CEO inside debt and risk taking: Evidence from property-liability insurance firms

Abstract

We examine the incentive effects of CEO inside debt (pensions and deferred compensation) on risk taking using the sample of the U.S. publicly traded property-liability insurers. To represent managerial risk-taking, we employ Value at Risk (VaR) and expected shortfall (ES) which capture extreme movements in the lower tail of insurer stock return distribution. We document that inside debt represents a significant component of CEOs' compensation in the insurance industry. The results indicate that there is a significant negative relationship between CEO inside debt holdings and risk-taking behavior, suggesting that CEO debt-like compensation can be an effective governance mechanism to reduce firm risk. The results are robust to alternative measures of key variables and various regression models.

Keywords: Inside debt; Risk taking; Managerial incentives; Property-liability insurance

Introduction

There has been a renewed interest in executive compensation issues from regulators, academic scholars, and the public following the recent financial crisis. While executive compensation as a governance mechanism has long been of academic as well as regulatory interests since the seminal work of Jensen and Meckling (1976), the major stream of the literature has focused on the role of equity-like compensation which aligns shareholder and managerial interests (e.g, Murphy, 1985; Morck, Shleifer, and Vishny, 1988; Coles, Daniel, and Naveen, 2006). However, the recent growing trend of the literature explores the importance of debt-like compensations (i.e., pensions and deferred compensation), collectively known as inside debt, in executive compensation packages. Because debt-like compensations are unsecured and typically underfunded obligations, they expose managers to the same default risks as outside creditors (e.g., Sundaram and Yermack, 2007; Wei and Yermack, 2011), suggesting that executives with inside debt holdings behave like the firm's bondholders. Consistent with this view, Cassell, Huang, Sanchez, and Stuart (2012) find that there is a significant incentive effect of inside debt that induces managers to exhibit high bondholder-like sensitivity to firm default risk. Supposing that banking industry played a central role in the financial crisis, recent studies explore the link between the executive inside debt holdings and managerial risk-taking. For example, Van Bekkum (2015) and Bennett, Güntay, and Unal (2015) show that executive inside debt holdings can significantly reduce the managerial risk-taking in the banking industry. These findings are consistent with the regulatory view that excessive and inappropriate executive compensation practices could lead to excessive managerial risk-taking in the banking industry[1].

[1] For example, in response to the financial crisis, Section 953 of Dodd Frank Wall Street Reform and Consumer Protection Act of 2010 was enacted to empower the Federal regulatory entities to prohibit any type of incentive-based compensation schemes that deemed to encourage inappropriate risk taking by covered financial institutions.

Although there is a subtle difference in business models between banking institutions and insurance companies, one might consider that insurance industry was also intensely involved in the financial crisis just like other financial firms. The spectacular near-collapse and the subsequent government rescue of American International Group (AIG) highlights this involvement and the potential costs of managerial excessive risk-taking faced by policyholders and the public. Despite some relevance of the insurance sector in the recent financial crisis, there is a lack of understanding in how the executive debt-like compensation structure or the use of inside debt has an influence on the managerial risk-taking in the insurance industry. This is somewhat surprising because consistent with studies of other non-insurance industries, equity-like compensations are shown to be effective contracting mechanisms in the insurance industry (e.g., Grace, 2004) and other forms of governance mechanisms such as boards and organizational structure of insurance firms are critical in controlling the considerable loss variability in the insurance industry (e.g., Ho, Lai, and Lee, 2013; Lamm-Tennant and Starks, 1993). Given the increasing attention paid to the role of debt-like compensation as a governance mechanism in other industries, whether there is a significant link between the managerial risk-taking and executive debt-like compensation holdings in the insurance industry is an empirical question that remains unanswered.

The purpose of this study is to provide the first empirical evidence to fill the gap in the insurance literature by exploring the effect of executive inside debt holdings on the managerial risk-taking. Based on the theoretical foundation of Jensen and Meckling (1976) who conjecture that inside debt can help minimize the cost of debt, we argue that unsecured and underfunded nature of inside debt induces executives to manage their firms more conservatively, thereby reducing their incentives to take more risk.

Employing the sample of CEOs from the (40) U.S. publicly traded property-liability insurance companies over the period 2006-2013, this study examines the average impact of inside debt on managerial risk-taking. We investigate a market-based measure of risk to represent managerial risk-taking. Consistent with the recent work of Van Bekkum (2015) who shows a significant impact of managerial inside debt holdings on bank risk-taking activities during the financial crisis period, we employ Value at Risk (VaR) and expected shortfall (ES) which capture the downside risk of a firm's stock performance. VaR and ES have been popular measures of risk for the market risk exposure of financial institutions and commonly employed in finance literature to estimate portfolio risk (e.g., Ané and Kharoubi, 2003; Rosenberg and Schuermann, 2006; Bali, Demirtas, and Levy, 2009).

Our inside debt data confirm that the magnitude and the prevalence of inside debt in executive compensation packages in the insurance industry is similar to or even more important than those of other industries. The average (median) value of CEO inside debt holdings for the publicly traded property-liability insurers is $7.9 million ($3.0 million). Similarly, Van Bekkum (2015) reports average (median) value of $4.28 million ($0.94 million) for the sample of banking industry[2]. CEO's average (median) debt-to-equity ratio (known as inside debt ratio) measured by total inside debt value divided by the value of equity compensation is 0.43 (0.16) for our insurer sample, whereas the sample of banking industry from Van Bekkum (2015) shows 0.25 (0.12). Outside of banking industry, Cassell et al. (2012) report the average (median) value of inside debt holding as $7.05 million ($2.87 million) along with the average (median) inside debt ratio of 0.40 (0.15).

[2] Somewhat noticeable differences in mean (median) value of inside debt between our sample and Van Bekkum's (2015) might be due to the fact that the sample of Van Bekkum (2015) includes small banks, while our source (Execucomp) of inside debt data does not include small firms.

Our empirical results indicate that there is a significant relationship between CEO inside debt holdings and risk-taking behavior. Consistent with theoretical predictions of Jensen and Meckling (1976) and Edmans and Liu (2011), managerial risk-taking is considerably lower for the firms with CEOs who hold a significant amount of inside debt in their compensation packages. The impact of inside debt holdings on managerial risk-taking is not only statistically significant, but is also economically meaningful. In particular, an increase in inside debt holdings by one standard deviation reduces the managerial risk-taking by about 18%-21%.

The literature suggests that potential endogeneity concerns arise when examining the effect of executive compensation structure on risk-taking behavior. To ensure that our results are not driven by the endogeneity problems, we perform two-stage least squares (2SLS) regressions with instrumental variables. In addition, we re-estimate the impact of CEO inside debt holdings on risk-taking using the firm fixed-effect models. We obtain consistent results through alternative regression models. Although it is difficult to rule out endogeneity issues completely, our research design allows us to confirm our findings that CEO inside debt can be used as a governance mechanism to incentivize CEO to reduce risk.

We conduct series of robustness checks additionally. Following the literature (e.g., Stiroh and Rumble, 2006; Laeven and Levine, 2009; Shim, 2015), we use the Z-score which has been widely used as a proxy measure of firm insolvency risk and find consistent results, suggesting that our initial measures of managerial risk-taking, VaR and ES, are reliable. We also measure risk from the perspective of shareholders. Equity-based compensation which has been found to be a critical governance mechanism in the insurance industry (e.g., Grace, 2004) encourages managerial risk-taking, while the inside debt which is believed to align managers' interests with those of bondholders discourages managers' risk-taking. These contrasting effects should be captured in measuring risk from the shareholder perspective if inside debt has its predicted governance mechanisms. Consistent with this view, we estimate various measures of stock return volatilities based on the three factor models and find similar results. We additionally report a significant negative relation between CEO inside debt and risk-taking when an alternative classification of inside debt holdings is used. Finally, excluding multiline insurers from the sample does not alter main results.

Our study contributes to the literature in three ways. First, this is the first study to document that inside debt represents a significant component of CEOs' compensation in the property-liability insurance industry, suggesting that understanding the incentive effects of CEO debt-like compensation is crucial because the use of inside debt is prevalent and its magnitude is substantial. Second, we provide evidence that CEO inside debt is an important governance mechanism to control for managerial risk-taking. While the importance of equity-based compensation has been examined in the insurance literature, this is, to the best of our knowledge, the first study that reports the governance effect of inside debt in the insurance industry. Third, the risk measures used in this study will provide a new avenue for identifying an appropriate risk measurement tool associated with governance issues in the insurance literature. The primary reason we choose VaR and ES for this study is related to insurer capital requirements. Capital serves as the financial cushion that insurance companies use to absorb adverse consequences due to unexpected catastrophic claims or unfavorable asset returns.[3] It can be assumed that all stakeholders are principally concerned with securing firm survival in a worst case scenario. Thus, the capital required for the firm begins with the quantification of a possible disaster (or the probability of failure) and can be determined by downside risk measure which is a function of VaR and ES. Because insurance business,

[3] Capital is used interchangeably with policyholder surplus in the insurance industry.

particularly for property-liability insurance industry, is the business of taking risks and extreme events are a major concern, VaR and ES which capture extreme movements in the lower tail of insurer stock return distribution seem to be the most appropriate measure of risk from the perspectives of both stockholders and bondholders, and to the extent of policyholders.

The paper is organized as follows. The Literature Review section provides a review of the literature on the relevant topic. The Methodology and Variable Estimation section discusses the regression model, dependent and independent variables used in this analysis. The Data Description section describes data sources and provides summary statistics for our sample. The results and additional tests are presented in the Empirical Results section. The paper ends with the Concluding Remark section.

Literature Review

In general, pensions and deferred compensation represent the main components of the executive debt-like compensation, which is also referred to as inside debt. Although disproportionate amount of attention has been paid to equity-like compensation in the governance literature, the inside debt is not new. For example, Bebchuk and Jackson (2005) report that the average actuarial value of pension holdings was $19.6 million for the CEOs of S&P 500 firms with ages between 63 and 67 in 2003. Similarly, Wei and Yermack (2011) show that in 2006 the average holdings of debt-like compensations by CEOs reported in Execucomp database is $5.7 million. Thus, the anecdotal evidence highlights the nontrivial nature of debt-like compensations in the U.S. executive compensation packages.

Despite the importance of inside debt in executive compensation packages, the incentive effects of inside debt are little known. In contrast, there is a broad consensus in the extant literature that the equity-like compensations are believed to align the CEO's interests with those of stockholders. The scarcity of research on inside debt in the extant literature is mainly due to the limited disclosure requirements related to executives' inside debt holdings prior to 2006. The Securities and Exchange Commission's (SEC) 2007 reform that promotes increased transparency in reporting of pension and deferred compensation further allows researchers to examine in details these components of inside debt.

A unique aspect of inside debt is that an executive's pension and deferred compensation constitutes an unsecured and potentially unfunded claim on the firm, thus turning the executive into another unsecured creditor of the firm. To preserve the tax-deferral benefits and to be exempt from the rules applicable to ordinary tax-qualified plans under Employee Retirement Income Security Act (ERISA), these executive pensions and deferred compensation are unfunded and unsecured (Liu, Mauer, and Zhang, 2014). Jensen and Meckling (1976) advance the theory that inside debt may alleviate the conflicts between stockholders and bondholders that result from the purely equity-aligned managers. Because of the inside debt's unsecured and underfunded nature that behave like risky debts, they dissuade the managers from taking excessive risk at the expense of bondholders and thereby align managerial incentives with those of bondholders.

Edmans and Liu (2011) extend the conjectures of Jensen and Meckling (1976) regarding the role of inside debt in executive compensation. In a corporation characterized by the two types of agency costs, agency costs of debt and equity, Edmans and Liu (2011) postulate that the inside debt holdings by executives induce them to align their interests with those of stakeholders, not with those of solely stockholders. The focus of Edmans and Liu (2011) is then the ratio of debt-to-equity ratios between the executive and firm. For instance, when a firm faces more significant agency cost of debt, employing a compensation structure where executive's leverage is greater than that of the firm will minimize the agency cost of debt.

Sundaram and Yermack (2007) provide one of the earliest empirical support for the conjecture advanced by Jensen and Meckling (1976) and Edmans and Liu (2011). Sundaram and Yermack (2007) find that the level of managerial pension holdings is negatively and significantly related to the probability of default, suggesting that high inside debt holdings curtail the executives' appetite for risk-taking behavior. Employing the event study methodology, Wei and Yermack (2011) find that bond prices rise, stock price fall, and volatility of both securities decline around the initial report of CEO's inside debt holdings following a 2007 SEC disclosure reform. More detailed analyses indicate that there are more pronounced reactions for the firms with a large level of CEO inside debt holdings. Cassell, Huang, Manuel Sanchez, and Stuart (2012) explore the relation between managerial risk-taking and inside debt holdings and provide evidence consistent with the predictions by Jensen and Meckling (1976) and Edmans and Liu (2011). Cassell, Huang, Manuel Sanchez, and Stuart (2012) show that their proxies of risk-taking behavior such as stock return volatility, R&D expenditure, and financial leverage are lower when a CEO holds a large level of inside debt, while the levels of diversification and asset liquidity that lead to lesser risk taking are high. Liu, Mauer, and Zhang (2014) report a positive relationship between CEO debt-like compensation and firm cash holdings, indicating CEOs' risk aversion propensity. Phan (2014) finds that there is a significant impact of CEO's inside debt holdings in mergers & acquisition decisions. Those firms with CEOs with high level of inside debt are involved in mergers & acquisitions that lead to positive abnormal bond returns and long-term operating performance and negative abnormal stock returns, suggesting that inside debt reduces the risk-taking appetite for CEOs during the M&A activities.

Chava, Kumar, and Warga (2010) examine whether inside debt has impact on the structure of bond covenants, the mechanisms believed to mitigate agency cost of debt. Consistent with predictions of Jensen and Meckling (1976) and Edmans and Liu (2011), they find a negative relation between the number of bond covenants and CEO inside debt. Anantharaman, Fang, and Gong (2014) report similar findings for the bank loans. Their results show that the bank loans are priced higher and have fewer covenants for the firms with CEOs with a high level of inside debt holdings.

Recently, some authors turn their attention to the banking industry. Van Bekkum (2015) reports that pre-financial crisis inside debt holdings by executives have a significant impact on the risk-taking behaviors during the financial crisis, and those banks led by CEOs with high level of inside debt experience lower level of losses and risk compared to those with CEOs with low inside debt holdings. Similarly, Bennett, Güntay, and Unal (2015) show that CEOs' higher level of inside debt holdings in the bank holdings companies are associated with lower default risk and better performance during the financial crisis.

Methodology and Variable Estimation

To explore the incentive effects of CEO debt-like compensation on risk-taking, we perform regressions using pooled cross-sectional and time series data. We also examine other factors that influence managerial risk-taking behavior by including CEO compensation characteristics, firm characteristics, and firm's governance characteristics as explanatory variables. Our primary regression model is specified as follows:

$$\begin{aligned} Risk_{i,t} &= \beta_0 + \beta_1 Relative\ Debt_{i,t} + \sum_{j=2}^{4} \beta_j Compensation\ Characteristics_{i,t} \\ &+ \sum_{j=5}^{11} \beta_j Firm\ Characteristics_{i,t} + \sum_{j=12}^{13} \beta_j Governance\ Characteristics_{i,t} \\ &+ \sum_{j=14}^{20} \beta_j Time_t + \varepsilon_{i,t} \end{aligned} \quad (1)$$

where *Risk* is the measures of managerial risk-taking which are VaR and ES estimated at 99.5%, 99%, and 95% confidence level for an insurer *i* in year *t*. The key variable of our interest is *Relative Debt*. Because *Relative Debt* is highly skewed as shown in the descriptive statistics, we apply a log transformation to this variable and winzorize at the 2.5^{th} and 97.5^{th} percentile following the literature (Van Bekkum, 2015). The expected negative coefficient on *Relative Debt* supports the theoretical view that debt-like compensation can reduce the managerial risk-taking. *The Compensation Characteristics* include the equity compensation incentives and CEO total compensations. We apply a log transformation to these variables following DeYoung, Peng, and Yan (2013). We add 1 to the value of the equity compensation incentives before applying the log transformation to save the sample with zero value. The *Firm Characteristics* include firm size, product and geographic diversification, premium growth rate, bond investment, ROA, and homeowners share. The *Governance Characteristics* include the board size and the proportion of independent directors. The *Time* represents year dummies.

Risk Measures

VaR has become one of the standard instruments for measuring risk and commonly employed by financial institutions and their regulators in setting and assessing capital requirements for market risk exposure. VaR is a statistical measure of downside risk and can be defined as the maximum expected loss that could occur on a portfolio of assets over a given time period at a specified confidence level (Crouhy, Galai, and Mark, 2001; Jorion, 2006). Although the number and types of approaches to estimating VaR have been growing exponentially, we follow Van Bekkum (2015) for the purpose of this study. We consider a real-valued random variable R that represents a firm's stock returns in a specified time period with the distribution, $F(r) = P\{R \le r\}$. Then, the worst return is simply infinity since F is unbounded in most models and the worst possible return is given by $\inf\{r : F(r) = 1\}$ on the real line, where 'inf' denotes a greatest lower bound. For each α, $0 < \alpha < 1$, the VaR is given by the smallest number r such that the probability that the return R does not exceed r is at least α. In mathematical terms, the VaR with a specified level of α is defined as[4]

$$VaR_{\alpha}(R) = \inf\{r : F(r) \geq \alpha\}. \tag{2}$$

VaR can be derived by reading the quantile off the actual empirical distribution that corresponds to the selected confidence level, 100 (1-α)%.[5] Bali, Demirtas, and Levy (2009) show that this simple non-parametric approach to calculating VaR produces similar results when compared with alternative measures of more sophisticated parametric VaR.[6]

VaR provides an aggregate measure of risk, summarizing risks in a single number in a portfolio framework. This explains why VaR is a crucial tool for conveying risk information to senior management and shareholders (Jorion, 2006). However, VaR has some limitations as a risk measure. For example, VaR does not capture statistical properties of the significant loss beyond the quantile point of interest. Thus, even if the severity of losses doubles beyond quantile point, the VaR figure may not be influenced and gives us no indication of how much (i.e., a loss in excess of VaR) that might be. Another fundamental problem is that VaR is not a coherent risk measure because it does not satisfy the subadditivity condition in general.[7] If the underlying risk factor is

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[4] VaR is also formulated by the survival (or reliability) function, $S(r) = P(R > r)$, such that $VaR_{\alpha}(R) = \inf\{r : S(r) \leq 1-\alpha\}$.

[5] The confidence level can be viewed as the risk of insolvency during a defined time period at which management has chosen to operate. The higher the confidence level selected, the lower the probability of insolvency.

[6] Krugman (2000) argues that complicated models are not necessarily more accurate than simple ad-hoc models.

[7] Artzner, Delbaen, Eber, and Heath (1999) present and justify the following four desirable properties for a measure of risk: monotonicity, subadditivity, positive homogeneity and translation invariance. A risk measure that satisfies all these conditions is called a coherent risk measure. The property of subadditivity implies that capital requirement for

an elliptical distribution, the use of VaR as a risk measure makes sense because VaR is a coherent risk measure. This is of limited consolation since there is increasing evidence in the empirical studies that financial asset returns are not normally distributed and their distributions exhibit heavy tails (e.g., Longin and Solnik, 2001; Dowd and Blake, 2006). Nonetheless, the VaR is a still widely used risk measure in finance literature to assess the risk associated with any type of portfolio positions (e.g., Ané and Kharoubi, 2003; Rosenberg and Schuermann, 2006). Dhaene, Laeven, Vanduffel, Darkiewicz, and Goovaerts (2008) propose that a risk measure for determining the solvency capital requirement should satisfy the regulator's condition (this condition is interpreted as a compromise between the subadditivity requirement and the requirement of "not too subadditive"). They show that when substituting the subadditivity condition by the regulator's condition, VaR is the most efficient capital requirement in the sense that it minimizes some reasonable cost function.[8]

To address some problems of VaR discussed above, we include ES which is a coherent risk measure in the sense of Artzner, Delbaen, Eber, and Heath (1999). ES is also known as conditional VaR, tail VaR and conditional tail expectation. ES calculates the conditional expected loss (return) given that the loss is beyond the VaR level. For a given α , ES is defined by

$$ES_{\alpha}(R) = \frac{1}{\alpha}\int_{0}^{\alpha} VaR_{u}(R)du. \tag{3}$$

ES is the expected value (or mean) of the rate of return in excess of VaR of the ranked return distribution. ES measures contain more information than VaR because ES tells us what we can

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the portfolio risks is less than sum of capital requirement for their separate risks due to risk diversification. See e.g., Dowd and Blake (2006) for more discussions about the properties of coherent risk measure.

[8] See Dhaene, Laeven, Vanduffel, Darkiewicz, and Goovaerts (2008) for the detailed discussions.

expect to lose if a tail event occurs. It is clear that ES is more conservative than VaR ($ES_{\alpha} > VaR_{\alpha}$) and presents a more complete description of the losses in the tails of the return distribution. Dhaene, Laeven, Vanduffel, Darkiewicz, and Goovaerts (2008) show that ES is the optimal capital requirement at a given confidence level when the regulator's condition is imposed to the class of concave distortion risk measures.

VaR and ES are computed for each firm for each year using various window sizes of daily firm stock returns. We choose three different confidence levels- 99.5%, 99% and 95% to check the robustness of VaR and ES estimates. The 99.5% confidence level is especially consistent with a solvency capital requirement under the new EU Solvency II regulation framework. It should be noted that the original values of VaR and ES are negative because they are obtained from the lower tail of the return distribution. As in Bali, Demirtas, and Levy (2009) and Van Bekkum (2015), we multiply VaR and ES measures by -1 before running the regressions. This facilitates interpretation that negative coefficients on the executive inside debt variable indicate an inverse relationship between the executive debt-like compensation and managerial risk-taking.

Relative Debt

Relative debt is a key explanatory variable of interest in this study. Jensen and Meckling (1976) hypothesize that the executive's inside debt holdings would have a significant influence on the agency cost of debt as inside debt incentivizes the CEO to act more like bondholders. Edmans and Liu (2011) extend the conjecture of Jensen and Meckling (1976) and emphasize the importance of the ratio of CEO's inside debt to equity ratio to that of firm's to measure the degree of CEO inside debt holdings. Following Edmans and Liu (2011) and other extant studies (e.g., Cassell, Huang, Manuel Sanchez, and Stuart, 2012; Liu, Mauer, and Zhang, 2014; Van Bekkum, 2015), the relative debt is constructed as the CEO's debt-to-equity ratio scaled by the firm's debt-to-equity ratio:

$$Relative\ Debt = \frac{CEO\ Inside\ Debt\,/\,CEO\ Equity}{Firm\ Debt\,/\,Firm\ Equity} \tag{4}$$

where the CEO inside debt is the summation of the present value of accumulated pension benefits and the balance of deferred compensation. CEO equity holdings is measured as the summation of stock and option holdings as a total CEO equity wealth in the firm. For stock ownership of the CEO, the value is calculated by multiplying the number of shares held times the share price at the end of the fiscal year. The value of stock option holdings is based on the dividend-adjusted Black-Scholes model. Firm debt is the summation of long-term debt and debt in current liabilities whereas the firm equity value is measured as the number of shares outstanding times the share price at the end of the fiscal year. The relative debt increases as the CEO's debt-equity ratio increases relative to the firm's debt-equity ratio which implies, based on the conjecture of Edmans and Liu (2011), that the CEO's incentives are more aligned with those of bondholders.

Equity-based Compensation Incentives

The extant literature presents that the equity-based compensation increases managerial risk-taking incentives (e.g., Guay, 1999; Coles, Daniel, and Naveen, 2006). It is very likely that both equity-based compensation and debt-based compensation incentives are determined simultaneously (Van Bekkum, 2015). To control for the incentive effects of equity-based compensation on managerial risk-taking behavior, we include equity delta and equity vega following the literature (Cassell, Huang, Manuel Sanchez, and Stuart, 2012; Liu, Mauer, and Zhang, 2014; Van Bekkum, 2015). Equity delta measures the sensitivity of the value of CEO's equity-based compensation to a one-percent change in stock price. We follow the method of Core and Guay (2002) to calculate equity delta. Equity vega determines the sensitivity of the value of

CEO's equity-based compensation to a one-percent change in the annualized standard deviation of stock returns. We also follow Core and Guay (2002) to calculate the equity vega, while assuming that the vega of any stockholdings including restricted stock is zero (Coles, Daniel, and Naveen, 2006).

Total Compensation

There is a relationship between CEO's total compensation and the managerial risk-taking behavior. Edmans and Gabaix (2011) develop a model under the presence of moral hazard that risky firms hire less talented CEOs and pay them highly compared to their skill level as a recompense. Similarly, Cheng, Hong, and Scheinkman (2015) argue that the riskier firm is required to pay higher total compensation than less risky firms to provide a risk-averse manager the same incentives. High total compensation might be an infestation of CEO entrenchment (i.e., Bebchuk, Fried, and Walker, 2002) due to the weak governance mechanisms. To control for the potential effect, we include CEO's total compensation. We measure the total compensation as the sum of salary, bonus, equity awards, option awards, non-equity incentive compensation and other compensation taken from Execucomp.

Firm Size

Firm size is likely to be associated with an insurer's risk-taking. Large firms are better diversified and tend to preserve higher franchise values by reducing their risk exposures (e.g., Keeley, 1990; Hellmann, Murdock, and Stiglitz, 2000). Saunders, Strock, and Travlos (1990) argue that larger banks appear to be more sensitive to extreme movements in stock return and are easier to monitor by financial analysts. This may restrict manager's risk increasing behaviors. Ho, Lai, and Lee (2013) show that firm size is inversely related to total risk measured by the standard deviation of return on assets. Each of these arguments and findings suggests that firm size measured by the natural logarithm of total admitted assets should be negatively related to managerial risk-taking.

Product and Geographical Diversification

Insurers may choose to diversify by expanding into other lines of business or operating across different states. If sources of risk are not perfectly correlated, product and geographical diversification can reduce an insurer's overall portfolio risk. Shim (2015) finds that both product and geographical diversification diminish the volatility of underwriting returns. We use a Herfindahl-Hirschman index (HHI) to measure the level of diversification. The product (geographic) diversification is calculated by the sum of the squares of the percentages of direct premium written across all product lines (across 50 states) for each insurer. Lower (higher) HHI indicates higher (lower) diversification.

Premium Growth

The premium growth rate is used as an indicator of financial impairment of insurers in regulatory and private risk assessment models. Insurers may attain rapid premium growth by relaxing their underwriting standards. Excessive premium growth may signal underestimating the true actuarial cost of business, leading to higher risk (Barth and Eckles, 2009). The premium growth rate is expected to be positively related to risk measures if fast premium growth is associated with weak underwriting practices that could be the leading cause of insolvencies. The premium growth rate is calculated by the percentage change in direct premiums written of each insurer in each year.

Bond Investment

It is noted that stocks, real estate, and mortgages are riskier investments, while bonds are considered to be relatively safer asset among the insurer's asset portfolio. To examine the relationship between an insurer's investment activity and firm riskiness, we include the percentage of the investment portfolio invested in bonds.

Return on Assets (ROA)

On one hand, stockholders as a holder of call options may have unlimited upside potential (Galai and Masulis, 1976) which incentivizes them to prefer risk-taking, holding else constant. On the other hand, when a firm is profitable, the risk-taking incentives faced by stockholders should be lower because they stand to lose more if the downside of risk-taking materializes (e.g., Keeley, 1990). Singh (1986) finds that organizational performance is negatively related to risk-taking in organizational decisions. To examine the effect of firm profitability on risk-taking, we include the return on assets (ROA). ROA is computed by net income after policyholder dividend but before taxes divided by total admitted assets.

Homeowners Share

The homeowners share measured by the proportion of direct premiums written in homeowners line is included to investigate how the proportion of homeowners line is associated with firm riskiness. We predict a positive sign on this variable if homeowners business is specifically exposed to natural catastrophes and more volatile than other lines of business (Shim, 2015).

Governance Mechanisms

In general, the firm performance is believed to be influenced by the governance mechanisms. For example, following the accounting scandal, in 2002 both NYSE and NASDAQ strengthened their corporate governance requirements for the listed companies by requiring the majority of board members to be independent and by revising definitions of independent directors. Despite this increasingly important corporate governance issues in industrial firms, the interpretation of corporate governance takes somewhat different implications for the financial firms. Unlike the theoretical perspective of the corporate governance, bank shareholders worry about executives taking too little risk (Van Bekkum, 2015). This suggests that shareholder-friendly boards (typically considered as a good governance) in financial firms might encourage executives to take on more risk. Consistent with this view, Beltratti and Stultz (2012) find that banks with more shareholder-friendly boards perform worse during the crisis than other banks. In addition, Adams and Mehran (2012) report that independent boards are not related to better performance while board size is positively related to firm performance in banking industry. Following Bennett, Güntay, and Unal (2015), we include the percentage of independent director and board size as additional explanatory variables in our model to control for governance attributes. The definitions of the variables are summarized in Table 1.

Data Description

Data Sources

We utilize four databases to generate our sample: Execucomp, Compustat, Center for Research in Security Price (CRSP) database, and SNL Financial database. Execucomp database provides annual CEO compensation information including salaries, bonuses, option grants/awards, actuarial values of pensions, and the balance of total deferred compensation. One limitation of Execucomp is that it only covers S&P 1,500 firms. The firms were not required to disclose the executives' inside debt holding information prior to 2006. With the Securities and Exchange Commission's (SEC) 2007 reform that promotes increased transparency in reporting of pensions and deferred compensation, the firms are required to disclose the information related to executives' inside debt holdings to the public. This allows us to use sample period from 2006 to 2013 that includes the recent financial crisis. We obtain firm leverage information from Compustat, consistent with the literature. The daily stock returns of the publicly traded property-liability insurers come from CRSP database. The financial data required for the insurer's operating characteristics are taken from the SNL Financial database.

Descriptive Statistics

Table 2 reports various descriptive statistics for our sample of 285 annual observations for 40 U.S. publicly traded property-liability insurance firms. Panel A reports the distribution of CEOs' compensation components. The dollar amount of CEO inside debt holdings clearly indicates the prevalence of these pay components in the insurance industry, similar to other industries (e.g., Wei and Yermack, 2011; Van Bekkum, 2015). The mean value of CEO inside debt holdings in the insurance industry is $7.9 million, while the median value is about $3.0 million. These numbers are comparable or a little higher than what is reported in other industries. For instance, Van Bekkum (2015) reports average (median) value of $4.28 million ($0.94 million) using the sample of banking industry. The difference in the mean (median) value of CEO inside debt holdings between our sample and Van Bekkum (2015) might be due to the fact that Van Bekkum (2015) includes small banks in his study. Consistent with Grace (2004), equity-based compensations are employed in this study. Both equity delta, the sensitivity of CEO stock and option portfolios to a 1% change in stock price (Core and Guay, 2002), and equity vega, the sensitivity of the CEO stock and option portfolios to a 0.01 change in the standard deviation of the firms return (Guay, 1999), have non-zero mean and median. The average (median) value of CEO total annual compensation is $6.2 million ($4.2 million). Given these annual salary figures, it is noticeable that the inside debt holding amount is not trivial. The key variable of our interest, relative debt, is shown to have a much skewed distribution, which is similar to other studies that employ the same variable (e.g., Wei and Yermack, 2011; Liu, Mauer, and Zhang, 2014; Van Bekkum, 2015). While the median value of relative debt is 0.597 which is less than the critical value of 1, the average is 9.47, highlighting a severe outlier problem. We observe that a few large insurers in our sample influence this phenomenon. We deal with outlier problems using the standard approach in the literature for a robustness check.

Panel B of Table 2 summarizes our measures of risk-taking. The distribution of VaR and ES shows no outlier concerns. As a shareholder risk measure, we calculate the idiosyncratic volatility, systematic volatility and total volatility based on the Fama-French three-factor model. The average values range from 0.16 to 0.24, while the median values are within 0.12 and 0.18. Panel C reports the values for the firm characteristics, most of which are similar to those in the literature (e.g., Shim, 2015). Panel D provides summary statistics for CEO and governance characteristics. The average (median) age of CEOs is 56.23 years (56 years) and these CEOs have held the position for 7.39 years on average. The typical board size of insurance firms is about 10. Among those, approximately 8 are classified as independent directors, as we expect high percentage of independent boards given our sample period is post Sarbanes-Oxley. Table 3 reports the correlation among the variables used in our main model. Our primary measures of managerial risk-taking are significantly negatively correlated with log of relative debt, indicating that there could be a negative relation between them.

Empirical Results

We present regression results of Equation (1) using the OLS model in Table 4 where odd-numbered (even-numbered) columns provide results using VaR (ES) estimated at three different confidence levels-99.5%, 99%, and 95%. P-values in parenthesis are based on the standard errors adjusted for heteroscedasticity and clustered at firm-level (Petersen, 2009). The most noticeable result reported in Table 4 is that the coefficients of relative debt are statistically significant and negative across all models, providing evidence that the inside debt has governance mechanisms to reduce managerial risk-taking behavior. The results are consistent with the theoretical predictions of Jensen and Meckling (1976) and Edmans and Liu (2011) and empirical findings in the banking industry (Van Bekkum, 2015; Bennett, Güntay, and Unal, 2015) as well as in industrial firms (Cassell, Huang, Manuel Sanchez, and Stuart, 2012). The results are also economically significant. Given the log transformed relative debt has a standard deviation of 1.837, an increase of one standard deviation in relative debt results in reduction of 18%-21% in risk measures, providing evidence on significant impact of CEO inside debt on risk-taking behavior in the insurance industry.

The results of Table 4 also show that the coefficients on the logged value of delta are negative and significant across all models, indicating that executive incentives to pursue risky investment projects become lower as equity delta increases. These findings are similar to the ones reported by Van Bekkum (2015) in his analysis of banking industry. Although other control variables are not consistently significant, it is worthwhile to mention some of them. For example, a few coefficients of ROA are negative and marginally significant, indicating that more profitable firms are less likely to take excessive risk. The results is consistent with the findings of Singh (1986). Contrary to expectations, the premium growth rate is significant and negative in four of the six models, suggesting that premium growth of insurance firms does not necessarily result from poor underwriting practices. Insurers may attain premium growth due to their effective business practice or competitive managerial skills. Interestingly, the coefficients of the percentage of independent directors are positive and significant across all models, indicating that insurers with higher proportion of independent directors are riskier, as these insurers have more extreme movements in their stock market performance. This finding is likely the case that more independent directors mean better alignment of interests of management with shareholders (Beltratti and Stulz, 2012).

Endogeneity Bias

Although our primary results are consistent with the theoretical view that larger inside debt affects top executives to take less risk, the potential endogeneity bias could pose a problem in drawing such a causal inference. CEOs with large inside debt holdings may benefit by taking a more conservative approach in investment projects. At the same time, firms with higher level of risk might offer higher level of inside debt compensation to the CEOs. Thus, the degree of firm risk and the level of inside debt compensation may be jointly determined as suggested in the literature (e.g., Cassell, Huang, Manuel Sanchez, and Stuart, 2012).

To mitigate the endogeneity problems, we employ the instrumental variable (IV) technique. The effective instruments must be highly correlated with relative debt and must be uncorrelated with the error term in the structural equation. We follow the literature to identify the instruments that satisfy those conditions. Among potential variables suggested in the literature, we choose five-year average firm size, firm age, and five-year average asset growth rate as our instrumental variables following the inside debt literature (e.g., Sundaram and Yermack, 2007; Cassell, Huang, Manuel Sanchez, and Stuart, 2012) and insurance literature (e.g., Shim, 2015).[9] We perform two tests to verify that these instruments are indeed effective. In the first stage regression, *F-test* is used to evaluate the relevance of the set of instruments. We use Hansen's *J-test* of overidentification to assess whether the instruments are uncorrelated with the error term.

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[9] Following Bennett, Güntay, and Unal (2015), we also use CEO age, CEO age squared, and the maximum state income tax rate for individual income as instruments. However, these variables do not satisfy the requirements of effective instruments for our sample as the *F-test* for excluded instruments cannot reject the null hypothesis that the instruments are weak.

Table 5 presents the results using the two-stage least squares (2SLS) models. The first column provides the results of the first stage regression where we focus our attention to the instruments. The five-year average asset growth rate is positive and significant, indicating that the insurer's asset growth has a positive impact on CEO relative debt holdings. The first stage results also show that five-year average firm size is one of important determinants of CEO relative debt, consistent with the findings of Cassell, Huang, Manuel Sanchez, and Stuart (2012). However, firm age is not significant. The statistic value (13.22) of the *F*-test and its *p*-value (0.04) indicate that our instruments are not weak. In addition, the *p*-values of Hansen's *J*-test suggest that our selected instruments satisfy validity requirements. The results for the second stage regression are reported in columns (1)-(6). The coefficients of relative debt are significant and negative across all models, consistent with the results shown in Table 4. The results in Table 5 imply that our earlier findings are not driven by the potential endogeneity problems.

Fixed-effect model

While the 2SLS regressions performed in the previous section deal with the potential endogeneity bias, our ability to estimate causal inferences might be limited if relevant variables are omitted. To address potential omitted variables problem, we run firm fixed-effect models using the same specification as in our primary model of Table 4. The firm fixed-effect models allow us to control for the effects of omitted (or unobservable) firm-specific characteristics which may be correlated with other regressors in the model.

The results of firm fixed-effect regression estimation are summarized in Table 6. Again, the negative and significant coefficients of relative debt are consistent with previous results in Tables 4 and 5, supporting the theoretical predictions of Jensen and Meckling (1976) and Edmans and Liu (2011). Some of explanatory variables that appear to be irrelevant to our model in Tables

4 and 5 are now statistically significant. The coefficients of the logged value of vega are significant and negative. This result is in line with Cassell, Huang, Manuel Sanchez, and Stuart (2012) and inconsistent with expectations. The coefficients of product HHI are positive and significant, indicating that diversified insurers can reduce firm risk more efficiently than focused firms. The significant and negative coefficient on bond investment is consistent with the view that bonds are a relatively less risky asset compared to other invested assets.

Additional Robustness Tests

The previous sections show that our findings are robust to corrections for potential endogeneity bias and an alternative estimation method. To enrich our results, we perform further robustness tests. In this section, we only report the results for the key variable of our interest to conserve the space.

In the results we have presented so far, we use the past four years of daily returns for the estimation of VaR and ES to mitigate concerns that our time window is not long enough to capture the implications of the executive debt-like compensation on the risk-taking behavior. As a further robustness check, we use one year of daily returns to estimate alternative VaR and ES measures from the empirical distribution (noted as VaR2 and ES2 in Panel A of Table 7).[10] Additionally, we take a different approach, hereafter referred to as historical simulation, to calculate another VaR and ES (noted as VaR3 and ES3 in Panel A of Table 7). Historical simulation involves using historical data of actual price movements to determine the probability distribution of asset's gains

[10] A large number of observations could be more appropriate to calculate ES which averages the observations beyond VaR threshold in the lower tail of return distribution. As noted in Bali, Demirtas, and Levy (2009), one limitation of using one year of daily returns (approximately 252 observations) is that there are not enough observations to calculate ES at high (e.g., 99.5%) confidence level. Thus, we also use the past three years of daily returns to estimate alternative VaR and ES measures. We find that the results are qualitatively similar. These results are available from the authors upon request.

and losses. It is implicitly assumed that historical distribution of returns is a good approximation of the distribution of expected future returns (Hull, 2015).[11] As a common accounting measure of risk, we also employ the Z-score. Similar to the literature (e.g., Stiroh and Rumble, 2006; Laeven and Levine, 2009; Shim, 2015), the Z-score is defined as return on assets (ROA) plus capital to asset ratio divided by the standard deviation of ROA where the standard deviation of ROA is calculated by using 5-year rolling periods observations. The Z-score is negatively related to the probability of insolvency, with higher Z-score implying a lower likelihood of insolvency. Panel A of Table 7 provides the results using alternative risk measures.[12] The estimations indicate that our main findings are robust to variants of risk measures.

It might be useful to measure firm risk from the shareholder perspective, even though the VaR and ES are valid risk measures for the purpose of this study. We estimate the idiosyncratic, systematic, and total volatilities using Fama-French 3-factor models with daily returns over the calendar year. Panel B of Table 7 presents consistent results for these volatilities measures.

Although the relative debt calculated by Equation (4) is commonly used in the studies of CEO inside debt following the theoretical predictions of Jensen and Meckling (1976) and Edmans and Liu (2011), the recent empirical literature suggests different proxies for this variable to mitigate potential misspecification problems. Similar to Bennett, Güntay, and Unal (2015), we separate CEO inside debt and firm leverage and include them both in the regressions. To address the problems of losing observations when using the logged value of relative debt (Liu, Mauer, and

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[11] Historical simulation is the most popular approach for the estimation of VaR and ES for market risk (Hull, 2015). One advantage of adopting this approach is that it does not require distributional assumptions and naturally addresses heavy tails problem. See Hull (2015) for detailed procedures of historical simulation.

[12] We report the results for both the log of Z-score and log of 1 plus Z-score because one observation has a negative Z-score.

Zhang, 2014), we also use an indicator variable set equal to one if CEO inside debt is greater than firm leverage and zero otherwise.[13] Panels C and D of Table 7 present the results using these proxies for relative debt. The coefficients of both the logged value of inside debt and indicator variable are negative and significant (some of them are marginally significant), consistent with the findings of our primary specification.

Finally, we repeat regressions by excluding multiline insurers which offer a significant portion of life insurance in addition to property-liability products.[14] The results shown in Panel E of Table 7 are still robust to using the sample of non-multiline property-liability insurers. Collectively, the results in Table 7 confirm this paper's main findings that CEO inside debt is negatively associated with managerial risk-taking.

Concluding Remark

We examine the incentive effects of CEO inside debt (pensions and deferred compensation) on managerial risk-taking in the U.S. property-liability insurance industry. Since the inside debt data became publicly available in 2006 following the SEC's newly implemented disclosure requirement, a growing number of studies have examined the impact of inside debt on corporate governance issues. From industrial firms to banking firms, the existing literature shows that the inside debt incentivizes executives to align their interests with those of bondholders and therefore significantly reduces risk. Despite the growing interests in inside debt and its potential governance roles, the study related to inside debt in the insurance literature has been very limited.

[13] Also note that by creating an indicator variable, we can check the robustness of outlier effects. Since the relative debt is known to have a skewed distribution, we can control for this issue by using the indicator variable.

[14] Only 7 out of 40 insurers are classified as multiline insurers in our sample.

This study attempts to provide one of the first empirical evidence on executive inside debt and its governance role in the insurance industry.

We employ the sample of the U.S. publicly traded property-liability insurers for a period of 2006 to 2013. We find that the use of inside debt is prevalent and significant in the insurance industry. With an average inside debt holdings of $7.9 million, CEOs of insurance firms hold as much inside debt as CEOs in other industries, suggesting that inside debt might be an important part of CEO compensation packages. Our regression analyses provide clear evidence that there is a significant and negative relation between CEO's debt-to-equity ratio relative to that of the firm and risk-taking. This indicates that the higher CEO inside debt holdings relative to firm leverage, the lower the risk-taking activities by top executives. These findings are consistent with the extant literature that examines non-insurance industries and with the theoretical predictions of Jensen and Meckling (1976) and Edmans and Liu (2011). Furthermore, our results are robust to alternative measures of key variables and various regression models. We expect that this study will provide important implications for the function of executive debt-like compensation as a potential governance mechanism in the insurance industry.

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Table 1 Definition of variables

Variable	Definition	Data Source
CEO Compensation		
Inside debt	CEO debt-like compensation (sum of pension total amount and deferred total balance amount) divided by CEO equity compensation (sum of equity holding and the value of stock options)	Execucomp
Relative debt	Inside debt divided by firm leverage (sum of current portion of long-term debt and total long-term debt divided by market capitalization of equity)	Execucomp Compustat
CEO delta	Sensitivity of the CEO's stock and option portfolios to a 1% change in stock price (Core and Guay, 2002) (in $000s)	Execucomp
CEO vega	Sensitivity of the CEO's stock and option portfolios to a 0.01 change in the standard deviation of the firms return (Guay, 1999) (in $000s)	Execucomp
Total compensation	Sum of salary, bonus, equity awards, option awards, non-equity incentive compensation, and other compensation	Execucomp
Risk Measure		
VAR	Maximum expected loss that could occur over a given time period at a specified confidence level	CRSP
ES	Conditional expected loss given that the loss is beyond the VaR	CRSP
Z-score	Return on assets (ROA) plus capital to asset ratio divided by standard deviation of ROA	SNL Financial
Idiosyncratic volatility	Standard deviation of residuals using a 3-factor models, estimated over 252 trading days for each year	CRSP Kenneth R French Data Library (HML and SMB factors, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html)
Systematic volatility	Standard deviation of the fitted value using a 3-factor model, estimated over 252 trading days for each year	CRSP Kenneth R French Data Library (HML and SMB factors, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html)
Total volatility	Standard deviation of daily returns, estimated over 252 days for each year	CRSP
Firm Characteristics		
Firm size	Natural logarithm of total admitted assets	SNL Financial
Product HHI	Herfindahl index of direct premiums written (DPW) across product lines	SNL Financial
Geographic HHI	Herfindahl Index of DPW across 50 states	SNL Financial
Premium growth	Percentage change in DPW	SNL Financial

ROA	Return on assets	SNL Financial
Bond investment	Percentage of the investment portfolio invested in bonds	SNL Financial
Firm leverage	Sum of current portion of long-term debt and total long-term debt divided by market capitalization of equity	Compustat
Firm age	The number of years since the firm was founded	SNL Financial
Homeowners share	Proportion of DPW in homeowners line	SNL Financial
CEO Characteristics		
Age	CEO age	Execucomp
Tenure	CEO tenure	Execucomp
Governance Characteristics		
Board size	The number of board of directors	Proxy filing available at SEC Edgar
Independent director	The ratio of independent director to the board size	Proxy filing available at SEC Edgar

Table 2 Descriptive statistics

	Mean	**St Dev.**	**Min**	**25th Quartile**	**Median**	**75th Quartile**	**Max**
Panel A: CEO Compensation							
Pension and deferred balance ($000s)	7,891.88	14,485	0	413.42	2,981.82	7,105.21	112,756
CEO delta ($000s)	673.58	1,505	0.48	71.01	189.58	553.36	10,250
CEO vega ($000s)	104.13	193.41	0	2.84	29.36	101.51	1,171.02
CEO total compensation ($000s)	6,236.80	5,634	409.88	2,145.89	4,201.08	9,314.60	28,340
Inside debt	0.419	0.814	0	0.022	0.142	0.503	7.561
Relative debt	9.51	117.55	0	0.043	0.598	2.278	1,894.90
Panel B: Risk Measures							
VAR(99.5)	0.094	0.056	0.027	0.054	0.084	0.116	0.306
VAR(99)	0.074	0.044	0.022	0.043	0.067	0.086	0.230
VAR(95)	0.037	0.022	0.009	0.023	0.032	0.041	0.126
ES(99.5)	0.119	0.074	0.033	0.067	0.100	0.140	0.397
ES(99)	0.100	0.060	0.028	0.057	0.086	0.120	0.312
ES(95)	0.059	0.035	0.017	0.035	0.052	0.067	0.189
Idiosyncratic volatility	0.017	0.015	0.005	0.009	0.013	0.021	0.103
Systematic volatility	0.016	0.013	0.003	0.008	0.012	0.019	0.079
Total volatility	0.024	0.019	0.008	0.013	0.018	0.029	0.129
Z-score	21.58	15.33	-0.049	11.20	18.64	26.79	81.74
Panel C: Firm Characteristics							
Firm size	15.56	1.63	9.80	14.70	15.54	16.65	18.56
Product HHI	0.452	0.322	0.118	0.181	0.296	0.772	1.000
Geographic HHI	0.173	0.253	0.035	0.046	0.067	0.122	1.000
Bond investment	0.720	0.148	0.008	0.642	0.745	0.819	1.009
Premium growth	0.038	0.186	-0.738	-0.037	0.014	0.075	1.387
ROA	0.046	0.052	-0.217	0.019	0.047	0.072	0.221
Firm leverage	0.554	1.789	0	0.113	0.206	0.349	18.904
Homeowners share	0.105	0.192	0	0	0.014	0.144	1.000
Firm age	62.37	41.08	4.00	32.00	52.00	81.00	203.00
Panel D: CEO/Governance Characteristics							
CEO age	56.23	6.08	40.00	52.00	56.00	60.00	74.00
CEO tenure	7.46	7.69	0	3.00	6.00	9.00	46.00
Board size	10.28	1.96	5.00	9.00	10.00	12.00	17.00
Independent director	8.14	2.14	3.00	7.00	8.00	10.00	13.00

Note: This table summarizes descriptive statics of variables employed in this study. Mean, median, standard deviation, 25th and 75th percentile of the observations are reported. Panel A reports descriptive statistics for variables related to CEO compensation that contains 282 annual CEO compensation observations in 40 property liability insurance companies from 2006 to 2013. Panel B reports the summary of descriptive statistics for risk measures. Panel C reports the firm characteristics descriptive statistics. Panel D presents descriptive statistics for variables related to CEO and governance characteristic. All variable are gathered or computed at the end of each year from 2006 to 2013.

Table 3 Correlation matrix of variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Log relative debt	1	**-0.30**	**-0.30**	**-0.31**	**-0.31**	**-0.29**	**-0.31**	**-0.17**	0.03	-0.06	**0.18**	0.01	**0.27**	**0.25**	**-0.23**	-0.03	**-0.18**	0.09	-0.00
2. VAR(99.5)		1	**0.98**	**0.98**	**0.99**	**0.92**	**0.98**	0.09	**0.22**	0.05	-0.09	-0.10	**-0.53**	-0.00	**-0.37**	**-0.21**	-0.07	0.02	**0.18**
3. ES(99.5)			1	**0.95**	**0.99**	**0.87**	**0.95**	0.10	**0.20**	0.03	-0.06	-0.09	**-0.51**	0.02	**-0.37**	**-0.19**	-0.05	0.02	**0.18**
4. VAR(99)				1	**0.98**	**0.95**	**0.99**	0.08	**0.24**	0.04	-0.08	-0.11	**-0.52**	-0.01	**-0.36**	**-0.23**	-0.06	0.01	**0.21**
5. ES(99)					1	**0.91**	**0.98**	0.09	**0.22**	0.04	-0.07	-0.09	**-0.52**	0.00	**-0.38**	**-0.21**	-0.06	0.02	**0.19**
6. VAR(95)						1	**0.97**	0.00	**0.31**	0.07	-0.11	-0.11	**-0.53**	-0.01	**-0.34**	**-0.24**	**-0.12**	-0.01	**0.23**
7. ES(95)							1	0.06	**0.26**	0.05	-0.09	-0.10	**-0.53**	-0.00	**-0.36**	**-0.23**	-0.08	0.01	**0.22**
8. Firm size								1	**-0.28**	**-0.44**	-0.01	**-0.20**	-0.07	**-0.37**	**0.23**	**0.24**	**0.55**	**0.46**	**0.19**
9. Product HHI									1	**0.46**	-0.09	-0.01	**-0.15**	**0.14**	**-0.28**	**-0.29**	**-0.30**	**-0.33**	0.06
10. Geographic HHI										1	**-0.31**	**0.14**	-0.05	**0.54**	-0.09	**-0.32**	**-0.22**	**-0.64**	**-0.21**
11. Bond investment											1	**-0.14**	**0.21**	**-0.44**	**-0.15**	-0.05	-0.08	0.02	**0.22**
12. Premium growth												1	-0.00	**0.21**	0.02	-0.07	0.04	-0.09	-0.02
13. ROA													1	0.05	**0.26**	**0.12**	**0.16**	0.07	-0.03
14. Homeowner share														1	0.01	0.03	0.03	**-0.27**	**-0.12**
15. Log delta															1	**0.37**	**0.58**	-0.03	0.04
16. Log vega																1	**0.30**	**0.25**	-0.02
17. Log total comp																	1	**0.21**	**0.25**
18. Log board size																		1	**0.24**
19. % independent																			1

Note: This table presents the correlation coefficients of variables used in the main regression models. The variable definitions are provided in Table 1. Variables that are significant at 1% and 5% levels are shown in bold.

Table 4 CEO relative debt and risk taking

	VAR(99.5)	ES(99.5)	VAR(99)	ES(99)	VAR(95)	ES(95)
	(1)	(2)	(3)	(4)	(5)	(6)
Log relative debt	-0.010***	-0.014***	-0.008***	-0.011***	-0.004***	-0.006***
	(<.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log delta	-0.002***	-0.023***	-0.013***	-0.018***	-0.005**	-0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log vega	-0.002	-0.003	-0.002	-0.002	-0.001	-0.001
	(0.266)	(0.287)	(0.172)	(0.233)	(0.185)	(0.205)
Log total compensation	0.003	0.002	0.003	0.003	0.001	0.002
	(0.602)	(0.786)	(0.479)	(0.705)	(0.669)	(0.593)
Firm size	0.007*	0.010**	0.005	0.008*	0.001	0.003
	(0.076)	(0.036)	(0.123)	(0.053)	(0.437)	(0.123)
Product HHI	0.031	0.032	0.031*	0.032	0.018*	0.024*
	(0.160)	(0.256)	(0.072)	(0.166)	(0.061)	(0.084)
Geographic HHI	-0.009	-0.030	-0.015	-0.024	-0.006	-0.013
	(0.793)	(0.514)	(0.582)	(0.509)	(0.706)	(0.547)
Premium growth	-0.019*	-0.017	-0.019**	-0.015	-0.011**	-0.013**
	(0.073)	(0.276)	(0.010)	(0.188)	(0.019)	(0.048)
Bond investment	-0.022	-0.006	-0.034	-0.018	-0.025*	-0.029
	(0.510)	(0.891)	(0.188)	(0.615)	(0.094)	(0.180)
ROA	-0.225*	-0.271	-0.170	-0.233	-0.113**	-0.158*
	(0.088)	(0.158)	(0.118)	(0.122)	(0.027)	(0.068)
Homeowners share	0.004	0.026	0.008	0.018	0.001	0.008
	(0.917)	(0.590)	(0.790)	(0.656)	(0.946)	(0.712)
Log board size	-0.014	-0.030	-0.018	-0.025	-0.005	-0.014
	(0.632)	(0.443)	(0.455)	(0.443)	(0.572)	(0.446)
% independent	0.070*	0.105**	0.062**	0.086**	0.034***	0.054**
	(0.066)	(0.029)	(0.044)	(0.033)	(0.010)	(0.019)
Constant	0.020	0.030	0.040	0.036	0.040*	0.041
	(0.730)	(0.699)	(0.399)	(0.568)	(0.082)	(0.262)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.72	0.69	0.71	0.71	0.69	0.72
Observations	221	221	221	221	221	221

Note: This table reports the results from the OLS regression modeling impact of CEO relative debt holdings on the risk taking measures of the firm while controlling for other compensation measures of the CEO and firm characteristics. The data covers the period from 1996 through 2013 for 33 property liability insurance companies. Dependent variables are our measures of firm's risk taking, including VAR995, ES995, VAR95, ES95, and sigma. The independent variables are: natural logarithm of relative debt, equity delta, equity vega, and natural logarithm of CEO's total compensation to capture the CEO compensation characteristics and firm characteristics that include natural logarithm of firm size, Product HHI, geographic HHI, NPW Ret Growth, percentage of risky investment, ROA, % of homeowner insurance, logarithm of board size and % of independent director. All models include year fixed effect. P-values are derived from firm-level clustered robust standard errors are in parentheses. ***, **, * represent statistical significance at the 0.01, 0.05, and 01 level, respectively.

Table 5 Endogeneity concerns on CEO relative debt and risk taking

	First stage	VAR(99.5)	ES(99.5)	VAR(99)	ES(99)	VAR(95)	ES(95)
		(1)	(2)	(3)	(4)	(5)	(6)
Log relative debt		-0.015*	-0.022***	-0.012***	-0.017***	-0.004***	-0.009***
		(0.008)	(0.006)	(0.004)	(0.004)	(0.002)	(0.002)
Log delta	-0.230	-0.017***	-0.025***	-0.014***	-0.020***	-0.005***	-0.011***
	(0.324)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log vega	0.057	-0.002	-0.003	-0.002	-0.003	-0.001	-0.002
	(0.639)	(0.185)	(0.210)	(0.108)	(0.163)	(0.125)	(0.133)
Log total compensation	-0.536	0.001	-0.001	0.002	0.000	0.001	0.001
	(0.194)	(0.857)	(0.942)	(0.712)	(0.968)	(0.810)	(0.593)
Firm size	0.951***	0.007*	0.010**	0.005	0.008*	0.001	0.003
	(0.001)	(0.054)	(0.039)	(0.119)	(0.054)	(0.414)	(0.114)
Product HHI	0.934	0.033	0.035	0.032**	0.034	0.018**	0.025**
	(0.420)	(0.110)	(0.193)	(0.040)	(0.115)	(0.034)	(0.048)
Geographic HHI	-2.682	-0.024	-0.054	-0.025	-0.041	-0.008	-0.021
	(0.108)	(0.579)	(0.376)	(0.416)	(0.374)	(0.587)	(0.400)
Premium growth	-0.140	-0.019*	-0.017	-0.019***	-0.015	-0.011***	-0.013**
	(0.800)	(0.058)	(0.267)	(0.010)	(0.178)	(0.007)	(0.038)
Bond investment	0.119	-0.023	-0.006	-0.035	-0.019	-0.025*	-0.029
	(0.950)	(0.492)	(0.871)	(0.167)	(0.599)	(0.067)	(0.158)
ROA	10.777***	-0.172	-0.186	-0.131	-0.171	-0.103**	-0.129
	(0.005)	(0.175)	(0.306)	(0.228)	(0.236)	(0.027)	(0.118)
Homeowners share	4.897***	0.021	0.053	0.020	0.037	0.004	0.017
	(0.008)	(0.617)	(0.341)	(0.547)	(0.407)	(0.766)	(0.480)
Log board size	0.168	-0.010	-0.023	-0.015	-0.020	-0.004	-0.011
	(0.888)	(0.725)	(0.554)	(0.504)	(0.526)	(0.616)	(0.504)
% of independent	-0.213	0.071**	0.108**	0.063**	0.088**	0.034***	0.054***
	(0.892)	(0.033)	(0.012)	(0.019)	(0.014)	(0.003)	(0.006)
5-year asset growth	9.568***						
	(0.008)						
5-year average size	-0.816***						
	(0.007)						
Firm age	-0.005						
	(0.476)						
Constant	0.875	0.029	0.044	0.046	0.046	0.042*	0.041
	(0.841)	(0.642)	(0.609)	(0.356)	(0.503)	(0.056)	(0.245)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weak Identification F-test	13.22**						
LM Underidentification test	7.84**						
J-statistics p-value		0.596	0.756	0.487	0.636	0.799	0.673
Adjusted-R^2		0.73	0.69	0.72	0.72	0.72	0.73
Observations	221	221	221	221	221	221	221

Note: This table reports the results of 2sls model to control for the possible endogeneity concerns between CEO's relative debt level and firm's risk taking measures. The model is the same as the ones in Table 4, except for two governance measures, log of the board size and percent of independent directors. The first stage model includes 5 average asset growth, 5-year average size, and firm age as the exogenous variables. The F-statistics for IV relevance test and J-test statistics for the exogeneity test (Stock and Watson, 2007) are reported. All models include year fixed effect. P-values are derived from firm-level clustered robust standard errors are in parentheses. ***, **, * represent statistical significance at the 0.01, 0.05, and 01 level, respectively.

Table 6 CEO relative debt and risk taking with firm-fixed effect

	VAR(99.5)	ES(99.5)	VAR(99)	ES(99)	VAR(95)	ES(95)
	(1)	(2)	(3)	(4)	(5)	(6)
Log relative debt	-0.008***	-0.010***	-0.007***	-0.009***	-0.003***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log delta	-0.014***	-0.020***	-0.012***	-0.016***	-0.007***	-0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log vega	-0.004**	-0.008***	-0.003**	-0.005***	-0.001	-0.002**
	(0.048)	(0.003)	(0.036)	(0.006)	(0.144)	(0.035)
Log total compensation	-0.038	-0.009	-0.005	-0.007	-0.002	-0.004
	(0.435)	(0.239)	(0.192)	(0.204)	(0.284)	(0.221)
Firm size	-0.009	-0.058**	0.003	-0.028	0.001	-0.002
	(0.565)	(0.013)	(0.819)	(0.116)	(0.842)	(0.819)
Product HHI	0.083*	0.128**	0.051	0.095*	0.045**	0.062**
	(0.061)	(0.049)	(0.159)	(0.054)	(0.016)	(0.027)
Geographic HHI	0.001	-0.120*	0.018	-0.051	0.029	0.008
	(0.973)	(0.052)	(0.608)	(0.274)	(0.103)	(0.769)
Premium growth	-0.009	-0.009	-0.014*	-0.008	-0.006	-0.007
	(0.342)	(0.542)	(0.083)	(0.474)	(0.133)	(0.257)
Bond investment	-0.096**	-0.152**	-0.104***	-0.128***	-0.055***	-0.080***
	(0.017)	(0.010)	(0.002)	(0.004)	(0.001)	(0.002)
ROA	-0.143**	-0.222***	-0.063	-0.156**	-0.045*	-0.085**
	(0.012)	(0.008)	(0.180)	(0.013)	(0.060)	(0.018)
Homeowners share	0.015	-0.036	0.043	-0.004	0.030	0.030
	(0.844)	(0.745)	(0.496)	(0.958)	(0.351)	(0.529)
Log board size	-0.028	-0.034	-0.017	-0.027	-0.008	-0.020*
	(0.157)	(0.236)	(0.295)	(0.211)	(0.341)	(0.100)
% independent	0.035	0.057	0.018	0.043	-0.010	0.004
	(0.363)	(0.319)	(0.563)	(0.318)	(0.546)	(0.856)
Constant	0.407*	1.326***	0.203	0.770***	0.098	0.245
	(0.088)	(0.001)	(0.305)	(0.004)	(0.334)	(0.104)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.89	0.89	0.88	0.88	0.87	0.89
Observations	221	221	221	221	221	221

Note: This table reports the results of impact of CEO relative debt holdings on the risk taking measures of the firm while controlling for other compensation measures of the CEO and firm characteristics, repeating the Table 4, except that all models in this table are firm-fixed effect models. The data covers the period from 1996 through 2013 for 33 property liability insurance companies. Dependent variables are our measures of firm's risk taking, including VAR995, ES995, VAR95, ES95, and sigma. The independent variables are: natural logarithm of relative debt, equity delta, equity vega, and natural logarithm of CEO's total compensation to capture the CEO compensation characteristics and firm characteristics that include natural logarithm of firm size, Product HHI, geographic HHI, NPW Ret Growth, percentage of risky investment, ROA, % of homeowner insurance, logarithm of board size, and % of independent director. All models include year fixed effect. P-values are reported in parentheses. ***, **, * represent statistical significance at the 0.01, 0.05, and 01 level, respectively.

Table 7 CEO relative debt and risk taking with alternative specifications

Panel A: Alternative measures of VAR and ES and accounting measure of risk						
	VAR2(99.5)	ES2(99.5)	VAR2(99)	ES2(99)	VAR2(95)	ES2(95)
Log of relative debt	-0.005**	-0.006**	-0.004**	-0.005**	-0.002**	-0.003**
	(0.012)	(0.043)	(0.029)	(0.036)	(0.036)	(0.029)
Variables from main models	Yes	Yes	Yes	Yes	Yes	Yes
Observations	221	221	221	221	221	221
Adjusted-R^2	0.74	0.67	0.74	0.70	0.75	0.75

	VAR3(99.5)	ES3(99.5)	VAR3(95)	ES3(95)	Log Z-score	Log (1+Z-score)
Log of relative debt	-0.012***	-0.019***	-0.004***	-0.008**	0.099**	0.095**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.041)	(0.040)
Variables from main models	Yes	Yes	Yes	Yes	Yes	Yes
Observations	218	218	218	218	220	221
Adjusted-R^2	0.72	0.65	0.71	0.72	0.32	0.34

Panel B: Stockholder risk measures			
	Idiosyncratic Volatility	Systematic Volatility	Total Volatility
Log of relative debt	-0.020**	-0.020***	-0.028**
	(0.038)	(0.010)	(0.022)
Variables from main models	Yes	Yes	Yes
Observations	221	221	221
Adjusted-R^2	0.65	0.77	0.72

Panel C: Employing log of inside debt and log of firm leverage separately						
	VAR(99.5)	ES(99.5)	VAR(99)	ES(99)	VAR(95)	ES(95)
Log of inside debt	-0.006*	-0.009*	-0.005*	-0.008**	-0.002*	-0.004*
	(0.066)	(0.059)	(0.071)	(0.050)	(0.069)	(0.063)
Log of firm leverage	0.022***	0.029***	0.017***	0.024***	0.007***	0.013***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Variables from main model	Yes	Yes	Yes	Yes	Yes	Yes
Observations	221	221	221	221	221	221
Adjusted-R^2	0.75	0.72	0.74	0.74	0.72	0.75

Panel D: Dummy variable equal to 1 if CEO relative debt>1 and 0 otherwise						
	VAR(99.5)	ES(99.5)	VAR(99)	ES(99)	VAR(95)	ES(95)
Relative debt dummy	-0.016*	-0.027**	-0.012*	-0.020**	-0.006*	-0.011**
	(0.060)	(0.016)	(0.088)	(0.026)	(0.075)	(0.046)
Variables from main model	Yes	Yes	Yes	Yes	Yes	Yes
Observations	282	282	282	282	282	282
Adjusted-R^2	0.59	0.57	0.57	0.59	0.56	0.59

Panel E: Without multiline insurers						
	VAR(99.5)	ES(99.5)	VAR(99)	ES(99)	VAR(95)	ES(95)
Relative debt dummy	-0.008**	-0.013**	-0.007***	-0.010***	-0.003***	-0.006***
	(0.011)	(0.008)	(0.010)	(0.008)	(0.010)	(0.007)
Variables from main model	Yes	Yes	Yes	Yes	Yes	Yes
Observations	169	169	169	169	169	169
Adjusted-R^2	0.78	0.73	0.79	0.77	0.74	0.79

Note: This table provides a results of alternate specifications of variables in the main models in Table 4. Panel A provides a results from using an alternate methodology to calculate VAR and ES, the main risk measures employed in this study. Panel B employs the risk measures from the perspective of shareholders of property liability insurance companies. Definitions of these stock volatility measures are found in Table 1. Panel C shows the results of separating inside debt and firm leverage from the relative leverage. Both inside debt and firm leverage are in natural logarithm form. Panel D employs the dummy variable that takes a value of 1 if the CEO relative leverage is great than 1 or otherwise 0. This classification allows us to use when the relative leverage is 0 unlike the logged value of relative leverage we employed, and thus reduces the potential bias of not including these CEO observations when relative leverage is undefined. Panel E shows the results of the main model without multiline insurers. P-values are derived from firm-level clustered robust standard errors are in parentheses. ***, **, * represent statistical significance at the 0.01, 0.05, and 01 level, respectively.