Executive Compensation and Debt Structure of REITs

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Abstract

This paper examines how executives' compensation structure interacts with firm debt structure, and focuses on how executives' compensation structure affects firm financing choice between secured debt and unsecured debt. Based on the compensation contracts, executives make corresponding investment and financing decisions for their firms. Therefore, different compensation structures may lead to different firm debt structures. First, a theoretical model is built to analyze the relationship between executive compensation and firm debt structure. Then U.S. equity Real Estate Investment Trust (REIT) data is used to test empirical implications of the model. Results show that when executive pay is more sensitive to firm stock price volatility (also known as $Vega$), the firm has more secured debt within their capital structure. Evidence also shows interesting links among sensitivity of executive pay to firm stock price (also known as $Delta$), firm investment, and firm secured debt usage. These findings offer a new perspective on firm collateral use, and provide insight on using executive compensation to mitigate the principal-agent problems between equity shareholders and executives.

Keywords: Executive Compensation, Debt Structure, Secured Debt, REITs

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1 Introduction

Executive compensation has long attracted a great deal of attention from researchers, and the recent financial crisis has placed it in the spotlight again. The financial crisis reminds us that the existing executive compensation schemes may offer too much incentive for executives to take risk. We still do not fully understand how executive compensation affects investment decisions and capital structure of the firms. Generally, executive compensation consists of various components, such as cash salary, benefits, bonus, stock, defined compensation, options and grants. The use of stock grants and options in executive compensation has increased dramatically during the past few decades.

Agency theory suggests that using stock grants and options as a part of executive compensation helps to align the interests of firm shareholders with executives. However, it is unclear how executive compensation, especially the use of stock grants and options, affects firm investment and financing decisions. Executive compensation may affect the executives' exposure to firm risk, and hence affect investment behavior of the firm, as well as the financing structure behind the investment decisions. A better understanding of how executive compensation affects firm investment and financing decisions allows boards of directors to design policies that mitigate agency problems between shareholders and executives, and provide a more comprehensive understanding of a matching or mismatching of firm investment strategies and capital structure.

This research examines the connection between executive compensation and firm debt financing choices of secured versus unsecured debt. To explore this relationship a theoretical model is built based on the work of Boot, Thakor and Udell (1991). The Boot, Thakor and Udell (1991) model shows that borrowers pledge collateral to mitigate moral hazard, as well as asymmetric information problems between borrowers and lenders. For this research, a model is constructed to measure how executives make financing decisions based on their compensation structure, especially how executive compensation affects capital structure through its effects on firm investment decisions. Assume that firms seeking to borrow a fixed amount of capital from outside lenders to finance a new project can choose either secured debt or unsecured debt. Lenders offering both types of debt expect to earn zero expected profit. Firm executives make financing decisions depending on their compensation structure.

The model shows that for projects more sensitive to managerial effort, the corresponding financing structure is secured debt. Secured debt mitigates the moral hazard problem that exists between firm executives and lenders. Financing with secured debt reduces incentives for managers to deviate from employing high effort levels, which are optimal levels for projects that are sensitive to managerial effort. Model also shows that managers make investment and financing decisions based on their compensation structures. If executive compensation includes higher incentive payments, in other words, the shareholders' interests are better aligned with the executive's interests, the executives will choose the projects that offer higher final payoff. If the risky project is chosen, then the corresponding debt structure will be secured debt.

Results of the model are tested using a sample of U.S. equity REIT data between the years 2000 to 2007. Several measures of executive compensation structure are used. Major findings show that firms with higher sensitivity of executive compensation to stock price volatility tend to hold more secured debt as part of total debt structure. A similar connection among sensitivity of executive pay to firm stock price, firm investment, and firm secured debt usage is also found. Results also show that risky firms, those highly sensitive to managerial effort, use higher levels of secured debt. These results suggest a strong connection among executive compensation, firm investment, and firm secured debt usage.

This research builds on current literature related to debt structure and executive compensation. First, it validates our recognition of the interaction between executive compensation structure and firm debt structure using firm investment as an important channel. The model in this paper complements the empirical studies analyzing executive compensation and firm financing. Second, this research contributes to the literature on the financing choice between secured and unsecured debt. By analyzing the choice between secured and unsecured debt, this research provides insights into how executive compensation structures impact the corporate secured debt usage. Finally, this research helps to understand the design of optimal executive compensation structures that motivate executives to make appropriate investment and financing decisions for firms. Depending on the characteristics of investment, and corresponding financing structure protecting the ownership interests of shareholders, the effective executive compensation structure may take different forms. Incentive compensation, such as stocks and options, may help mitigate the agency problems between firm shareholders and executives. Different incentive payments may induce the manager to make different investment decisions. This will further affects the firm financing decisions. The connection between executive compensation and firm secured debt usage might also be observable through time. Under different market conditions, the characteristics of investment might be different. This might lead to changing executive compensation policies and changing debt policies. Although the focus of this research is on equity REITs, the theoretical and empirical results of this paper can be applied to industrial and service corporations.

There is a large collection of research surrounding executive compensation (Murphy, 1999). One major research direction in the study of executive compensation is the effect of executive compensation schemes on firm-level decision making. There are two major components of executive compensation: cash compensation and non-cash compensation. Cash compensation includes salary and bonus, and non-cash compensation includes stock grants, options and other non-cash incentives. Due to the"undiversified" position that Chief Executive Officers (CEOs) take in the value of the firm, they can suffer big financial, legal, and reputational losses if the firm fails. On the other hand, shareholders are more widely diversified in their holdings, so they prefer more risk taking than CEOs. Therefore incentives should be designed and delivered to firm executives encouraging them to take risks (Jensen and Meckling, 1976)). Stock option awards, as one component of non-cash incentives, became the largest component of CEO compensation during the 1990s. Stock options have convex payoffs and may affect managers' incentives to take risks (Smith and Stulz, 1985, Milgrom and Roberts, 1992)).

Empirical findings are generally consistent with this rationale. For example, May (1995) shows how a manager's decision-making is affected by personal risks and finds that CEOs who have more personal wealth associated with firm equity tend to take less risks and diversify. Coles, Daniel and Naveen (2006) provides evidence of the relationship between managerial compensation structures and firm investment and debt policies, and find that if the CEO's wealth has a higher sensitivity to the firm's stock volatility, then these firms will take on riskier policies, such as investing more in R&D, are more focused, and take on higher leverage. Brisley (2006) finds that the stock options exercise schedules of executives affect risk-taking incentives and propose a "progressive performance vesting" strategy of options to allow the firm to more efficiently rebalance risking-taking incentives for managers. Gibbons and Murphy (2005) find that investment on research, development and advertising are all affected during the final years of a CEO's time in office. Aggarwal and Samwick (2003) find that managers diversify the firms investment portfolio because of private benefits they can obtain from diversification. All literature review findings imply that due to principal-agent problems, firm risk taking behaviors are affected by executives' personal interests and compensation structure.

In addition to firm risk taking, related research studies show that other firm level activities, such as firm performance and firm debt structure, are also affected by managerial compensation schemes. For example, Mehran (1995) finds firms whose executives have more equity-based compensation perform better. Findings also suggest the form of executive compensation plays an important role in motivating managers to increase firm value. Ortiz-Molina (2007) examines how executive compensation is related to capital structure and finds pay-performance sensitivity responds differently to varying debt levels. As leverage ratio changes, pay-performance sensitivity changes. The findings suggest capital structure and executive compensation are related. One possible explanation for this correlation is agency problems between executives and shareholders are connected to agency problems between debt-holders and equity shareholders. Studies based on this reasoning include Brockman, Martin and Unlu (2010), whose research shows a negative relation between the sensitivity of a CEO's personal investment portfolio to changes in firm stock price and shorter-maturity debt; but a positive relation between sensitivity of a CEO's portfolio to stock price volatility and shorter term debt.

Other studies about executive pay and firm debt structures include Chava and Purnanandam (2007). The authors find a CFO's incentives have strong influences on floating-to-fixed rate debt structure of firm. If CFOs have incentives to increase firm risk, firms adopt a volatility-increasing debt structure, which means more floating-rate debt. In the context of REITs, Ertugrul, Sezer and Sirmans (2008) find CEO's compensation structure affects derivative usage of REITs, the higher the ratio of CEO cash compensation to total compensation, the less hedging activity.

Despite the importance of secured and unsecured debt in firm financing, research concerning them is limited. The choice between secured and unsecured debt can be influenced by several factors. Stulz and Johnson (1985) explain the existence of secured debt by focusing on the moral hazard problem. They argue the advantage of secured debt is it allows firms to undertake profitable projects that otherwise would not be undertaken if only use equity or unsecured debt is used. This is because secured debt helps to reduce the underinvestment problem caused by the existence of outstanding debt. Secured debt also mitigates the asset substitution problem which may arise with unsecured debt. In a more recent paper, Eisdorfer (2008) finds that secured debt helps to mitigate risk-shifting (asset substitution) of financially distressed firms.

Another factor that is significant in secured debt usage is asymmetric information. As the borrower may have some private information about the investment, that is not known by the lender, the lender requires collateral to reduce risks. Dennis, Nandy and Sharpe (2000) find that secured debt is used when asymmetric information exists. As the firm grows and builds a reputation with lenders, the asymmetric information problem is less severe, and more unsecured debt is used.

Some research studies look at the role of collateral when both moral hazard and asymmetric information problems exist. Boot, Thakor and Udell (1991) analyze the economic role of collateral under both private information and moral hazard. They conclude that if only moral hazard is considered, then using collateral is a useful instrument to reduce moral hazard problems. The theoretical model of this research assumes that banks compete for borrowers, and borrowers take unobservable actions, which affect the project payoffs and cause moral hazard. Even with a repossession cost, secured debt can help reduce the moral hazard. When pre-contract private information is also considered, the collateral usage in contracts increase. The authors then empirically test the predictions of the model and show that larger loans and loans of longer maturity have less collateral.

Collateral usage is also believed to be influenced by factors other than moral hazard and asymmetric information problems. For examples, Inderst and Mueller (2007) show that in an imperfectly competitive loan market, riskier borrowers should pledge more collateral. In the context of REITs, Giambona, Mello and Riddiough (2010) show both theoretically and empirically that firms of better quality use secured debt to finance new investment opportunities.

This research extends the current literature by examining the relationship between executive compensation, firm investment and debt structure, specifically, secured debt versus unsecured debt. Similar to Coles, Daniel and Naveen (2006), in this paper, executive compensation is linked to both firm investment and firm financial structures. However, whereas Coles, Daniel and Naveen (2006) examine the investment and financing decisions separately, this research argues that executive compensation affects debt structure through its influence on investment risk-taking. Another addition this research makes to the literature is by examining executive compensation and choice between secured and unsecured debt. This research analyzes the determinants of the use of secured versus unsecured debt with a focus on the moral hazard problem. The ways in which managerial compensation, especially the personal portfolio structure of managerial compensation, affects the choice between secured and unsecured debt has not been studied before.

2 The Model

A research model is developed based on Boot, Thakor and Udell (1991) (BTU). The basic setting of the model is a cash-constrained firm that needs to borrow a fixed amount of capital from a lender. Major differences between the BTU model and this research are: i) executives make the decision between using secured debt and unsecured debt, while principal-agent problem between shareholders and firm executives is not considered in BTU; and ii) the property itself is the collateral in this model, as real estate properties are tangible, while collateral used in BTU is outside collateral other than the project itself. More specific assumptions used in the model are described below.

2.1 Assumptions

Consider a research model in which the lender, shareholders and executives are all risk neutral. Lenders compete for loans and earn zero expected profit. The model is a one-period model. At time t=0, which is the beginning of the period, the borrower (firm) borrows money, which is normalized to 1, from the lender and invests the money in a project. At time t=1, which is the end of the period, the project is finished and the firm is liquidated. There are two types of projects available for firms, $\overline{\theta}$ and $\underline{\theta}$. The first type, $\overline{\theta}$, is called the less risky project, with payoffs $\overline{R}$ when the project is successful and payoff $\underline{R}$ when the project fails. The second type, $\underline{\theta}$, is called the risky project, with payoffs $\overline{R}$ when the project is successful and payoff $\underline{R}$ when the project fails. The probability of project success depends on the risk level of the project and manager's effort, a, which can be classified as either a high effort, $\overline{a}$, or a low effort, $\underline{a}$. The executive faces an effort cost of $V(a)$ and $V(\underline{a}) = \underline{V}$

and $V(\overline{a}) = \overline{V}$.

$$p(\overline{\theta}, \overline{a}) = \overline{h}, p(\overline{\theta}, \underline{a}) = \underline{h}, \overline{h} > \underline{h} \tag{1}$$

$$p(\underline{\theta}, \overline{a}) = \overline{q}, p(\underline{\theta}, \underline{a}) = \underline{q}, \overline{q} > \underline{q} \tag{2}$$

$$\overline{h} < \overline{q}, \underline{h} > \underline{q} \tag{3}$$

The risky project $\underline{\theta}$ is defined to be risky due to the fact that the probability of success is more volatile and more sensitive to the level of managerial effort. On the other hand, the probability of success for less risky project is less sensitive to the level of managerial effort. It is important to note that the risky project is not necessarily a bad project. When the manager uses high effort, the risky project has a higher probability of success. Since effort is costly for the manager, to induce the manager to use high effort, the firm should offer proper incentives in the compensation structure.

To finance the investment, the executive needs to choose between two types of loans: secured debt and unsecured debt. A secured loan requires assigned collateral. Unsecured debt has no assigned collateral. Secured debt allows the debt holder to have a claim on the residual value of the project. However, a transaction cost C exists for the lender if the project fails and the lender wants to secure the payoff. Such transaction costs may include the loss the lender must face selling the collateral quickly, or the discount in the value of the property for lender compared to borrower. In the first best equilibrium with full information, the bank can observe the effort made by the executive. With moral hazard, the bank can not observe the effort made by the executive. The manager of the firm has a compensation contract that includes α shares of the firm's stocks and β shares of stock options. It is assumed that stock options are exercisable only when the project is successful. When the project fails, the manager faces a loss of L, which can be thought of as reputation loss or loss in income due to discontinuity of employment when the firm goes bankrupt. This gives the manager an incentive to avoid taking too much investment and financial risk.

2.2 Timing of the Model

The model is a one period model. At time t=0, the players take actions in a sequence shown in Figure 1. The manager is provided with a compensation contract. Then, the manager makes firm investment decisions based on the compensation contract given. In the final step, the lender offers a series of debt contracts. At time t=1, the project is finished and the firm is liquidated.

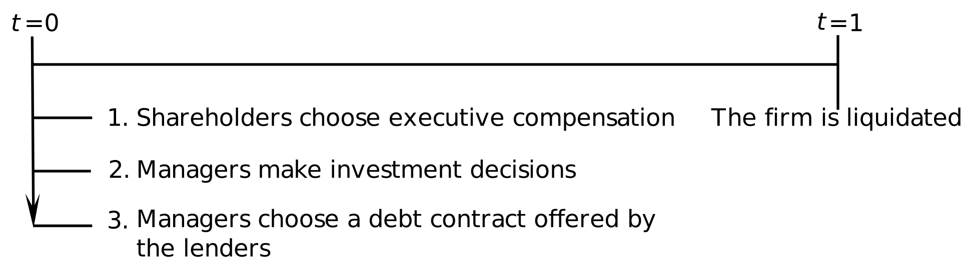

Figure 1: Timing of the model

2.3 Equilibrium

Based on the model timing, the equilibrium is defined as following:

Definition: An equilibrium of this game is a set of (α, β, θ, a, d, r), such that:

(1) lenders break even;

(2) managers maximizes their own benefits by choosing the type of project and the corresponding debt structure;

(3) shareholders maximize their value by choosing the optimal executive compensation structure.

Here, α is the number of shares in common stocks that the manager is given. β is the number of stock options the manager is given. θ is the project type, risky or less risky, d is the debt structure, a is the effort choice and r is the interest rate. The lender can observe the project type and the compensation contract the executive is given. Assume that the project type is common knowledge in order to simplify the analysis. The manager makes investment and financing decisions for the firm according to the compensation contract given. Shareholders choose the compensation contract with anticipation of the investment and financing decisions made by the manager. The following sections solve for the equilibrium.

2.4 Choice of Debt Structure

First the debt financing choice is analyzed. The lender's problem is to choose the corresponding debt contract according to the project risk type and managerial effort choice. The debt contract includes two terms: the interest rate and the use of collateral or not, *i.e.*, whether it is secured or unsecured.

2.4.1 Choice of Debt Structure-Full Information

The first step in this analysis starts with the equilibrium under full information, which means the lender knows what type of project it is, and can observe the effort choice of managers. The manager is offered α shares of firm stocks and β shares of firm stock options. Note that stock and option compensation (α, β and z) are assumed to be exogenous. z is the exercise price of the stock options. Assume stock options are exercisable only when the project is successful. θ is the project type, risky or less risky, d is the debt structure, a is the effort choice and r is the interest rate. The lender can observe the project type and the compensation contract the executive is given. Since lenders compete for loans, they earn zero expected profit. The manager needs to choose the effort level, a, and the debt contract, d and r, for the project. If secured debt is used, $d = s$, otherwise $d = u$. A manager that invests in a less risky project maximizes his expected payoff:

$$\max_{a,d,r} E(Comp(\alpha, \beta, \overline{\theta}, a, d, r)) - V(a) - (1 - p(\overline{\theta}, a))L \tag{4}$$

subject to:

$$E(Lender(\overline{\theta}, a, d, r)) = 1 \tag{5}$$

$$E(Comp(\alpha, \beta, \overline{\theta}, a, d, r)) - V(a) - (1 - p(\overline{\theta}, a))L \geq 0 \tag{6}$$

where

$$E(Comp(\alpha, \beta, \overline{\theta}, a, d, r)) = p(\overline{\theta}, a)[(\alpha + \beta)(\overline{R} - r) - \beta z] + (1 - p(\overline{\theta}, a))\alpha X_{\overline{\theta},d} \tag{7}$$

$$E(Lender(\overline{\theta}, a, d, r)) = p(\overline{\theta}, a)r + (1 - p(\overline{\theta}, a))(\underline{R} - X_{\overline{\theta},u}) \tag{8}$$

and

$X_{\overline{\theta},u} = \underline{R}$ if unsecured debt is used ($d = u$);

$X_{\overline{\theta},s} = 0$ if secured debt is used ($d = s$).

Here $E(Comp)$ is the expected compensation of the manager. $E(Lender)$ is the expected payoff to the lender.

Similarly, for the risky project, the manager solves:

$$\max_{a,d,r} E(Comp(\alpha, \beta, \underline{\theta}, a, d, r)) - V(a) - (1 - p(\underline{\theta}, a))L \tag{9}$$

subject to:

$$E(Lender(\underline{\theta}, a, d, r)) = 1 \tag{10}$$

$$E(Comp(\alpha, \beta, \underline{\theta}, a, d, r)) - V(a) - (1 - p(\underline{\theta}, a))L \geq 0 \tag{11}$$

where

$$E(Comp(\alpha, \beta, \underline{\theta}, a, d, r)) = p(\underline{\theta}, a)[(\alpha + \beta)(\overline{R} - r) - \beta z] + (1 - p(\underline{\theta}, a))\alpha X_{\underline{\theta},d} \tag{12}$$

$$E(Lender(\underline{\theta}, a, d, r)) = p(\underline{\theta}, a)r + (1 - p(\underline{\theta}, a))(\underline{R} - X_{\underline{\theta},u}) \tag{13}$$

and

$X_{\underline{\theta},u} = \underline{R}$ if unsecured debt is used ($d = u$);

$X_{\underline{\theta},s} = 0$ if secured debt is used ($d = s$).

The results are stated in the following proposition.

Proposition 1: *Assume there is no moral hazard problem and* $(\overline{h}-\underline{h})[(\alpha+\beta)\overline{R}-\beta z-\alpha\underline{R}+L]<\overline{V}-\underline{V}<(\overline{q}-\underline{q})[(\alpha+\beta)\overline{R}-\beta z-\alpha\underline{R}+L]$, *then*

(1) The manager of the less risky investment uses unsecured debt with interest rate $r_{\overline{\theta},\underline{a},u}=\frac{1}{\underline{h}}$;

(2) The manager of the risky investment uses unsecured debt with interest rate $r_{\underline{\theta},\overline{a},u}=\frac{1}{\overline{q}}$

Proof: See Appendix.

The intuition underlying this result is straightforward. In the first best equilibrium under perfect information, secured debt is unattractive, due to the existence of transaction costs when the project fails. Since unsecured debt has no such transaction cost, managers choose unsecured debt for both the risky and less risky projects. What is different for the two types of projects is the level of effort put forth by managers. The assumption in Proposition 1 compares the marginal benefit of using high effort with the marginal cost. Since the risky project offers a higher marginal benefit to effort, managers utilize high effort for the risky project but low effort for the less risky project.

2.4.2 Choice of Debt Structure-With Moral Hazard Problem

Moral hazard problems exist if the risky project manager finds it more profitable to use low effort $\underline{a}$ instead of high effort $\overline{a}$ with unsecured debt, as in the first best equilibrium. This implies

$$E(Comp(\alpha,\beta,\theta,\underline{a},d,r_{\theta,\overline{a},d}))-V(\underline{a})-(1-p(\theta,\underline{a}))L>E(Comp(\alpha,\beta,\theta,\overline{a},d,r_{\theta,\overline{a},d})) -V(\overline{a})-(1-p(\theta,\overline{a}))L. \quad (14)$$

For observable θ, the equilibrium debt contract solves the following problem:

$$\max_{d,r} E(Comp(\alpha,\beta,\theta,a^*,d,r))-V(a^*)-(1-p(\theta,a^*))L \quad (15)$$

subject to

$$E(Lender(\theta, a^*, d, r)) = 1 \tag{16}$$

$$E(Comp(\alpha, \beta, \theta, a, d, r)) - V(a) - (1 - p(\theta, a))L \geq 0 \tag{17}$$

$$a^* = argmaxE(Comp(\alpha, \beta, \theta, a, d, r)) - V(a) - (1 - p(\theta, a))L \tag{18}$$

By solving the maximization problem, we can get the following proposition.

Proposition 2: *When managers' effort levels can not be observed*

(1) The manager of the less risky investment uses unsecured debt with interest rate $r_{\overline{\theta},\underline{a},u} = \frac{1}{\underline{h}}$*;*

(2) Given $(\overline{q} - \underline{q})[(\alpha + \beta)(\overline{R} - \frac{1-(1-\overline{q})(\overline{R}-C)}{\overline{q}}) - \beta z + L] > \overline{V} - \underline{V}$*, the manager of the risky investment uses secured debt with interest rate* $r_{\underline{\theta},\overline{a},s} = \frac{1-(1-\overline{q})(\underline{R}-C)}{\overline{q}}$

Proof: See Appendix.

Proposition 2 states that secured debt helps to mitigate the moral hazard problem associated with unsecured debt. The reason secured debt with high effort could reduce the moral hazard problem is as followed: with unsecured debt, the manager still has a claim on the firm residual value when the project is not successful. While with secured debt, the manager is paid nothing if the project fails. This pushes the manager to use higher effort. Therefore, secured debt helps to mitigate the moral hazard problem, as the manager has more incentive to work hard.

In summary, in this moral hazard problem, there exists an equilibrium in which risky projects use secured debt with high effort $\overline{a}$, and less risky projects use unsecured debt with low effort $\underline{a}$.

2.5 The Investment Decision

At this stage, the executive compensation contract is given by the shareholders, and the manager needs to choose the type of investment.

$$\max_{\theta} E(Comp(\alpha, \beta, \theta, a^*, d^*, r^*)) - V(a^*) - (1 - p(a^*, \theta))L \tag{19}$$

subject to:

$$E(Lender(\theta, a^*, d^*, r^*)) = 1 \tag{20}$$

$$E(Comp(\alpha, \beta, \theta, a, d, r)) - V(a) - (1 - p(a, \theta))L \geq 0 \tag{21}$$

$$a^*, d^*, r^* = argmax\ E(Comp(\alpha, \beta, \theta, a, d, r)) - V(a) - (1 - p(\theta, a))L \tag{22}$$

When makes the investment decision, the manager compares the expected payoffs from two types of projects and decides which project to choose. If executive chooses the risky project, then the final payoff is:

$$\overline{q}((\alpha + \beta)(\overline{R} - \frac{1 - (1 - \overline{q})(\underline{R} - C)}{\overline{q}}) - \beta z) - \overline{V} - (1 - \overline{q})L \tag{23}$$

If the manager chooses the less risky project, then the final payoff is:

$$\underline{h}((\alpha + \beta)(\overline{R} - \frac{1}{\underline{h}}) - \beta z) + (1 - \underline{h})(\alpha \underline{R}) - \underline{V} - (1 - \underline{h})L \tag{24}$$

The type of project that will be chosen depends on the difference between equations. (23) - (24) equals

$$\begin{aligned} &\alpha[\overline{q}\overline{R} + (1 - \overline{q})(\underline{R} - C) - (\underline{h}\overline{R} + (1 - \underline{h})\underline{R})] \\ &+\beta[\overline{q}\overline{R} + (1 - \overline{q})(\underline{R} - C) - \underline{h}\overline{R} - (\overline{q} - \underline{h})z] + (\overline{q} - \underline{h})L - (\overline{V} - \underline{V}) \end{aligned} \tag{25}$$

If Equation (25) ≥ 0, then choosing a risky project gives the manager higher payoff. On the other hand, if Equation (25) < 0, then choosing a less risky project gives the manager higher payoff. It can also be easily seen that if

$$\overline{q}\overline{R} + (1-\overline{q})(\underline{R} - C) > (\underline{h}\overline{R} + (1-\underline{h})\underline{R}), \tag{26}$$

then an increase in α will induce the manager to choose the risky project. Similarly, for β, if

$$\overline{q}\overline{R} + (1-\overline{q})(\underline{R} - C) - \overline{q}z > \underline{h}\overline{R} - \underline{h}z, \tag{27}$$

then an increase in β implies that a risky project is more likely to be selected.

As higher α and β lead to investment in risky investment, we also know that secured debt is used for risky investment, then a connection between executive compensation structure and firm secured debt usage is built. Higher α and β implies risky investment and more secured debt.

2.6 Shareholders' Problem

The shareholders' objective function is to maximize shareholders' value:

$$\max_{\alpha,\beta} p(\theta^*, a^*)\overline{R} + (1 - p(\theta^*))\underline{R} - E(Comp(\alpha, \beta, \theta^*, a^*, d^*, r^*)) - 1 \tag{28}$$

s.t.

$$E(Lender(\theta^*, a^*, d^*, r^*)) = 1 \tag{29}$$

$$E(Comp(\alpha, \beta, \theta, a, d, r)) - V(a) - (1 - p(\theta, a))L \geq 0 \tag{30}$$

$$\theta^*, a^*, d^*, r^* = argmax\ E(Comp(\alpha, \beta, \theta, a, d, r)) - V(a) - (1 - p(\theta, a))L \tag{31}$$

Proposition 3 summarizes the results.

Proposition 3: *The compensation contract for the risky investment, (α_r, β_r), hashigherstockandoptionsthan (α_l, β_l), which is the optimal compensation contract for the less risky investment.*

Proof: See Appendix.

The model shows higher uses of stock and options in executive compensation leads to investment in risky investment, and the corresponding debt structure is secured debt. In next section we will discuss the empirical implications of the model.

2.7 Empirical Implications

Executive's compensation structure is measured using different proxies. $Delta$ and $Vega$ are two recently developed measures. The calculation of $Delta$ follows from Core and Guay (2002) and it measures the change in the dollar value of executive compensation for a 1% change in stock price. The calculation of $Vega$ follows Guay (1999), and it is calculated as the change in the dollar value of executive compensation for a 0.01 change in the annualized standard deviation of stock returns. Calculation of $Vega$ is based on the Black-Scholes formula for valuing European call options with a modification to account for dividend payouts. Guay (1999) finds stock options, not stock holdings, capture most of the sensitivity of the CEO's wealth to stock volatility. Higher $Delta$ implies that executive compensation is more sensitive to firm value. Compensation with higher $Delta$ can be thought of as having higher incentive compensation. Higher $Delta$ is expected to have a positive effect on secured debt usage. On the other hand, higher $Vega$ implies that executive compensation is more sensitive to firm value volatility. In the model, the riskier project has higher volatility, therefore, a higher $Vega$ is predicted to imply both a riskier investment and a higher secured debt usage. Another measure of executive compensation structure is proportion of non-cash compensation to total CEO compensation, otherwise called $Incentive$. As predicted by the model, higher $Incentive$ has a positive effect on firm secured debt usage. Now we get the following hypotheses:

Hypothesis 1: Higher $Vega$ leads to more secured debt in firm capital structure.

Hypothesis 2: Higher Delta leads to more secured debt in firm capital structure.

Hypothesis 3: Higher $Incentive$ leads to more secured debt in firm capital structure.

Investment with higher sensitivity to managerial effort is considered to be riskier in the model, so measures of firm risk are expected to capture the sensitivity of project payoffs to managerial effort. Several different proxies for project risk are used. The first is capital expenditures[1]. For real estate firms, if properties under management are relatively old, then we expect higher capital expenditures as reported in firm financial statements, and the payoffs from these properties are more sensitive to managerial effort. Also, firms with high capital expenditures require more intensive management effort, therefore their payoffs are sensitive to managerial effort. Based on this logic, the first proxy chosen for firm risk is capital expenditures. Another proxy for firm risk is firm landholding. Since payoffs of firms that hold more land for development tend to be more sensitive to managerial effort, a higher landholding is expected to associated with more secured debt usage. Now we get the next hypothesis:

Hypothesis 4: Firms with higher capital expenditures uses more secured debt in total debt.

Firm secured debt usage is proxied by secured leverage ratio, and the proportion of secured debt to total firm debt. These two ratios differ in that the secured leverage ratio also captures the total use of leverage. The secured leverage ratio includes several components. The primary component of secured debt is mortgage debt. Mezzanine debt and secured lines of credit are also included in total secured debt. On the other hand, unsecured debt includes corporate debt and unsecured lines of credit. The secured leverage ratio is calculated in two different ways: (1) the secured market leverage ratio and (2) the secured book leverage ratio. The secured market leverage ratio is the ratio of secured debt to the market value of total assets; and the secured book leverage ratio is the ratio of secured debt to the book value of total assets. Another important measure of secured debt ratio is the proportion of secured debt in total debt, which is calculated as the ratio of secured debt ratio over total leverage ratio.

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[1]Capital expenditures for real estate firms normally include leasing commissions, major repairs or replacement of expensive physical elements of buildings, expanding or otherwise contributing to the amount or quality of the space available for leasing, etc. (Young, 1996)

3 Empirical Analysis

3.1 Data

The data used in this research comes from several different sources. Data combines REIT executive compensation data from the SNL database and the Compustat Executive Compensation database, with stock return information from the Center for Research in Security Prices (CRSP) database, and accounting variables from the Compustat. Overall, the data includes annual compensation of top executives and firm financial statement data for U.S. equity REITs. Companies with missing data are excluded. After merging these different data sources, the final sample covers annual data from the period 2001 to 2005, and includes 280 CEO-year observations. According to property sector classification from the SNL database, the final sample includes REITs of the following property sector: office, diversified, industrial, multi-family, retail, and self-storage. This is the primary sample set of data used for estimation. SNL compensation data combined with Compustat and CRSP data is used to augment the data sample as a supplemental sample. The supplemental sample has 433 CEO-year observations and is used in the panel data analysis. It covers the period from 2000 to 2007, and the sample includes office, industrial, specialty, multi-family, hotel, diversified, regional mall, and shopping center REITs. Although the supplemental sample has more observations and longer time periods, the executive compensation data is limited compared to the main sample.

3.2 Summary Statistics

The summary statistics for key variables are listed in Table 1. Data includes annual observations from COMPUSTAT Execucomp, SNL and CRSP databases. The definitions of variables are as follows. *Salary* is the dollar value of the base salary earned by the executive during the year. *Bonus* is the dollar value of the bonus earned by the executive during the year. $Vega$ is the dollar change in the executive's compensation for a 0.01 change in the standard deviation of firm stock price return. *Delta* is the dollar change in the executive's compensation for a 1% change in firm stock price. *Incentive* is the proportion of incentive payments (other than cash compensation) in executives total compensation. *Age* is the current age of the executive at the year of observation. *Gender* equals one if the executive is a male and zero if the executive is a female. *Board* equals one if the executive is a board member and zero otherwise. Firm *Size* is measured as the total assets of the firm. q is the market value of firm assets divided by the book value. *Secured* is the proportion of secured debt in total debt. *SecuredBook* is the secured book leverage ratio. $CAPX$ is capital expenditure scaled by the book value of total assets. *Land* is the value of land over the book value of total assets. $Profitability$ is the return on assets, measured as EBITDA scaled by assets. We winsorize $Vega$, *Delta*, and *Salary* at the 1st and 99th percentiles. Mean (median) $Vega$ is \$117,510 (\$79,660), mean (median) *Delta* is \$253,990 (\$107,490), and mean (median) *Salary* is \$360,720 (\$340,000).

Pairwise correlation analysis of the variables is presented in Table 2. Results from the correlation analysis show, as the age of the CEO increases, the amount of salary, bonus and total compensation increase. The value of *Delta* and $Vega$ also increase. At the same time, a male CEO has higher *Delta* and $Vega$ than a female CEO. REIT data shows as a REIT grows in size, the proportion of secured debt as a percentage of total leverage decreases.

3.3 Simultaneous regressions

A three-stage least square regression is applied as executive compensation, firm investment decisions, and firm financing decisions might be simultaneously correlated. The structure of the equations are as following:

debt structure=f(compensation, investment, control variables)

compensation=f(debt structure, investment, control variables, instruments)

investment=f(compensation, debt structure, control variables, instruments)

The secured debt usage is specified in the first estimation equation. It is expected to find significant effects of compensation and firm risk taking on firm secured debt usage. $CAPX$ is used as the proxy for firm investment risk taking. Other variables included in the estimation include firm size, age, Q, firm profitability, interest rate, and firm land holding.

The compensation estimation equation isolates determinants of executive compensation as it interacts with firm risk taking and firm capital structure. The executive compensation policy might be affected by firm investment and capital structure decisions (Coles, Daniel and Naveen, 2006). Executive age and gender are included as instrumental variables in the specification. Firm investment risk taking decision is specified in the final equation. We expect firm investment decisions to react to executive compensation structures. Property type and year fixed effects are included in the model specifications in addition to an intercept term.

The choice between secured debt and unsecured debt might be affected by firm secured debt capacity, which can not be observed directly. At the same time, variables that capture firm investment risks, such as $CAPX$, property type, etc, may also affect firm secured debt capacity. This will bias the estimation results. To address this concern, I estimate firm secured debt capacity by regressing the secured debt ratio, unsecured debt ratio, and total debt ratio on several control variables. The results from this procedure allow for the determination of the estimated debt capacity level. By including estimated debt capacity in the primary estimation, the model can tease out the potential influence of firm asset characteristics on the choice between secured debt and unsecured debt due to debt capacity.

To estimate the determinants of secured debt capacity, a regression of secured debt on several variables is conducted. $Profitability$ is the ratio of $EBITDA$ over total assets. *Rating* is a dummy variable which equals one if the firm has a credit rating given from one or more of rating agencies ($S\&P$, Moody, and Fitch), and zero otherwise.

Table 3 displays the estimation results associated with debt capacity. The results show larger firms and more profitable firms tend to have more secured debt capacity. Higher $CAPX$ reduces the secured debt capacity. On the other hand, with a higher holding of land as a proportion of firm assets, secured debt capacity is increased. The effect of the credit rating on secured debt capacity is negative, which might be due to covenants on issuing unsecured debt. The results are consistent using both secured book leverage ratio and secured market leverage ratio. Regressions on both unsecured debt book ratio and unsecured debt market ratio show $CAPX$ affects the unsecured debt ratio positively, which means that firms with higher $CAPX$ (scaled by total assets) has lower secured debt capacity. Having a credit rating obviously implies more unsecured debt usage for the firm. For total book leverage and total market leverage, the results are less obvious.

Table 4 presents the results of the regressions testing the interaction among $Delta$, $CAPX$ and proportion of secured debt in total debt. In Panel B, all variables are first-differenced to control for firm fixed effects. Results of the compensation estimation equation show that $Delta$ increases as executive age increases, and male executives tend to have higher $Delta$. Results of the second estimation equation show that although variables such as firm age, size, cash flow, firm growth rate and profitability ratio have significant effect on $CAPX$, $Delta$ has insignificant effect on $CAPX$. This means that higher $Delta$ does not imply more risk taking, which is different from $Vega$.

The secured debt estimation shows $Delta$ has a significant positive coefficient. This implies that as the executive compensation is more sensitive to firm stock price, it is expected to see a higher secured debt usage. Similarly, a higher firm investment risk taking also implies a higher secured debt usage. This is consistent with the implications of the model. We also find a positive effect of land holding on firm secured debt usage. On the other hand, a debt rating has a negative effect on secured debt usage. More profitable firms also have a higher secured debt ratio. Q affects secured debt ratio negatively. Results from Panel B and consistent with the results from Panel A and together they show the connection between $Delta$, $CAPX$ and secured debt usage.

Table 5 presents results on simultaneous regressions between $Vega$, $CAPX$ and use of secured debt. Both Panel A tests and Panel B tests show $Vega$ affects $CAPX$ positively, which is consistent with the hypothesis that firms with higher $Vega$ choose riskier investment. The results show that $Vega$ have a significant positive effect on the use of secured debt. At the same time, higher $CAPX$ also implies higher usage of secured debt. Increasing $Vega$ by one standard deviation implies a 31%increase in capital expenditures (change of 0.025 relative to an average of 0.08). We can also see that increasing $CAPX$ by one standard deviation implies a 10% increase in secured debt usage (change of 0.07 relative to an average of 0.71). This confirms the conclusions from the model. If we compare the results in Table 5 and Table 4, we can see that $Vega$ does a better job in inducing the manager to take risky investment compared to $Delta$. This is due to the fact that $Vega$ captures the sensitivity of executive compensation to firm stock return volatility, while $Delta$ is the sensitivity of executive compensation to firm stock return, so $Vega$ induces more risk taking.

Three stage least squares estimation allows us to disentangle the causalities between the variables. In the system of equations, what is most interesting to us is the secured debt estimation equation. Besides the three stage least squares estimation reported in the paper, iterated three stage least squares estimation is also carried out and the result is not reported here as the results of the iterated three stage least squares estimation are similar to the three stage least squares estimation. In next sections, several robustness checks are conducted using different econometric methods and different proxies of variables.

3.4 Dynamic Panel Data Analysis

In this section, a test is conducted to measure the connection between secured debt usage and executive compensation using the supplementary sample. The panel data in the supplementary sample allows us to run a panel data estimation and better understand the evolution of secured debt ratio. The Arellano-Bond (1991) difference generalized-method-of moments (GMM) estimator first proposed by Holtz-Eakin, Newey and Rosen (1988) is used.

The regression to be estimated is:

$$secured_{i,t} = \beta_1 secured_{i,t-1} + \beta_2 comp_{i,t} + \beta_3 risk_{i,t} + \beta_4 controls_{i,t} + \mu_{i,t} \tag{32}$$

where

$secured_{i,t}$ is the secured debt ratio for firm i at year t;

$comp_{i,t}$ is the proxy of the compensation structure for the executives of firm i at year t;

$risk_{i,t}$ is the proxy of the investment risk for firm i at year t;

$controls_{i,t}$ includes control variables such as firm size, profitability ratio, market-to-book ratio, etc;

and $\mu_{i,t} = \eta_i + \epsilon_{i,t}$, where η_i is unobserved firm fixed effect and $\epsilon_{i,t}$ is the error term.

To cope with the firm fixed effects, take the first difference:

$$\Delta secured_{i,t} = \beta_1 \Delta secured_{i,t-1} + \beta_2 \Delta comp_{i,t} + \beta_3 \Delta risk_{i,t} + \beta_4 \Delta controls_{i,t} + \Delta\mu_{i,t} \tag{33}$$

Since the firm fixed effect does not vary over time, it is removed. $\Delta\mu_{i,t} = \mu_{i,t} - \mu_{i,t-1} = \epsilon_{i,t} - \epsilon_{i,t-1}$. In the estimation, the instruments include past levels of endogenous variables and exogenous instrument variables, such as executive age, executive gender and firm cash flow. To increase the efficiency of the estimation, the level equation is added to the estimation as a second equation.

The GMM estimation result is shown in Table 6. *Secured* is the proportion of secured debt in total debt, and incentive pay is the proportion of stock and options in total executive compensation. From the results, we can see a higher incentive payment induces an increase of secured debt within total debt. This is consistent with the model. The results also show that as the firm age grows, there is more unsecured debt in the firm debt structure. The estimated coefficient of variable *Profitability* shows that more profitable firms use more secured debt in total debt. Using the log of executive base salary as a proxy for executive compensation, results show that the higher an executive's base salary, the less secured debt is used in firm debt structure. Since a higher base salary implies executive compensation is less sensitive to firm value or stock return volatility, the negative coefficient of $Salary$ on $Secured$ is consistent with the implications of the model. Across all estimation results, $CAPX$ affects secured debt positively. A higher $CAPX$ is associated with investment more sensitive to managerial effort, so the positive coefficient implies that such investment uses more secured debt. Instruments include executive age, executive gender, and firm cash flow. In each estimation, the $p-value$ of the Sargan test shows that the instruments are exogenous.

As a robustness check, salary is used as an alternative measure of executive compensation to estimate the equations. It is expected that an inverse relation exists between salary paid and managerial risk taking. Table 7 displays results of the regression. Consistent with the model, results show that higher salary decreases the ratio of secured debt in total debt. We can also find that higher salary causes a decrease in firm investment risk-taking. Firm investment risk-taking has a positive effect on secured debt usage, which is consistent with the model prediction.

In summary, the results indicate that when firm executive compensation has a higher variable compensation, there is more secured debt in total firm debt. Different measures of executive compensation structures are used in the analysis. $Delta$ and $Vega$ have positive effect on secured debt usage. $Vega$ also affects firm capital structure decisions through its effect on firm investment decision. On the other hand, $Salary$ affects secured debt usage negatively.

4 Conclusion

This paper examines the relationship between executive compensation and firm debt structure. A theoretical model is constructed to show how executive compensation affects firm investment and financing decisions. Depending on the compensation contract, executives make investment and financing decisions that maximize their own payoffs. The model shows that executive compensation affects firm debt structure through its effect on firm investment. The model also shows that for riskier projects, the optimal debt contract should be secured debt.

The empirical research conducted pulls from REITs data to verify relationships and links between executive compensation structure and firm debt structure. The sensitivity of CEO wealth to firm stock price volatility leads to increased use of secured debt by the firm. The sensitivity of CEO wealth to firm stock price and use of secured debt show a similarly positive relationship. Dynamic panel data analysis confirms these findings, indicating that executives use more secured debt if their compensation entails a high proportion of equity incentives.

These findings establish the connection between executive compensation and firm debt structure, and suggest an economic relationship between capital structure and executive compensation practices. Evidence from this research shows that firm investment links capital structure and executive compensation. Based on the results of this research, studies of compensation and debt structure can no longer ignore these close relationships between executive compensation, firm investment and capital structure.

This paper contributes to the literature by connecting executive compensation with capital structure of REITs. Findings of this paper shed some light into the optimal design of executive compensation structure to better align the interests of shareholders and managers. Executives should be provided with proper incentives to make the best investment and financing decisions for the shareholders of the firms. Optimal executive compensation contracts should consider the characteristics of firm assets, and the impact of manager's compensation on firm investment and financing decisions. For example, to give the mangers more incentives to take risks, a compensation contract with high $Vega$ might be more appropriate.

At the same time, the findings also suggest the agency problems between firm executives and shareholders should be considered in analyzing the firm debt structure. Lenders may have a better understanding of manager's risking taking and effort choices by analyzing executive compensation contract. Managers with different compensation contracts may choose different risk levels for firms and use different levels of efforts. Lenders may use this information to have better monitoring of the borrowers.

Future research should carry out more detailed analysis about executive' incentives, and how executives' incentives affect different aspects of firm investment and financing decisions. It is also interesting to analyze how executive compensation affects the secured debt usage for common corporations. An optimal executive compensation structure should be designed to consider the influence of executive compensation on firm investment and financing decisions. It should also consider firm asset characteristics and manager's types. The measures of executive compensation in this research come from studies on executive compensation for common corporations. One interesting future research topic is to design unique measures of executive compensation for REITs based on how we evaluate the performance of REITs managers.

Table 1: Summary statistics

	Mean	Stdev	25th percentile	50th percentile	75th percentile
Executive characteristics					
$Salary$(\$000s)	360.72	149.25	258.50	340.00	442.16
$Bonus$(\$000s)	351.00	286.42	150.50	300.00	487.00
$Total\ Comp$(\$000s)	2167.36	1907.72	829.72	1672.43	3000.89
$Vega$(\$000s)	117.51	156.37	37.06	79.66	146.99
$Delta$(\$000s)	253.99	473.42	50.01	107.49	275.76
$Incentive\ Pay$	0.57	0.19	0.43	0.60	0.72
Age	56.41	7.75	52	57	61
$Gender$	0.92	0.25	1	1	1
$Board$	0.51	0.50	0	1	1
Firm characteristics					
$Size$(MM\$)	5390.63	3438.17	3078.64	4798.06	6138.59
$Firm\ Age$	10.70	4.41	8	10	11
Q	1.33	0.23	1.18	1.33	1.54
$Secured$	0.71	0.33	0.19	0.53	0.84
$SecuredBook$	0.39	0.15	0.08	0.34	0.57
$CAPX$	0.08	0.22	0.08	0.10	0.24
$Land$	0.18	0.05	0.11	0.16	0.21
$CashFlow$	0.03	0.01	0.02	0.04	0.06
$profitability$	0.10	0.16	0.01	0.09	0.13

Table 2: Pairwise Correlation

	Salary	*Bonus*	*Total Comp*	*Vega*	*Delta*	*Incentive Pay*	*Age*	*Gender*
Salary	1.00	0.69	0.64	0.31	0.37	0.14	0.30	0.04
Bonus		1.00	0.81	0.39	0.23	0.30	0.24	-0.06
Total Comp			1.00	0.51	0.27	0.61	0.16	-0.03
Vega				1.00	0.57	0.41	0.20	0.09
Delta					1.00	0.11	0.36	0.09
IncentivePay						1.00	-0.02	-0.12
Age							1.00	0.01
Gender								1.00
	Size	*Q*	*Secured*	σ	*profitability*	*CAPX*		
Size	1.00	-0.07	-0.15	-0.25	-0.07	0.49		
Q		1.00	-0.28	0.14	-0.04	-0.13		
Secured			1.00	0.20	0.22	0.14		
σ				1.00	0.21	-0.09		
Profitability					1.00	-0.02		
CAPX						1.00		

Table 3: Estimation of Debt Capacity

Dependent variable *SecuredBook* equals the ratio of secured debt over the book value of total assets. *SecuredMarket* equals the ratio of secured debt over the market value of total assets. The Ordinary Least Squares Estimation is applied. Dummies for property type are included in the estimation. ***, **, * indicate statistical significance at the 1%, 5% and 10% test levels.

	SecuredBook	*SecuredMarket*	*UnsecuredBook*	*UnsecuredMarket*	*BookLeverage*	*MarketLeverage*
size	-0.098***	-0.081***	0.138***	0.113***	-0.023**	-0.029**
CAPX	-0.248***	-0.239***	0.052***	0.039***	-0.097***	-0.134***
land	1.213***	0.985***	-0.056	-0.056	-0.019	0.221
profitability	0.312***	0.253***	-0.036	0.146	0.221	0.999**
rating	-0.668***	-0.598***	0.325***	0.340***	-0.030	-0.124***
age	-0.016***	-0.015***	0.020***	0.015***	0.003**	-0.002
Q	-0.084***	-0.0129***	-0.045**	-0.197***	-0.113***	-0.333***
R-Square	0.632	0.630	0.904	0.866	0.433	0.513

Table 4: Simultaneous equations (3SLS): *Delta*, investment, and capital structure

Simultaneous regressions of *Delta*, CAPX, and proportion of secured debt in total debt are listed below. ***, **, * indicate statistical significance at the 1%, 5% and 10% test levels. In Panel B, all the variables are first-differenced to control for firm fixed effects.

Panel A	*Delta*	*CAPX*	*Secured*
Delta		0.353e-4	0.020e-3**
CAPX	0.505e3**		0.110***
Secured	0.928e3	-0.404*	
Capacity(BookLeverage)			0.742***
Land			0.224**
Rating			-0.107***
Profitability	0.261e3**	-3.329**	0.533***
Size	0.527e4*	0.179***	-0.250
r			-0.350
Growth		6.902***	-7.873***
CashFlow		-0.933***	
Executive Age	0.151e2***		
Firm Age	-0.430e2	-0.019***	-0.015**
Board	2.165e2***		
Gender	0.276e3***		
Q	-0.729e2**	-0.056	-0.153***
Weighted R^2	0.711	0.711	0.711
Panel B	*Delta*	*CAPX*	*Secured*
Delta		0.197e-4	0.016e-3***
CAPX	0.563e3**		0.312***
Secured	0.989e3*	-0.374**	
Capacity(BookLeverage)			0.751***
Land			0.453***
Profitability	0.584e3***	-4.823**	0.396***
Size	0.203e3	0.156***	-0.162*
r			0.612
Growth		6.355***	
CashFlow		-0.626***	
Executive Age	0.783e2**		
Firm Age	-0.618e2**	-0.082**	-0.059*
Q	-0.718e2	0.138	-0.279***
Weighted R^2	0.743	0.743	0.743

Table 5: Simultaneous equations (3SLS): $Vega$, investment and capital structure

Simultaneous regressions of $Vega$, $CAPX$, and the proportion of secured debt in total debt are listed below. ***, **, * indicate statistical significance at the 1%, 5% and 10% test levels. In Panel B, all the variables are first-differenced to control for firm fixed effects.

Panel A	$Vega$	$CAPX$	$Secured$
$Vega$		1.600e-4**	0.350e-3***
$CAPX$	0.298e3**		0.308***
$Secured$	0.631e3***	-0.566	
$Capacity(BookLeverage)$			1.245***
$land$			0.362**
$Rating$			-0.125***
$Profitability$	0.104e3	2.460**	0.452***
$Size$	0.016e3*	0.176***	-0.235
r			-0.677
$Growth$		4.369***	-5.736***
$CashFlow$		-0.758***	
$Executive\ Age$	0.241e2**		
$Firm\ Age$	-6.946	-0.020***	-0.020***
$Gender$	0.703e2**		
$Board$	1.119e2***		
Q	0.243e3**	-0.136	-0.176***
Weighted R^2	0.755	0.755	0.755

Panel B	$Vega$	$CAPX$	$Secured$
$Vega$		1.489e-4**	0.412e-3***
$CAPX$	0.358e3**		0.373***
$Secured$	0.674e3**	-0.731**	
$Capacity(BookLeverage)$			1.643***
$Land$			0.379**
$Profitability$	0.129e3	3.548***	0.465***
$Size$	-0.096e3*	0.352***	-0.549**
r			-0.937*
$Growth$		6.167**	-3.128**
$CashFlow$		-1.203***	
$Executive\ Age$	0.951e2**		
$Firm\ Age$	-7.432*	-0.195**	-0.029***
Q	0.357e3**	-1.792	-0.353***
Weighted R^2	0.699	0.699	0.699

Table 6: System GMM Estimation

The dependent variable *Secured* equals the ratio of secured debt over total debt. Property type and year-fixed effects are controlled for in the estimation. ***, **, * indicate statistical significance at the 1%, 5% and 10% test levels. Incentive pay and logarithmic value of *Salary* are used as measures of executive compensation in the estimation.

	Secured			
Incentive Pay	0.440**		0.299**	
Salary		-0.030***		-0.018*
CAPX	0.205***	0.105**	0.139**	0.155***
Land	0.463	0.078	0.403***	0.203**
Secured(lag)	0.933***	0.914***	0.932***	0.914***
Profitability	1.442***	3.539***	1.106***	2.235***
Capacity(SecuredBook)	0.387***	0.637***		
Capacity(BookLeverage)			0.281***	0.240***
Size	-0.185***	-0.224***	-0.174***	-0.185***
OP	0.375***	0.423***	0.309***	0.436***
Sargan test (P-value)	0.387	0.313	0.339	0.406

Table 7: Simultaneous equations (3SLS): *Salary*, investment and capital structure

Simultaneous regressions of *Salary*, *CAPX*, and the proportion of secured debt in total debt are listed below. ***, **, * indicate statistical significance at the 1%, 5% and 10% test levels. The logarithmic value of *Salary* is used as the measure of executive compensation in the estimation.

Independent	*Salary*	*CAPX*	*Secured*
Salary		-0.0497**	-0.051***
CAPX	-0.299**		0.178***
Secured	-1.744***	-0.598**	
Capacity(BookLeverage)			0.212***
Land			1.938***
Rating			-0.073***
Profitability	1.136**	4.311	0.708***
Size	0.213**	0.188***	-0.296**
r			-0.093**
Growth		0.047***	-0.104***
CashFlow		-2.469***	
Executive Age	0.169***		
Firm Age	-0.001**	-0.052***	-0.017**
Q	-0.469**	-0.190*	-0.152***
Weighted R^2	0.743	0.743	0.743

5 Appendix

5.1 Proof of Proposition 1

Proposition 1: Assume there is no moral hazard problem and $(\overline{h}-\underline{h})[(\alpha+\beta)\overline{R}-\beta z-\alpha\underline{R}+L] < \overline{V}-\underline{V} < (\overline{q}-\underline{q})[(\alpha+\beta)\overline{R}-\beta z-\alpha\underline{R}+L]$*, then*

(1) The less risky borrower will use unsecured debt with interest rate $r_{\overline{\theta},\underline{a},u} = \frac{1}{\underline{h}}$*;*

(2) The risky borrower will use unsecured debt with interest rate $r_{\underline{\theta},\overline{a},u} = \frac{1}{\overline{q}}$

Proof. The interest rates for secured debt and unsecured debt are determined by the lender's zero expected profit condition. For secured debt:

$$r_{\overline{\theta},a,s} = \frac{1-(1-p(\overline{\theta},a))(\underline{R}-C)}{p(\overline{\theta},a)} \tag{34}$$

For unsecured debt:

$$r_{\overline{\theta},a,u} = 1/p(\overline{\theta},a) \tag{35}$$

Manager's payoff when using secured debt equals:

$$= p(\overline{\theta},a)[(\alpha+\beta)(\overline{R}-r_{\overline{\theta},a,s})-\beta z]-V-(1-p(\overline{\theta},a))L \tag{36}$$

Manager's payoff when using unsecured debt equals:

$$= p(\overline{\theta},a)[(\alpha+\beta)(\overline{R}-r_{\overline{\theta},a,u})-\beta z]+(1-p(\overline{\theta},a))\alpha\underline{R}-V-(1-p(\overline{\theta},a))L \tag{37}$$

As we have calculated $r_{\overline{\theta},a,u}$, $r_{\overline{\theta},a,s}$, we can easily find that equation (36) is less than equation (37). This implies that unsecured debt will be used by the borrower, and this applies to both the high effort choice and the low effort choice. The result also holds for a risky project.

Now, I need to find out the optimal effort choice made by the managers in the first best equilibrium. First, I look at the effort choice of the less risky project manager. With high effort choice $\overline{a}$ and unsecured debt, the payoff to the manager is:

$$= \overline{h}[(\alpha+\beta)(\overline{R}-\frac{1}{\overline{h}})-\beta z]+(1-\overline{h})(\alpha\underline{R}-L)-\overline{V} \tag{38}$$

If low effort $\underline{a}$ is used, then the payoff to the manager is:

$$= \underline{h}[(\alpha+\beta)(\overline{R} - \frac{1}{\underline{h}}) - \beta z] + (1-\underline{h})(\alpha \underline{R} - L) - \underline{V} \tag{39}$$

For the risky project manager, the payoff with effort $\overline{a}$ and unsecured debt is as following:

$$= \overline{q}[(\alpha+\beta)(\overline{R} - \frac{1}{\overline{q}}) - \beta z] + (1-\overline{q})(\alpha \underline{R} - L) - \overline{V} \tag{40}$$

The payoff with effort $\underline{a}$ is:

$$= \underline{q}[(\alpha+\beta)(\overline{R} - \frac{1}{\underline{q}}) - \beta z] + (1-\underline{q})(\alpha \underline{R} - L) - \underline{V} \tag{41}$$

Although the other cases are also interesting, I will focus on the case when

$$(\overline{h} - \underline{h})[(\alpha+\beta)\overline{R} - \beta z - \alpha \underline{R} + L] < \overline{V} - \underline{V} < (\overline{q} - \underline{q})[(\alpha+\beta)\overline{R} - \beta z - \alpha \underline{R} + L] \tag{42}$$

That is $a^* = \overline{a}$ for the risky project and $a^* = \underline{a}$ for the less risky project. ∎

5.2 Proof of Proposition 2

Proposition 2: When manager's effort can not be observed

(1) The less risky borrower will use unsecured debt with interest rate $r_{\overline{\theta},\underline{a},u} = \frac{1}{\underline{h}}$*;*

(2) Given $(\overline{q} - \underline{q})[(\alpha+\beta)(\overline{R} - \frac{1-(1-\overline{q})(\overline{R}-C)}{\overline{q}}) - \beta z + L] > \overline{V} - \underline{V}$*, the risky borrower will use secured debt with interest rate* $r_{\underline{\theta},\overline{a},s} = \frac{1-(1-\overline{q})(\underline{R}-C)}{\overline{q}}$

Proof. Since unsecured debt with effort $\overline{a}$ suffers a moral hazard problem, the lender can not break even and suffers a loss. The alternative choices for the debt structure are listed below.

(1) Unsecured debt with induced effort level $\underline{a}$

(2) Secured debt with induced effort level $\underline{a}$

(3) Secured debt with induced effort level $\overline{a}$

Debt structure (2) is not an optimal choice, as the manager's payoff is inferior to debt structure (1), which has been proven earlier, in the case with no moral hazard.

If debt structure (3) is used, i.e. secured debt based on effort $\overline{a}$, and

$$E(Comp(\alpha, \beta, \underline{\theta}, \underline{a}, r_{\underline{\theta},\overline{a},s})) - V(\underline{a}) - (1 - p(\underline{\theta}, \underline{a}))L \leq E(Comp(\alpha, \beta, \underline{\theta}, \overline{a}, r_{\underline{\theta},\overline{a},s})) - V(\overline{a}) - (1 - p(\underline{\theta}, \overline{a}))L \tag{43}$$

then moral hazard problem can be mitigated. Equation (43) can be expressed as:

$$\begin{aligned} &\underline{q}((\alpha+\beta)(\overline{R} - \frac{1-(1-\overline{q})(\underline{R}-C)}{\overline{q}}) - \beta z) - \underline{V} - (1-\underline{q})L \\ &> \overline{q}((\alpha+\beta)(\overline{R} - \frac{1-(1-\overline{q})(\underline{R}-C)}{\overline{q}}) - \beta z) - \overline{V} - (1-\overline{q})L \end{aligned} \tag{44}$$

$$(\overline{q} - \underline{q})[(\alpha+\beta)(\overline{R} - \frac{1-(1-\overline{q})(\overline{R}-C)}{\overline{q}}) - \beta z + L] > \overline{V} - \underline{V} \tag{45}$$

If Equation (45) holds, then debt structure (3) generates no moral hazard problem. We also find that if Equation (45) holds, then debt structure (3) generates higher payoff to the manager than debt structure (1). The equilibrium contract for the risk borrower is secured debt and the equilibrium effort level is $\overline{a}$. ■

5.3 Proof of Proposition 3

Proposition 3: The compensation contract for the risky investment, (α_r, β_r)>(α_l, β_l), which is the optimal compensation contract for the less risky investment.

Proof. The optimal compensation contract for the less risky project, (α_l, β_l), should satisfy the participation constraint: Equation (24) ≥ 0. At the same time, it should satisfy: Equation (25) ≤ 0. The optimal compensation contract for the risky project, (α_r, β_r), should satisfy the participation constraint: Equation (23) ≥ 0. At the same time, it should satisfy: Equation (25) ≥ 0. It is obvious that (α_r, β_r)>(α_l, β_l). ■

5.4 Estimate of $Delta$ and $Vega$

Using the Black-Scholes formula for valuing European call options, as modified by Merton (1973) to account for dividend payouts,

$$Option\ Value = Se^{-dT}N(Z) - Xe^{-rT}N(Z - \sigma T^{\frac{1}{2}}), \tag{46}$$

where

$Z = [ln(S/X) + T(r - d + \sigma^2/2)]/\sigma T^{\frac{1}{2}}$

N=cumulative probability function for the normal distribution

S= price of the underlying stock

X=exercise price of the option

σ=expected stock-return volatility over the life of the option

r=natural logarithm of risk-free interest rate

T=time to maturity, in years, of the option

d=natural logarithm of expected dividend yield over the life of the option.

The sensitivity with respect to a 1% change in stock price is defined as:

$$[\partial(option\ value)/\partial(price)] * (price/100) = e^{-dT} N(Z) * (price/100) \tag{47}$$

The sensitivity with respect to a 0.01 change in stock-return volatility is defined as:

$$[\partial(option\ value)/\partial(stock\ volatility)] * 0.01 = e^{-dT} N'(Z) S T^{\frac{1}{2}} * (0.01) \tag{48}$$

where N' is the normal density function.

For previously granted exercisable and unexercisable stock options, I use the method in Ertugrul, Sezer and Sirmans (2008) to determine the exercise price and time-to-maturity data:

1. For exercisable options:

a. the exercise price X=S - [(Realizable value of the exercisable options - realizable value of new granted that are exercisable as of the fiscal year end)/(Number of exercisable options - number of newly granted options, which are exercisable as of the fiscal year end)]

b. the time-to-maturity, T =time-to-maturity of the unexercisable options - 3;

2. For unexercisable options:

a. the exercisable price X=S-[(Realizable value of the unexercisable options - realizable value of newly granted options that are unexercisable as of the fiscal year end)/(Number of unexercisable options - number of newly granted options that are unexercisable as of the fiscal year end0]

b. the time-to-maturity, T = average time-to-maturity of the newly granted options - 1.

The total sensitivity of the option portfolio is the sum of the sensitivities of newly granted options, exercisable options and unexercisable options weighted by the number of their respective shares.

*Total sensitivity =(Sensitivity of newly granted options * Number of newly granted options) + (Sensitivity of exercisable option * Number of exercisable options) + (Sensitivity of unexercisable option * Number of unexercisable options)*

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