but not the value (since that is held constant). Higher option compensation must be paid to the executive, but, since there is no increased value, a point is reached when it is no longer cost effective to increase the option compensation, so there is sub-optimal investment by the firm. Over Region B, the same analysis holds and the firm continues to bear the investment incentive cost.

The unusual result of the model is that at higher levels of optimal investment risk, not only is the first-best investment policy again feasible, but it can be motivated by equity compensation. This outcome is the effect of the higher optimal investment risk on the incentive effects of equity compensation. There is a trade off for the executive: while volatile forms of compensation are needed to motivate the executive to undertake risky investment,<sup>14</sup> if that volatility is too high, the concavity of the utility function eliminates the gain in utility. Compensation is only an effective when it falls within a ‘risk window’: volatile enough to motivate risky investment, but not so volatile that its utility is destroyed. The volatility of compensation is a function of two factors: 1) the type of compensation, option (higher risk) or equity (lower risk), and 2) the level of investment

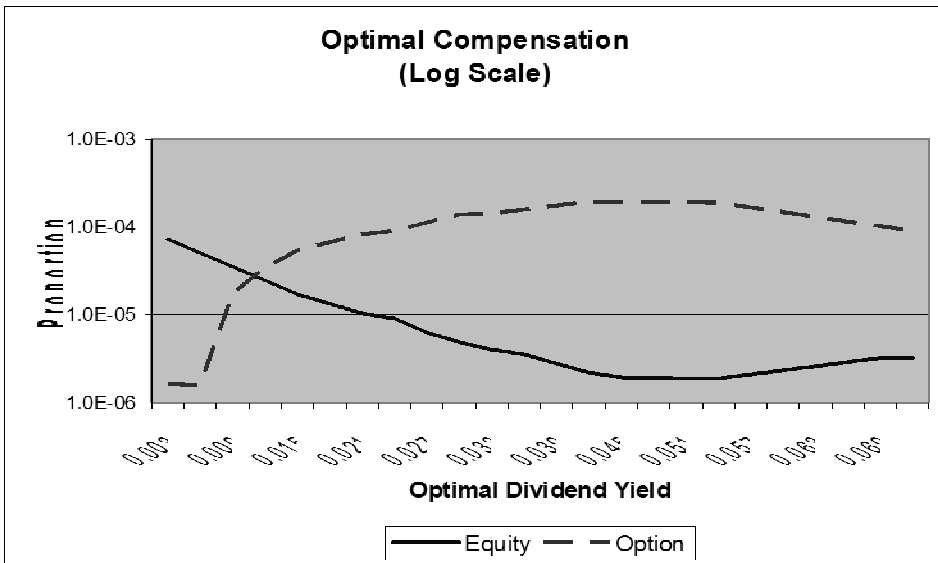
<sup>14</sup> (Coles *et al.*, 2006) show the sensitivity of CEO wealth to equity volatility induces riskier corporate policies. (Chen *et al.*, 2006) show that option compensation induces risk in the case of banks, while (Ghosh and Sirmans, 2006) shows the same result for REITs.

risk. When the optimal investment risk is low (Region A), option compensation falls within the risk window, while the volatility of equity compensation is too low. At moderate levels of optimal investment risk (Region B), the volatility of equity compensation is still insufficient, while option compensation is now excessively risky—neither falls within the risk window and the first-best investment risk is not obtained. Finally, when the optimal investment risk is high enough (Region C), equity compensation is sufficiently risky to motivate the first-best level of investment risk.

### 3.2. Dividend Yield

The model also introduces an exogenous advantage from dividends.<sup>15</sup> The dividend yield function is concave in the dividend yield. The maximum of that function specifies the optimal dividend yield, i.e., the dividend yield that will *ceteris paribus* maximize firm value. The value added to the firm from paying out the optimal dividends is constant, but the level of dividend achieving that value varies.

**Figure 3: Optimal Compensation as a Log Function of the Optimal Dividend Yield.**

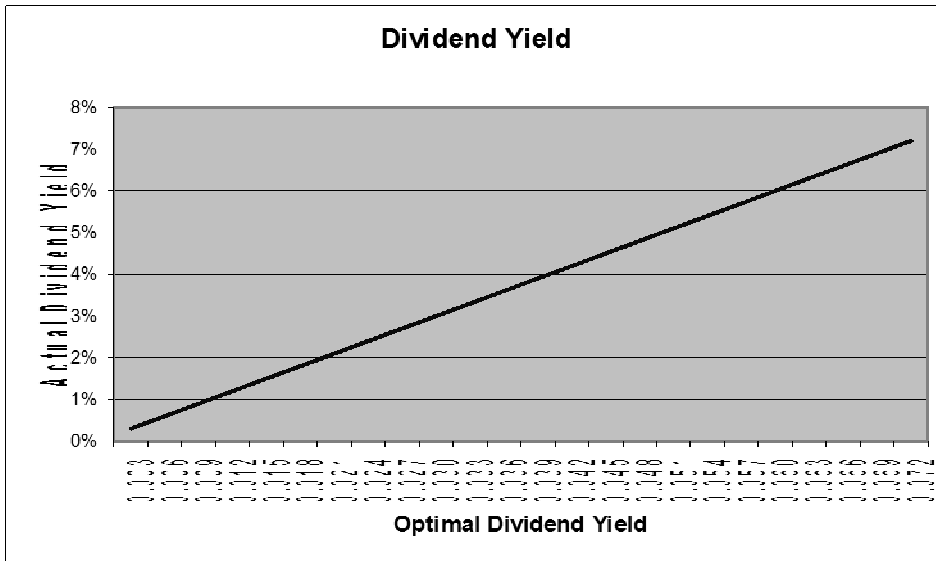


As we can see in Figure 3, option compensation is increasing in the optimal dividend yield while equity compensation is decreasing. Nonetheless, over the entire range of optimal dividend yields, the first-best dividend yield is maintained, so that firms do not suffer incentive costs (Figure 4):

<sup>15</sup>(Lambert *et al.*, 1989) and (Lewellen *et al.*, 1987) study the relationship between dividends and compensation.



**Figure 4: Actual Dividend Yield as a Function of the Optimal Dividend Yield.**



Initially, this shift from equity to option compensation may appear counter-intuitive—we would normally associate dividend payments with equity compensation.<sup>16</sup> The reasoning is that executives holding a restricted equity grant have rights to dividends payments even before any vesting occurs<sup>17</sup> and thus directly benefit from an increased dividend yield. By contrast, option compensation gives no claim upon dividends. Further, any payment of dividends lowers the value of the share price, and, consequently, the value of options written on the firm’s equity. So it is perplexing to understand why *prima facie* the model would suggest that sustaining a higher dividend yield would require option compensation. But such reasoning remains valid only when we consider the effect of dividends *simpliciter*; it does not take into account the joint modeling of both investment risk and dividends.

In this model, the firm gains value from *both* making risky investments *and* paying dividends. A higher dividend 1) decreases the value of the firm and 2) (in the presence of financial leverage) increases the volatility of equity cash flows—the firm is both worth less and more risky. In response, greater option compensation must be awarded to maintain the same incentives and utility to the risk-averse executive. The increase in option compensation is due to the need to continue to motivate risky investment while the firm is more volatile due to the increased dividend.

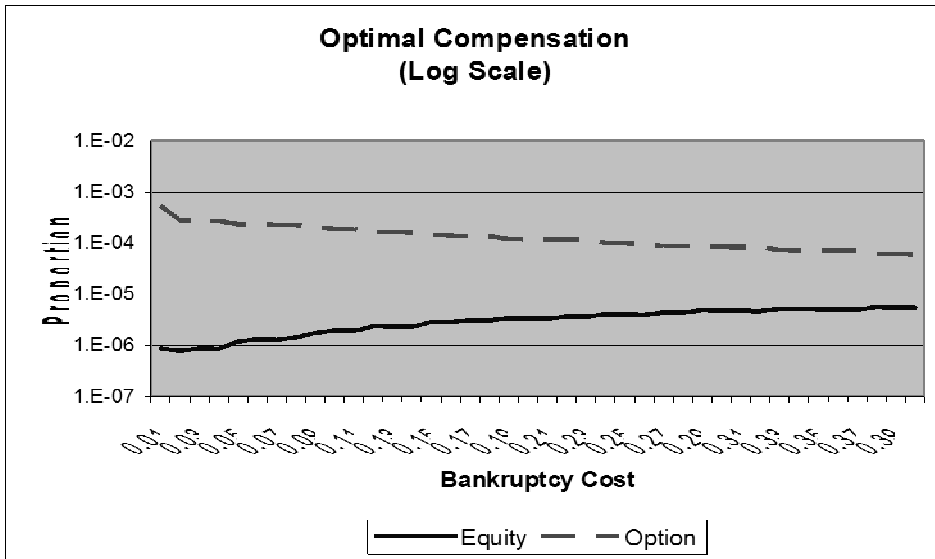
<sup>16</sup> (Brown *et al.*, forthcoming) find that greater executive ownership leads to higher dividends, but they do not, as here, consider the effect of different levels of dividends. (Chetty and Saez, 2005) also support the compensation-dividends connection when they find that, after the 2003 dividend tax cut, firms with high executive ownership and low option compensation were particularly likely to increase dividends.

<sup>17</sup> This is how equity compensation is implicitly modeled here, since the model does not try to capture vesting.

### 3.3. Bankruptcy Cost

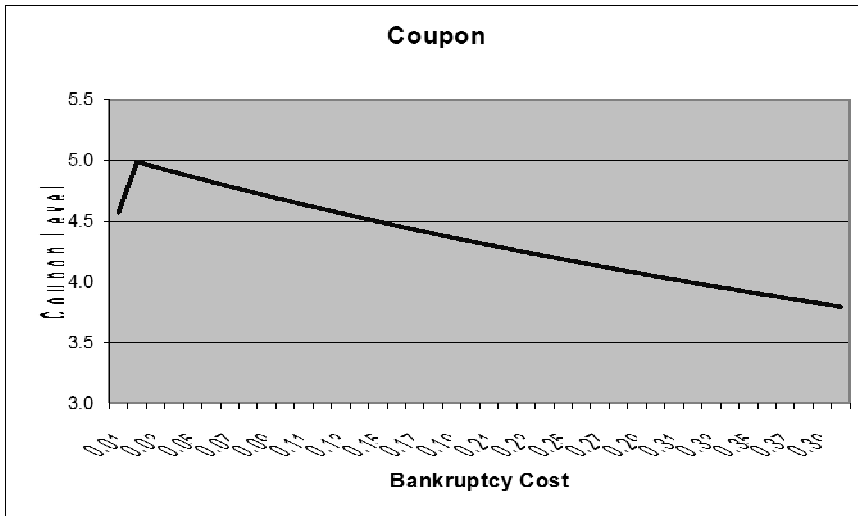
Our final firm parameter is the deadweight cost of bankruptcy. As is well documented, firms face varying costs associated with financial distress and bankruptcy. Here the bankruptcy cost is the deadweight loss to the firm (expressed as a proportion of firm value) associated with bankruptcy. As this cost increases, there is an obvious effect on both the debt and the equity of the firm. Further, however, there is an additional impact upon the optimal compensation awarded to the executive. Figure 5 shows the change in compensation design as the cost of bankruptcy increases:

**Figure 5: Optimal Compensation as a Log Function of the Bankruptcy Cost.**



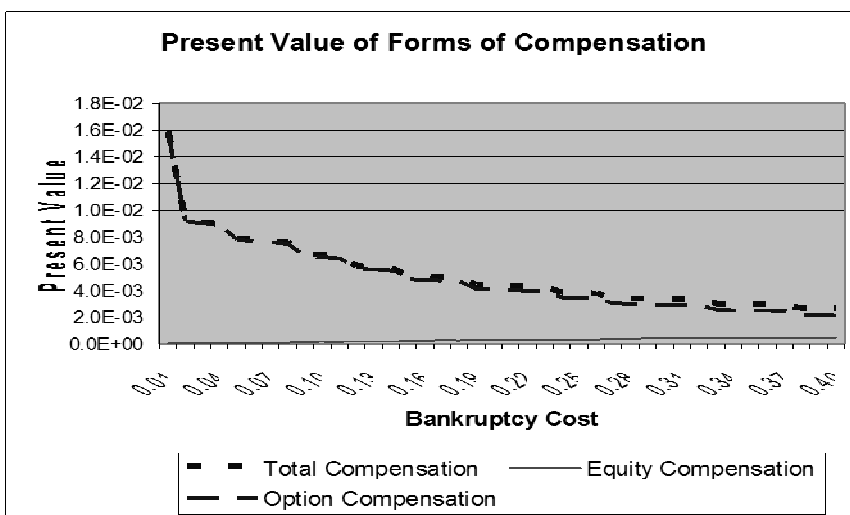
As in the case of investment risk, we see a shift from option to equity compensation. The main influence of bankruptcy costs is on the amount of debt issued by the firm, so, while the executive always implements the first-best debt policy, the optimal level of debt decreases as bankruptcy costs increase (Figure 6):

**Figure 6: Debt Coupon as a Function of the Bankruptcy Cost.**



When the debt levels moves downward, compensation shifts toward equity compensation because less option compensation is required to achieve the first-best investment level. The higher cost of bankruptcy has reduced the firm’s ability to support debt. This lowers the volatility of firm cash flows and alters the utility obtained from the various forms of compensation. Option compensation, in particular, is now less risky and generates more utility for the risk-averse executive. As firm risk declines, the level (and cost) of option compensation also declines, as less is needed to motivate the executive to set the first-best level of investment. Figure 7 shows how the cost of option (and correspondingly total) compensation is reduced by higher bankruptcy costs:

**Figure 7: Compensation Cost as a Function of the Bankruptcy Cost.**



While increased bankruptcy costs do lower the value of the firm, they also introduce compensation savings. Thus, the model predicts that the proportion of option compensation will be declining in the cost of bankruptcy.

#### 4. CONCLUSION

This study shows how the optimal compensation package (as a mixture of option and equity awards) responds to changes in the level of investment risk, dividends and bankruptcy costs of the firm.

*Investment Risk:* As the optimal level of risky investment increases, the concave utility function of the executive places a ‘ceiling’ on the risk acceptable to the executive, and option compensation become too expensive. Also at higher levels of investment risk, equity compensation becomes more efficacious in motivating investment risk, so there is a shift from option to equity compensation.

*Dividend Yield:* At higher dividend yields the firm losses value and gains volatility. To maintain a consistent level of executive utility, option compensation must be increased resulting in a shift from equity to option compensation.

*Bankruptcy Costs:* A higher cost of bankruptcy lowers optimal debt levels and firm risk. This, less option compensation is required to achieve the first-best investment level, and there is a shift from option to equity compensation.

While it is widely acknowledged that executive compensation should contain some performance-based reward, we lack a model that explains the specific types of variable compensation needed for firms with different properties. It is too often assumed that these different forms of compensation are (at least approximate) substitutes. In addition, executives are multitasking—while the abstract goal may be to increase the value of the firm; this is achieved through different, concrete channels, e.g., investment vs. financing. This model shows that the relationships between different forms of compensation and corporate policies are complex and depend on the specific character of individual firms: what is optimal compensation for one firm will not necessarily be optimal for another.

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