EXECUTIVE COMPENSATION AND MACROECONOMIC FACTORS: INTEREST RATES AND CORPORATE TAXATION

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ABSTRACT

It is frequently argued that effective executive compensation should contain some performance-based remuneration. We lack, however, serious understanding of the characteristics of the many patterns of variable compensation in use. It is too often assumed that these different methods of compensation are (at least approximate) substitutes. In this paper, we develop a simulation model of executive compensation, in which both equity and option compensation is utilized, in order to analyze the effect of macroeconomic factors, namely, interest rates and the level of corporate taxation, on optimal executive compensation. The model forecasts that, as the risk free rate of interest increases, there is a general shift toward equity compensation; by contrast, as the level of corporate taxation increases the shift is toward option compensation.

JEL: G30, H2, H25, J33

INTRODUCTION

Performance-based measures are the basis for much of executive compensation and most of the ensuing controversy. While both academics and practitioners typically recommend such compensation, little consideration is given to the manifold patterns of variable compensation and their differing incentive effects; beyond a fixed salary, executives receive, among many other forms, bonuses, options, premium-priced options, performance shares, performance units, restricted equity, phantom equity and dividend-based compensation. (The effect of executive compensation is one of the six unanswered questions in Abowd and Kaplan (1999).) The implicit supposition that different methods of variable compensation are close substitutes is too naïve. To expand our understanding of the complexity of the different forms of compensation, this paper investigates the effect of changes in the macroeconomic environment on the choice between equity and option compensation for executives. It develops a simulation model in which executives, motivated by a combination of equity and option compensation, set the investment, financing and payout policies of the firm and then studies the effect of macroeconomic factors, namely, interest rates and the level of corporate taxation, on optimal executive compensation. The model simulated here predicts that an increase in the risk free rate of interest will predispose firms toward awarding equity compensation, whereas a similar increase in the corporate tax rate will stimulate the firm toward awarding option compensation. The latter effect is accompanied by a rise in the value and use of debt that amplifies the risk of the firm. Unfortunately, the risk-averse executive has an upper bound to acceptable risk. When optimal financial policies would jointly exceed this bound, one or more optimal policies must be abandoned.

Equity holders delegate most business decisions of the firm, including the investment, financing and payout policies, to executives, while retaining for themselves control over the compensation of those executives. To motivate executives, equity holders must introduce forms of variable compensation, e.g., equity participation and options (Coles, Daniel and Naveen (2006) shows the sensitivity of CEO wealth to equity volatility induces riskier corporate policies. This is further substantiated by studies showing that the level of managerial compensation is higher in firms with more risk (Per, 1999)). This study examines how the ability of these types of compensation to motivate executives varies under different macroeconomic factors (Schrenk (2006) applies this same form of analysis to examine how compensation

varies for firms with different characteristics, e.g., bankruptcy costs, in contrast, to the analysis here of macroeconomic factors.). It demonstrates when one form of compensation is superior to another, how the optimal form of variable compensation changes as the exogenous economic parameters change, and the implications of these changes for the resulting investment, financing and payout policies of the firm.

LITERATURE SURVEY

The tradition within which this study is developed stresses that the executive is risk-averse–in contrast to well-diversified equity holders–and this engenders an agency problem. Compensation must alter the incentive structure given to executives, so that their (unobservable) actions are aligned with equity holder goals. While studies indicate the need to offer variable compensation (Antia and Mayer (1984) and Smith and Watts (1982)), few explicitly characterize, as is done here, the specific forms for the optimal compensation. For the risk-averse executive, Jensen and Smith (1985) identify three significant areas of sub-optimal behavior: investment policy (the executive may invest in projects of insufficient risk), financing policy (the executive may issue insufficient debt), and payout policy (the executive may disburse an insufficient dividend). In the case of underinvestment, a range of models analyze managerial risk-taking behavior and the effect upon it of differing compensation design. Most have argued that managers have little opportunity to diversify their wealth portfolio (Murphy, 1999). Studies have examined both equity (e.g., Bizjak, Brickley and Coles, 1993) and option compensation (e.g., Hirshleifer and Suh, 1992). None of these, however, considers the effect of alternate forms of variable compensation in solving on underinvestment problem. The literature also recognizes that risk-averse executives have an incentive to issue less than optimal debt (Firth (1995) and Mehran (1992)) and are inclined to the over-retention of earnings (Smith and Watts (1982), Jensen and Smith (1985)). Unfortunately, the effect of equity holder-executive conflicts and compensation design on financing and payout policies has been largely neglected. While individual studies have considered each of these agency conflicts in isolation, none has addressed the multitasking question nor has any offered a rationale for choosing between different forms of variable compensation.

THE MODEL

We investigate the comparative statics of the problem to determine the sensitivity of optimal compensation and corporate policies to changes in macroeconomic parameters, i.e., interest rates and corporate taxation. The model endogenizes the firm's investment, financing and payout policies as well as the compensation decision, so we can vary each exogenous economic parameter to examine the effect of economic environment on compensation and how these different economic conditions alter the incentive effects of compensation on the investment, financing and payout policies of the firm.

The model represents the interaction of two agents: equity holders and executives. Each operates with different economic assumptions: equity holders are well diversified and invest in a complete markets environment, while executives are risk-averse and receive all of their wealth from their human capital 'invested' in the firm. Information is incomplete: equity holders know the risk preferences, etc. of executives and they can (with certainty) determine how executives will set the policies of the firm for any given compensation. Equity holders, however, do not themselves have the specialized knowledge to form optimal investment, financing and payout policies; 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. We seek the Nash equilibrium between compensation and the investment, financing and payout policies.

The Firm

The firm begins with an initial equity value, and executives, by implementing different investment, financing and payout policies, may alter that value. In investment policy, the firm has the opportunity to accept a finite number of risky, positive net present value projects that are infinite and irreversible. The executive selects the aggregate level of risk by choosing the volatility of total investment. Further, executives choose the financing of the firm by choosing the debt coupon level. Finally, there is an exogenous benefit to a dividend payout (as there is ample evidence of a positive benefit to the payout of dividends due to informational and agency problems (cf. Lease, John, Kalay, Loewenstein, and Sarig, 1999)). As with investment risk and debt, there is an optimal dividend yield that maximizes the unlevered firm value. Both because of the exogenous benefit of dividends, and because the executive is risk-averse and without access to a complete market, this formulation differs from the traditional Miller-Modigliani (1961) result that dividend policy should not matter. Once the corporate policies have been determined, the value of the firm follows a geometric Brownian motion. We assume that the equity and bonds are issued by the firm in a complete market and use the no arbitrage framework of Leland (1994) to calculate values for the firm's equity and debt: a fundamental differential equation eliminates the stochastic component through a replicating portfolio and values instruments deriving from that security.

Agent Characteristics

Executives are risk-averse and maximize the utility derived from their compensation. They obtain all of their wealth from their employment by the firm and do not save. Thus, they do not hold independent portfolios and therefore cannot hedge the risk of variable compensation (Ofek and Yermack (1999) show that managers may 'unwind' positions if they can sell shares which they already own. Ozerturk (2006) studies the effect of this on executive incentives.). Equity holders, by contrast, are diversified and lonely concerned with the expected value of equity. This environment is an application of the general model of Mirrlees (1976), Holmström (1979), and Grossman and Hart (1983).

The executive evaluates compensation with a power utility function. This specification displays constant relative risk aversion and decreasing absolute risk aversion, that is, 1) the agent always takes the same 'relative risks' (in a portfolio context, for example, they would place the same proportion of wealth in risky assets), and 2) the agent is less risk-averse at higher valued payouts. The last is theoretically more plausible (than absolute or decreasing risk aversion), since we are evaluating potentially large variations in wealth. (Himmelberg and Hubbard (2000) make a similar use of this utility function.)

The Forms of Compensation

While there are, in practice, many forms of variable compensation, we consider the two most typical. First, executives may receive compensation in the form of equity participation in the firm. This models a restricted equity plan: conditional upon the solvency of the firm, executives receive dividend cash flows throughout their employment, but only obtain capital gains at the terminal date. Second, executives may receive options in the form of European call options that can be exercised at the termination date. These specifications are consistent with what managers typically receive (Kole (1997) and Murphy (1998)). Equity and option compensation differ along two relevant dimensions: they have different incentive effects on the behavior of executives, and they have different compensation costs to equity holders. In general, these two factors will have opposing effects, i.e., the forms of compensation that more readily align executive-equity holders interests are the most costly to grant, since risk-averse executives discount their value more severely. The lower valuation by executive can be considerable: Meulbroek (2000) estimates, for example, that the value of option compensation to executives in the case of internet firms is only 53% of the total cost to the firm. The key trade off is between the efficacy of compensation in motivating executives to execute optimal corporate policies and the cost to equity holders.

Each agent has choice variables corresponding to the areas of corporate policy under their authority. Executives have control over investment, financing and payout policies: they may choose the level of aggregate investment risk, the level of debt (as represented by the debt coupon) and the dividend yield. Equity holders establish the compensation of executives: equity participation in the firm and options on the firm's equity. The objective function constructed from these elements is complex, but in general structure it follows the traditional agency model (cf. Campbell, 1995)–except that it is not slacking, but sub-optimal polices that equity holders seek to ameliorate. Unfortunately, a closed form solution to this stochastic control problem is not possible, so we find numerical solutions for a discrete analogy to this problem using the benchmark values in Table 1.

Table 1: Benchmark Values

Parameter	Value
Value of the Unlevered, Risk Free Firm	$50.00
Risk Free Rate of Interest	5%
Corporate Tax Level	35%
Bankruptcy Cost	10%
Optimal Investment Risk	20%
Optimal Dividend Yield	5%
Time to Expiration (i.e., length of model)	10 years
Exercise Price for Option Compensation	$50.00

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 (for a general and throughout discussion of this issue, see Jensen and Smith (1985)). We distinguish between the opportunity costs of sub-optimal corporate policies and the loss due to the costs of compensating the executive. The former are incentives costs associated with the inability to prompt the executive to set optimal policies, i.e., the first-best policies; the latter are compensation costs from the payment of compensation to executives. The optimal compensation design is a trade off between the costs of compensation and the resolution of incentive costs.

Model Mechanics

The model seeks the Nash equilibrium between executives maximizing their own utility and equity holders maximizing equity value. We optimize the problem by utilizing a two-level grid search: At the first optimization (executive) level (given the exogenous parameters in Table 1), we employ a grid search to find the corporate policies (investment risk, debt coupon and dividend yield) that maximize executive utility for a specified combination of equity and option compensation. For example, using the exogenous parameters in Table 1 and setting equity compensation at 4E-7% of firm value and option compensation at 5E-5% of firm value, the utility maximizing policies set by the executive are an investment risk with a standard deviation of 20%, a debt coupon of $4.51 and a dividend yield of 5%.

At the second optimization (equity holder) level, the first grid search is iterated for a range of equity and option combinations to produce a two dimensional surface representing the executive's utility maximizing reaction to different combinations of equity and option compensation. The optimal compensation is the equity holders' best response to the utility maximization (first level grid search) by the executive; that is equity holders will select as optimal compensation the point on the two dimensional surface maximizing equity value. Equity value is maximized when net gain from corporate policies less the cost, i.e., present value, of executive compensation is greatest. Thus, over the range of compensation possibilities, i.e., the

results from the first grid search, equity holders select the compensation that maximizes the value of equity as the optimal compensation to offer the executive.

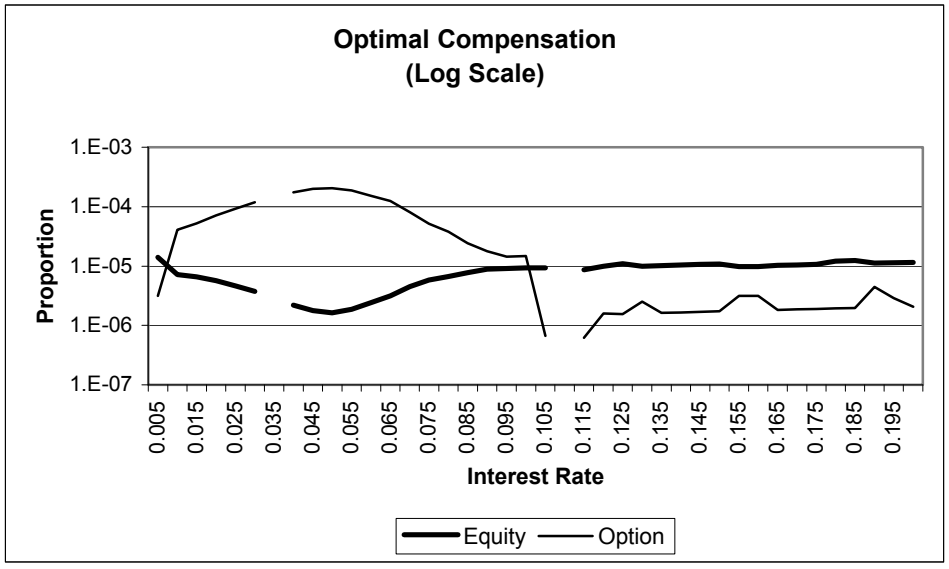
RESULTS

We examine the sensitivity of optimal compensation to two characteristics of the economy, the risk free rate of interest and the level of corporate taxation. In analyzing these sensitivities, it is important to distinguish two ways in which changes in exogenous parameters may alter the optimal compensation. First, there is an effect on the utility and the cost of forms of compensation: the changes in exogenous economic parameters change the value of the equity issued by the firm and, consequently, on any derivative securities written upon that equity. Such effects directly modify the value of compensation based on these financial instruments. But, second, there are indirect effects: changes in exogenous parameters alter corporate policies which modify the utility and cost of compensation. We consider both the direct impact on the value of compensation and the indirect effect through changes in firm policies.

The Risk Free Rate of Interest

The risk free rate of interest has pervasive implications for the results of the model, since almost every feature is, to some degree, a function of the risk free rate. First, for example, the basic value of the firm follows a geometric Brownian motion, so that its upward drift is increasing in the risk free rate. Second, the executive may receive value from two types of financial securities written on the firm: equity grants and options. *Ceteris paribus*, the value of the equity will move upward with the risk free rate, since it a direct function of the firm value. Further, options are dependent on the risk free rate in two ways: their value is increasing in the equity value and a rise in the risk free rate will decrease the present value of the exercise price thereby escalating the value of the options. But there are also contravening effects: First, a rise in the risk free rate will add to the intertemporal discount rate causing the utility derived from compensation to decline. Second, a rise in the risk free rate may alter the optimal investment, financing and payout policies. Our concern is the net effect on the optimal mix of option and equity compensation.

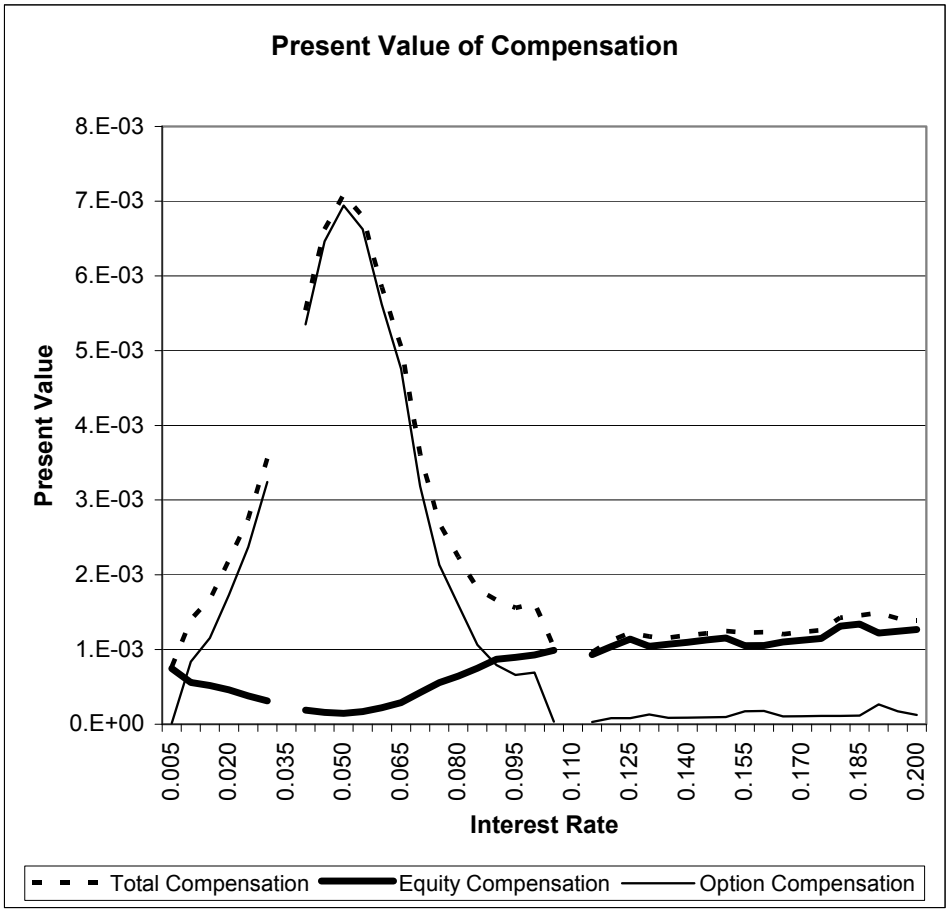
Figure 1: Optimal Compensation as a Log Function of the Risk Free Rate of Interest



The optimal compensation design displays a clear change in behavior at higher interest rates: when the risk free rate is low, option compensation dominates, but as the interest rate goes up, equity compensation

dominates. (Note that the model is a complex, discrete analogy of a continuous time model, and the breaks in the lines in Figure 1 and 2 indicate values for which there are difficulties in obtaining a numerical solution.) The net effect of an increase in the interest rate is to move compensation toward equity compensation. The explanation lies in the effect of the interest rate on executive behavior– executives will discount their utility more severely. Since equity compensation produces dividends and has a lower duration, the utility of equity compensation inclines with the interest rate.

Figure 2: Compensation Cost as a Function of the Risk Free Rate of Interest



As the risk free rate increases, the shift from option and toward equity compensation is accompanied by a net decrease in the total cost of compensation (Figure 2). Since option compensation is riskier than equity compensation, a far larger value must be awarded to generate similar utility for the executive. The model predicts a gradual transfer from option to equity compensation will occur as the risk free rate of interest goes up as well as a decrease in the total cost of compensation. This is contrary to the corresponding result for the risk neutral setting, where option value is increasing in the interest rate.

The Corporate Tax Level

The level of corporate taxation is also factor in the valuation of debt and the consequent capital structure.

The relative allocation to option compensation rises with the level of corporate taxation. The change in the tax level most directly affects financing policy, since the tax benefit creates the value of debt. Consistent with this, the level of debt is also increasing in the level of corporate taxation (Figure 4):

Figure 3: Optimal Compensation as a Log Function of the Corporate Rate of Taxation

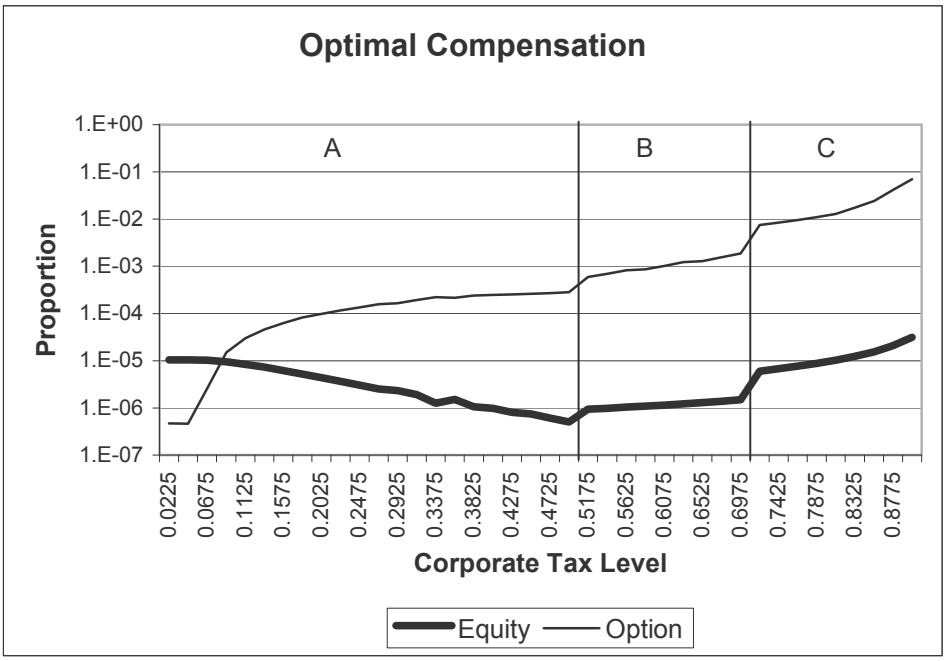
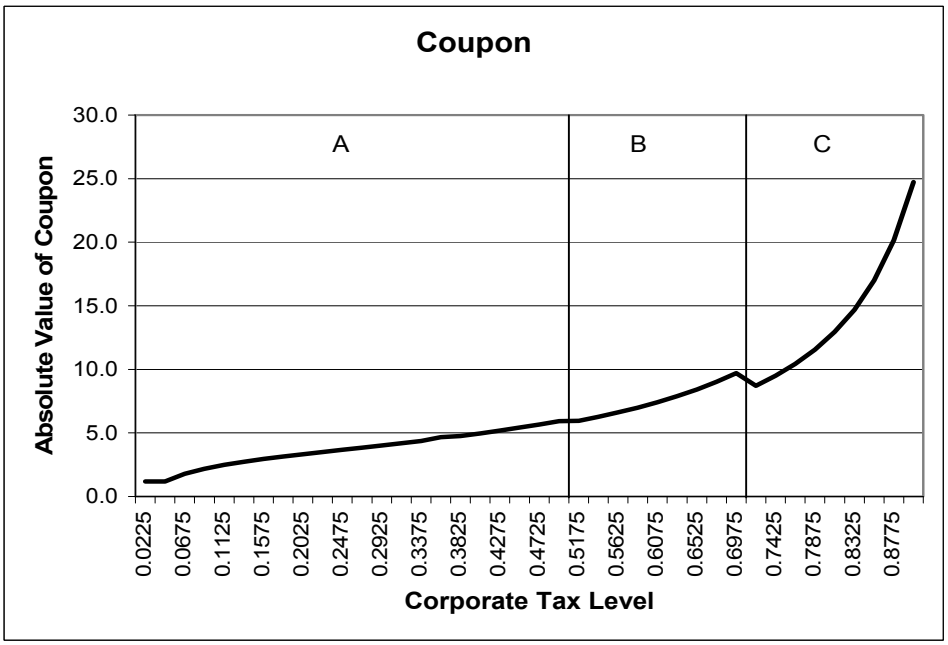
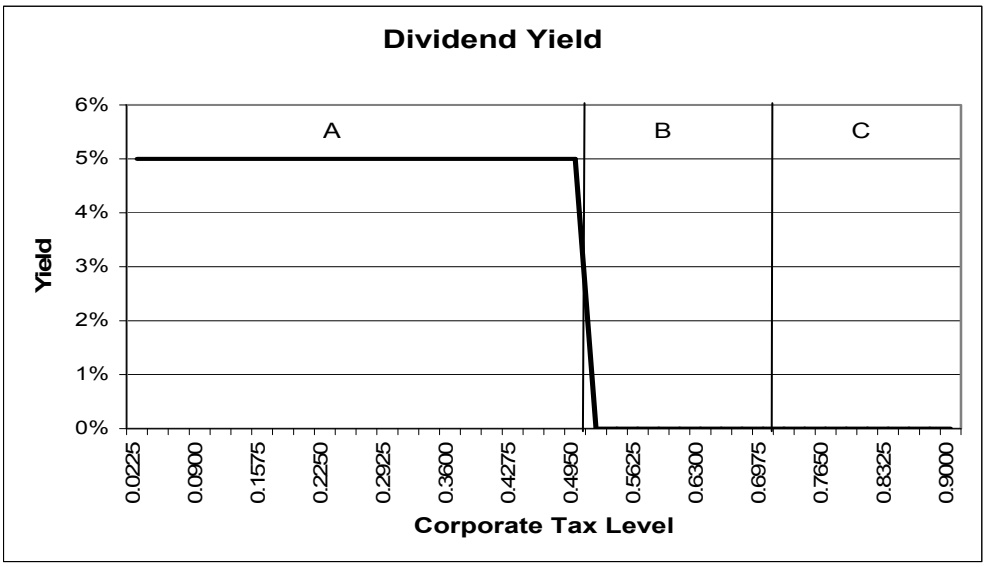


Figure 4: Debt Coupon as a Function of the Corporate Rate of Taxation



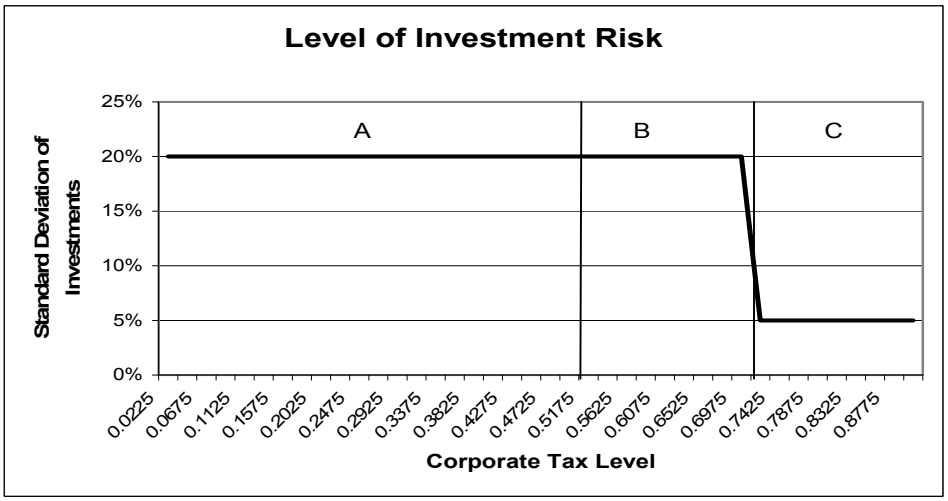
Within our multi-tasking environment, however, we also consider the effects on investment and payout policies. As a higher tax level induces more debt, the firm becomes more risky; however, a risk-averse executive, due to the concavity of their utility function, tolerates only limited risk. Once that limit is reached, then the risk engendered by one corporate policy can only be exacerbated if the risk from another is lessened. In this case, as the tax benefit of debt adds greater value, risk must be lowered in investment and dividends to accommodate the higher level of debt and its ensuing risk. In both cases, the higher tax rate, by increasing the benefit to debt, introduces incentive costs. Figure 5 shows the effect:

Figure 5: Dividend as a Function of the Corporate Rate of Taxation



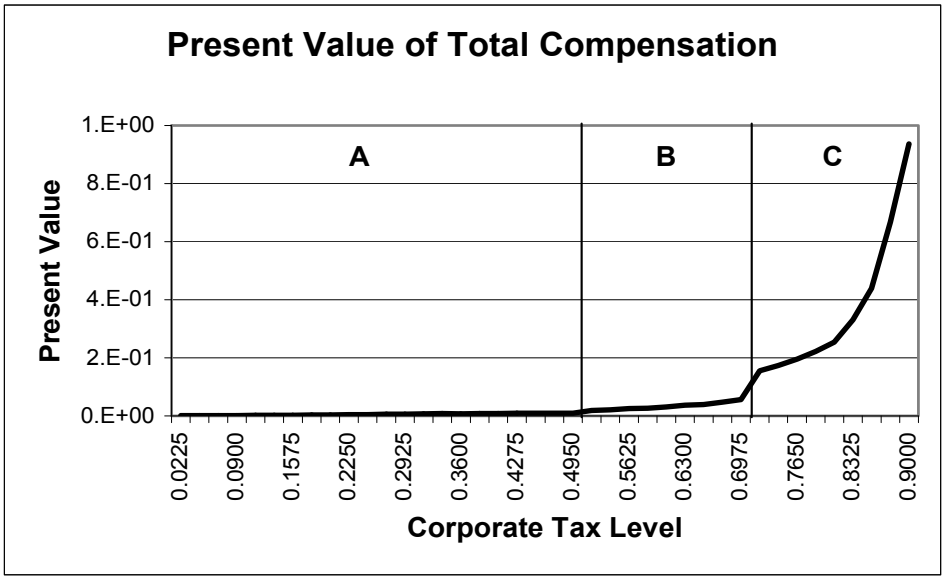
At low levels of net firm risk (Region A), the executive can be motivated to set first-best policies in all policy areas, but the existence of a risk-averse executive effectively places a 'cap' on the aggregate level of risk a firm can support. Additional debt financing adds value to the firm through the creation of tax shields, but it also augments the total risk of the firm. The latter forces the executive to abandon the first-best payout policy (Region B) in order to allow more debt and reap the benefits of the debt tax shields.

Figure 6: Investment Risk as a Function of the Corporate Rate of Taxation



After the first-best payout policy has been abandon, a continued raise in the debt level then forces the executive to abandon the first-best investment policy (Region C): the marginal value of debt eventually surpasses both the marginal value of dividends and investment risk. The cost of compensation is also rising due to the greater reliance on option compensation (Figure 7).

Figure 7: The Compensation Costs as a Function of the Corporate Rate of Taxation



In sum, option compensation (and the cost of total compensation) will increase as the level of corporate taxation gets higher. Higher tax rates will make higher leverage of the firm's capital structure optimal and induce incentives costs.

CONCLUSION

The model has noteworthy implications for the effect of exogenous parameters, the risk free rate of interest and the level of corporate taxation, on the compensation optimally awarded to the executive and the behavior of that executive in setting corporate policies. As the risk free rate of interest increases, there is a change to equity compensation. This shift appreciably decreases the present value of compensation. The importance of the prediction is further augmented by being counter to the intuition of models that price options in a risk neutral environment, where the boost in the risk free rate of interest would (by lowering the present value of the exercise price) raise the value of a call option. Once risk-aversion is introduced, however, the analysis becomes more complex: the utility implications for option compensation of a higher risk free rate are ambiguous. First, there will be the aforementioned increase in the value of the option compensation, but there will be, second, a more steep discounting of the utility in each period. Since equity compensation produces dividends and has a lower duration than option compensation, the relative utility of equity compensation is increasing in the interest rate. This suggests that the utility loss from higher discounting exceeds the gain in the value of option compensation.

As the level of corporate taxation rises, there is an increase in the value of debt financing and, consequently, greater use of debt. The risk of the firm goes up, but for the risk-averse executive there is an upper bound to acceptable risk. When optimal policies would exceed this bound, one or more of those policies must be forsaken: as higher taxes levels add to the value of debt, the optimal payout policy and

then the optimal investment policy are discarded. As the firm becomes more risky, more option compensation is needed to motivate the executive, so the cost of compensation is greater.

BIBLIOGRAPHY

Abowd, John M. and David S. Kaplan (1999) "Executive Compensation: Six Questions that Need Answering," *Journal of Economic Perspectives*, vol. 13(4), p. 145-168.

Antia, Murad J. and Richard L. Meyer (1984) "The Growth Optimal Capital Structure: Manager versus Shareholder Objectives," *Journal of Financial Research*, vol. 7, p. 259-267.

Bizjak, John M., James A. Brickley, and Jeffery L. Coles (1993) "Stock-Based Incentive Compensation and Investment Behavior," *Journal of Accounting and Economics*, vol. 16, p. 349-372.

Campbell, David E. (1995) *Incentives: Motivation and the Economics of Information*. Cambridge.

Coles, Jeffrey L., Naveen D. Daniel, and Lalitha Naveen (2006) "Managerial Incentives and Risk-Taking," *Journal of Financial Economics*, vol. 79(2), p. 431-468.

Firth, Michael (1995) "The Impact of Institutional Stockholders and Managerial Interests on the Capital Structure of Firms," *Managerial and Decision Economics*, vol. 16, p. 167-175.

Grossman, Sanford J. and Oliver D. Hart (1982) "Corporate Financial Structure and Managerial Incentives," In *The Economics of Information and Uncertainty*, ed. John J. McCall. Chicago, pp. 107-140.

Himmelberg, Charles P. and R. Glenn Hubbard (2000) "Incentive Pay and the Market for CEOs: An Analysis of Pay-for-Performance Sensitivity," Working Paper, Columbia University.

Hirshleifer, David and Yoon Suh (1992) "Risk, Managerial Effort, and Project Choice," *Journal of Financial Intermediation*, vol. 2, p. 308-345.

Holmström, Bengt R. (1979) "Moral Hazard and Observability," *Bell Journal of Economics*, vol. 10, p. 74-91.

Jensen, Michael C. and Clifford W. Smith (1985) "Stockholder, Manager, and Creditor Interests: Applications of Agency Theory," In Edward I. Altman and Marti G. Subrahmanyam, eds. *Recent Advances in Corporate Finance*. Homewood, IL, pp. 93-131.

Kole, Stacey R. (1997) "The Complexity of Compensation Contracts," *Journal of Financial Economics*, vol. 43, p. 79-104.

Lease, Ronald C., Kose John, Avner Kalay, Uri Loewenstein, and Oded H. Sarig (1999) *Dividend Policy: Its Impact on Firm Value*. Boston.

Leland, Hayne E. (1994) "Corporate Debt Value, Bond Covenants, and Optimal Capital Structure," *The Journal of Finance*, vol. 49, p. 1213-1252.

Mehran, Hamid (1992) "Executive Incentive Plans, Corporate Control, and Capital Structure," *Journal of Financial and Quantitative Ana*lysis, vol. 27, p. 539-560.

Meulbroek, Lisa K. (2001) "The Efficiency of Equity-Linked Compensation: Understanding the Full Cost of Awarding Executive Stock Options," *Financial Management*, vol. 30(2), p. 5-44.

Miller, Merton H. and Franco Modigliani (1961) "Dividend Policy, Growth, and the Valuation of Shares," *The Journal of Business*, vol. 34, p. 411-433.

Mirrlees, James (1976) "The Optimal Structure of Incentives and Authority within an Organization," *Bell Journal of Economics*, vol. 7, p. 105-131.

Murphy, Kevin James (1999) "Executive Compensation," In Orley Ashenfelter and David Card, eds. *Handbook of Labor Economics*, vol. 3, North Holland. pp. 2485-2563.

Ofek, Eli and David L. Yermack (2000) "Taking Stock: Equity-Based Compensation and the Evolution of Managerial Ownership," *Journal of Finance*, vol. 55, p. 1367-1384.

Ozerturk, Saltuk (2006) "Managerial Risk Reduction, Incentives and Firm Value," *Economic Theory*, vol. 27(3), p. 523-535.

Per, Obeua (1999) "The Relationship between Research and Development Expenditure and Executive Compensation in High-Technology Industries," *Managerial Finance*, vol. 25(9), p. 55-67.

Schrenk, Lawrence P. (2006) "The Effect of Firm Characteristics on the Option versus Stock Compensation: Investment Opportunities, Dividend Targets and Bankruptcy Costs," Working Paper, Merrick School of Business, University of Baltimore.

Smith, Clifford W. and Ross L. Watts (1982) "Incentive and Tax Effects of Executive Compensation Plans," *Australian Journal of Management*, vol. 7, p. 139-157.

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