CEO Inside Debt and Overinvestment

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Theoretical studies suggest that overinvestment is driven by equity holders' desire to shift wealth from debt holders, while underinvestment is driven by equity holders' desire to prevent the enhancement of debt-holder wealth. Therefore, debt holders have a stronger incentive to eliminate overinvestment than to eliminate underinvestment. We find that firms with higher inside-debt ratios are less likely to overinvest. Firms with above-median CEO inside-debt ratios drive this negative effect. These results support our expectation that CEO inside debt serves as a curb on overinvestment in order to prevent a wealth shift from debt holders to equity holders.

INTRODUCTION

Managerial incentives have a substantial impact on a firm's investment decisions. Prior literature has examined the use of equity compensations (i.e., stocks and stock options) in mitigating the conflicts between managers and shareholders (Coles, Daniel, & Naveen, 2006; Low, 2009; Amstrong, Gow, & Larcker, 2013). The other part of the agency conflict arises between managers and debt holders when managers engage in risk-seeking activities to benefit shareholders at the expense of debt holders. Jensen and Meckling (1976) hypothesize that there is an optimal mixture of equity-like and debt-like compensations to resolve the agency problems within the firm. They refer to debt-like compensation as "inside debt,"[1] which is often used to align CEO incentives with those of debt holders. A theoretical study by Childs, Mauer, and Ott (2005) suggest that equity holders' desire to shift wealth from debt holders drives overinvestment. In this study, we empirically examine whether CEO inside debt serves as a curb on overinvestment in order to prevent the wealth shift from debt holders to equity holders.

This study is built on two schools of literature. First, stock-based compensation alone cannot produce efficient investment (Narayanan, 1996). Stock compensation creates an incentive of overinvestment although it might reduce underinvestment in long-term projects. However, larger executive debt compensation is often associated with underinvestment and is more likely to increase the value of debt. A recent study by Eisdorfer, Giaccotto, and White (2013) finds that larger positive or negative differences between compensation leverage and firm leverage lead to larger deviations from optimal investment policy.

Second, a bulk of prior studies suggest that CEOs manage their firms more conservatively when their inside debt is large relative to firm equity holdings, leading to a less risky operation with lower probabilities of default. For example, Cassell, Huang, Sanchez, and Stuart (2012) document a negative

relation between inside debt holdings and R&D expenses. Edmans and Liu (2011) suggest that inside debt not only reduces risk-shifting overinvestment but also induces executives to increase a firm's liquidation value. Chen, Dou, and Wang (2010) suggest that inside debt is associated with accounting conservatism and higher liquidation value. Cho, Fu, and Yu-Thompson (2015) find that a CEO's relatively large holdings of inside debt will result in a well-funded pension status. They also find that firms' other investment activities decrease during the same period, which reflects the trade-off between the decreased net position of pension liabilities and reduced cash flows for other investments. Lu-Andrews and Yu-Thompson (2015) document that CEOs with increased inside debt prefer tangible asset investment to riskier investments, such as R&D.

Because financial investment efficiency increases with reporting quality (Easley & O'Hara, 2004; Lambert, Leuz, & Verrecchia, 2007; Biddle, Hilary, & Verdi, 2009), CEOs who have larger inside debt should care more about firm riskiness and the costs of financial misreporting that arise in the long term, which may in turn induce overinvestment in risky projects. Therefore, we hypothesize that CEO inside debt is negatively associated with investment and such a negative relation is more pronounced when firms overinvest.

Our sample consists of 3,903 firm-year observations with complete compensation, investment, and other necessary data, from 2006 to 2013. CEO inside-debt ratio is the ratio of the CEO's debt-to-equity ratio to the firm's debt-to-equity ratio. CEO inside debt-to-equity ratio is calculated as the sum of the present value of accumulated pension benefits and deferred compensation divided by the CEO's equity holdings. We obtain executive compensation data from Compustat for the period of 2006–2013. We employ the following measures to proxy for investment: (1) firm investment (*INVESTMENT*) as capital expenditures net of depreciation expenses that is obtained from the cash flow statement; (2) residual investment (*RINVEST*) estimated from the investment function of a vector of explanatory factors that prior literature has shown can affect firm investment behavior; and (3) overinvestment (*OVERINVESTMENT*), which takes a value of one if the residual investment is positive. By conducting OLS and logit regression analyses, we find that, after controlling for factors that drive investment activities and inside debt, industry and year fixed effects, and heteroscedasticity, firms with higher inside-debt ratios have overall lower investment. This negative effect is driven by those firms with CEO inside debt that is higher than its median value in each year. We also find that CEO inside debt is more negatively associated with investment spending if firms overinvest. Our empirical findings confirm our expectation that firms with higher inside debt tend not to deviate their investment from its optimal level.

Our study contributes to the existing literature in three ways. First, we provide further empirical evidence to support the idea that higher CEO inside debt reduces firm overinvestment and capital allocations. Second, we directly test whether higher CEO inside debt can curb managerial activities in value-destroying activities such as empire building in firms with ample capital. We provide significant empirical evidence to support the theory suggested by Childs et al. (2005) that CEO inside debt serves as a curb on overinvestment in order to prevent the wealth shift from debt holders to equity holders. Third, we provide additional empirical evidence that firms with relatively high inside-debt ratios drive the negative relation between CEO debt compensation and overinvestment.

This study is different from Eisdorfer et al. (2013) in the following ways: (1) we use a high (low) CEO inside-debt ratio that is above (below) median CEO inside debt relative to firm debt-to-equity ratio in each year rather than the difference between executive and firm leverage ratio; (2) we focus on examining whether the negative relation between overinvestment and CEO debt compensation is driven by extreme high CEO inside debt in its distribution; and (3) we focus on empirical examination of whether CEO debt compensation can be used to prevent overinvestment in investment distortion groups.

The remainder of the paper is organized as follows. In Section 2, we review recent related literature and introduce the main hypotheses. Section 3 describes research design. Section 4 discusses data sample and empirical results and Section 5 concludes.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

The typical agency problem (i.e., the separation of ownership and control) creates agency costs associated with both equity holding and debt holding. Jensen and Meckling (1976) hypothesize that an optimal mixture of equity-like and debt-like compensations exists to resolve agency problems within the firm.

CEO inside debt is composed of accumulated pension benefits and deferred compensation, which are unsecured and unfunded.[2] The nature of inside debt exposes CEOs to the same default risks faced by outside debt holders so that CEOs' inside debt aligns their wealth with their firms' liquidation value when firms are solvent or default (Edmans & Liu, 2011). Equity compensation negatively affects debt holders because the probability of default increases as risk-shifting behavior becomes excessive. In this case, managers manage firms in a way that benefits shareholders at the expense of debt holders. Therefore, inside debt serves as a curb on a CEO's risk-taking incentive and reduces the agency's cost of debt. Edmans and Liu (2011) offer a theoretical framework to justify the use of inside debt as an efficient compensation, showing that inside debt not only reduces risk-shifting overinvestment but also induces executives to increase the liquidation value of a firm.

With the increasing availability of inside-debt data disclosure, numerous studies have been empirically focused on the effects of inside debt holdings on firm performance, firm risk, and firm investment policies. A recent literature review shows tremendous evidence of the conservative nature of inside debt holdings by executives. Sundaram and Yermack (2007) report a negative relation between inside debt holdings and default risk. Anantharaman, Fang, and Gong (2013) find a negative correlation between inside debt and the cost of debt. Wei and Yermack (2011) show reduced volatility of both bond and stock securities at initial disclosure of CEO inside debt holdings. Chen et al. (2010) suggest that inside debt is associated with accounting conservatism and higher liquidation value. Belkhir and Boubaker (2013) study CEO inside debt holdings in U.S. banks and find that bank CEOs with higher inside debt holdings engage in more risk-hedging activities. Liu, Mauer, and Zhang (2014) suggest a propensity of excessive cash holdings among firms in which CEOs have higher inside-debt holdings. Anantharaman and Lee (2014) argue that compensation creates managerial incentives that affect pension risk shifting and pension asset-investment decisions. They find that when executive compensation aligns a manager's interest with that of stockholders, the firm's pension becomes excessively underfunded. Furthermore, Cho et al. (2015) focus on how pension risk shifting can be explained and constrained by the debt component in CEO compensation. In particular, they find a CEO's relatively large holdings of inside debt will result in a well-funded pension status. They also find that firms' other investment activities decrease during the same period, which reflects the trade-off between the decreased net position of pension liabilities and reduced cash flow for other investments. Cassell et al. (2012) document that firms with higher CEO inside debt holdings present safety-seeking behavior and invest less in R&D projects. Lu-Andrews and Yu-Thompson (2015) document that CEOs with increased inside debt prefer safer tangible asset investments to riskier investments (e.g., R&D) in both contemporaneous and subsequent years.

In a frictionless market, managers undertake every positive NPV project to maximize firm value. Mangers whose compensation is tied to accounting earnings may decide to forego positive NPV projects or undertake negative NPV projects if the benefits of undertaking or foregoing the project are greater than the costs, resulting in both over- and underinvestment. Over- or underinvestment depends not only on managers' incentives, but also on the availability of external financing and the cost of financing. Previous literature (e.g., Almeida, Campello, & Weisbach, 2004; Faulkender & Wang, 2006, Denis & Sibikov, 2010) has shown that financially constrained firms are more (less) likely to suffer underinvestment (overinvestment) because such firms have limited access to external financing and the cost of financing is also high. However, prior research has documented a positive relation between investment expenditure and free cash flow (Hubbard, 1998). Richardson (2006) suggests two interpretations for this positive relation. First, the positive relation is a manifestation of an agency problem, wherein managers in firms with free cash flow engage in wasteful expenditure (Jensen, 1986; Stulz, 1990). Second, costly external

financing creates the potential for internally generated cash flow to expand the feasible investment opportunity set (Fazzari, Hubbard, & Petersen, 1988; Hubbard, 1998).

He (2015) finds that higher CEO inside debt is associated with lower abnormal accruals and higher accruals quality, which suggests that inside debt promotes high financial reporting quality. Prior studies find financial reporting quality increases with investment efficiency (Easley & O'Hara, 2004, Lambert et al., 2007, Biddle et al., 2009). Biddle et al. (2009) find higher reporting quality is negatively associated with both over- and underinvestment and firms with higher reporting quality are less likely to deviate from their predicted levels of investment. The abovementioned empirical evidence shows that CEOs who have larger inside debt should care more about firm riskiness and the costs of financial misreporting that arise in the long term, which in turn may induce overinvestment in risky projects.

Previous literature has also documented that overinvestment results in a reduction of asset productivity and poor operating and stock performance. Fu (2010) finds that firms' operating performance deterioration following seasoned equity offerings (SEO) is due to overinvestment of SEO proceeds. Nohel and Tarhan (1998) find that operating performance improves after firms buy back stocks through tender offers because stock-repurchase firms pay out free cash flow and employ assets more efficiently. Loughran and Ritter (1997) find firms that rapidly increase capital expenditures have lower subsequent stock returns than other firms. Lyandres, Sun, & Zhang (2008) find a new investment factor, long in low investment-to-assets stocks and short in high investment-to-assets stocks, explains a substantial part of the new issues puzzle. A theoretical study by Childs et al. (2005) examines interactions between flexible financing and investment decisions in a model with stockholder-bondholder conflicts over investment policy. They find that equity holders' desire to shift wealth from debt holders drives overinvestment. Based on the abovementioned discussion and evidence in prior literature, we would expect to find that CEO inside debt serves as a curb on overinvestment in order to prevent a wealth shift from debt holders to equity holders. This expectation leads to the following hypotheses:

H1: CEO inside debt is negatively associated with firm investment.

H2: The negative relation between investment and inside debt is more pronounced when firms are overinvested.

As suggested in Childs et al. (2005)'s theoretical study, equity holders' desire to prevent the enhancement of debt-holder wealth drives underinvestment. Therefore, we do not make a prediction on the relationship between CEO inside debt and underinvestment.

RESEARCH DESIGN

CEO Inside-Debt Holdings

Following Cassell et al. (2012), Wei and Yermack (2011), and Edmans and Liu (2011), we measure inside-debt ratio (*INSIDE_DEBT*) as the ratio of CEO debt-to-equity ratio to firm debt-to-equity ratio.

$$INSIDE\_DEBT = CEO\ \frac{DEBT}{EQUITY} \div FIRM\ \frac{DEBT}{EQUITY} \quad (1)$$

The ratio of a CEO's debt portion to equity holdings ($CEO\ \frac{DEBT}{EQUITY}$) is calculated as the sum of the actuarial present value of accumulated pension benefits and deferred compensation divided by the CEO's equity holdings, where equity holdings are measured as the sum of stock value and stock options. The value of a CEO's stock holdings is measured by multiplying the number of shares held by the stock price at the end of the fiscal year. The option value is calculated using Black-Scholes' (1973) option valuation model. Firm leverage ($FIRM\ \frac{DEBT}{EQUITY}$) is calculated as total debt divided by total equity. Total debt is the

sum of current liability and long-term debt (Compustat items LCT+DLTT). Total equity is the market value of equity (Compustat items CSHO×PRCC_F).

Investment Model

To examine the relation between CEO inside debt and firm investment, we estimate the following equation through two measures of investment: (1) the net capital expenditure (*INVESTMENT*), and (2) the residual investment (*RINVEST*).

$$INVESTMENT_{i,t}(RINVEST_{i,t}) = \gamma_0 + \gamma_1 INSIDE\_DEBT_{i,t} + \gamma_2 VEGA/DELTA_{i,t} + \gamma_3 SIZE_{i,t} + \gamma_4 LEVERAGE_{i,t} + \gamma_5 TENURE_{i,t} + \gamma_6 FIRMAGE_{i,t} + +\gamma_7 SALESGRTH_{i,t} + \gamma_8 CASH_{i,t} + \gamma_9 TOBIN'SQ_{i,t} + \gamma_{10} RET_{i,t} + \sum \rho_T YEAR + \sum \tau_T INDUSTRY + \varphi_{i,t} \quad (2)$$

The dependent variable *INVESTMENT* is the net capital expenditure (Compustat items CAPX–XDP) scaled by the beginning total assets (Compustat item AT). To alleviate the concern for endogeneity, we estimate the residual investment (*RINVEST*) in Eq. (3) by controlling for the lagged values of firm characteristics.

$$INVESTMENT_{i,t} = \alpha_0 + \alpha_1 LEVERAGE_{i,t-1} + \alpha_2 SALESGRTH_{i,t-1} + \alpha_3 CASH_{i,t-1} + \alpha_4 TOBIN'S\ Q_{i,t-1} + \alpha_5 RET_{i,t-1} + \sum INDUSTRY + \sum YEAR + \varepsilon_{i,t}. \quad (3)$$

Measurement of the ratio of CEO inside-debt holdings (*INSIDE_DEBT*) is described in the previous section. Prior literature finds that stock option grants are positively related to risk-seeking behavior (e.g., Guay, 1999; Rajgopal & Shevlin, 2002; Coles et al., 2006). Therefore, we control for the CEO *VEGA/DELTA* ratio. *SIZE* is the natural logarithm of the total assets. *TENURE* is the natural logarithm of the number of years since the CEO was appointed. *FIRMAGE* is the natural logarithm of the number of years since the firm first appeared in the Compustat. Similar to Richardson (2006), we control for firm leverage, cash, and stock returns. *LEVERAGE* is the sum of long-term and current debt, deflated by total assets. *CASH* is the net cash flow from operations, deflated by beginning total assets. *RET* is the compounded stock returns over the 12-month period beginning with 9 months prior to the fiscal-year end. Following Biddle et al. (2009), we control for sales growth (*SALESGRTH*) in the investment regressions. *SALESGRTH* is the percentage change in sales in each year. Following Tobin (1969), we include the firm's average q (*TOBIN'S Q*) to control for the firm's growth opportunity, which is measured as the sum of the market value of equity, long-term and current debt, deflated by the book value of beginning total assets.

In Eqs. (2) and (3), we also control for industry and year fixed effects. Industries are defined by Fama and French's (1997) 48 industry classifications.[3] Detailed description of these measures are included in the Appendix A.

DATA SAMPLE AND EMPIRICAL RESULTS

Data

Our sample coverage is from 2006 to 2013. In order to be consistent with other studies (Cho et al., 2015; Lu-Andrews & Yu-Thompson, 2015) in this area, we begin our sample period in the year of 2006. In 2006, the SEC mandated the disclosure of firms' top five executives' deferred compensation plans, the annual accrual of pension benefits, the present value of accrued pension benefits, and other post-employment payments. Executive compensation data are available from year 2006 for the related information. We require the data to include complete executive compensation data, which include CEO equity compensation, accumulated pension benefits, and deferred compensations. We eliminate observations with missing data for firm investment and other control variables from Execucomp,

Compustat, and CRSP. The final sample consists of 3,903 firm-year observations. Table 1 outlines the sample selection procedure.

TABLE 1
SAMPLE SELECTION

Filters	Number of firm-year observations
Total number of observations with complete executive compensation data and Compustat annual data for CEO inside-debt ratio in the periods 2006-2013	5,173
Less: firms with missing data for investment variables	(942)
Less: firms with missing data for other control variables used in the regressions	(328)
Final sample in the period of 2006–2013	3,903

Note: This table presents the sample selection procedure. Our final sample includes 3,903 firm-year observations in the period of 2006–2013.

Sample Description

Table 2 presents the descriptive statistics of the variables used in this analysis. The mean and median values of CEO debt-to-equity ratio (*CEO* $\frac{DEBT}{EQUITY}$) are 0.649 and 0.289, respectively, suggesting that for the majority of our sample firms, CEO equity holdings are higher than CEO debt holdings. However, CEO inside-debt holdings are substantial in our sample firms. The mean (median) of firm debt-to-equity ratio (*FIRM* $\frac{DEBT}{EQUITY}$) is 0.774 (0.491), indicating that the majority of firms in our sample have higher equity holdings than debt holdings. The mean (median) of CEO inside-debt ratio (*INSIDE_DEBT*) is 1.240 (0.600), exhibiting a right-skewed distribution and indicating that the CEO debt-to-equity ratio is less than the firm's debt-to-equity ratio for the majority of firms. The mean (median) vega-to-delta ratio (*VEGA/DELTA*) is 0.441 (0.369). Overall, these results suggest that equity-based incentives are dominant and popular for the majority of firms in the sample.

INVESTMENT has the mean and median value of 0.012 and 0.001. Residual investment (*RINVEST*) has the mean and median value of -0.002 and -0.002. *OVERINVESTMENT* has the mean and median value of 0.440 and 0.000. The average CEO tenure is 7 years and the average firm age is 38 years (untabulated).

TABLE 2
SUMMARY STATITICS

	N	Mean	25th	Median	75th	Std. Dev.
INVESTMENT	3,903	0.012	-0.008	0.001	0.022	0.034
RINVEST	3,903	-0.002	-0.015	-0.002	0.008	0.027
OVERINVESTMENT	3,903	0.440	0.000	0.000	1.000	0.497
INSIDE_DEBT	3,903	1.240	0.192	0.600	1.464	1.924
CEO $\frac{DEBT}{EQUITY}$	3,903	0.649	0.094	0.289	0.674	1.479
FIRM $\frac{DEBT}{EQUITY}$	3,903	0.774	0.273	0.491	0.873	1.532
VEGA/DELTA	3,903	0.441	0.116	0.369	0.661	0.388
SIZE	3,903	8.603	7.451	8.468	9.654	1.601
LEVERAGE	3,903	0.244	0.136	0.237	0.340	0.148
TENURE	3,903	1.610	1.099	1.609	2.197	0.826
FIRMAGE	3,903	3.473	2.996	3.714	4.025	0.638
SALESGRTH	3,903	0.054	-0.021	0.049	0.122	0.164
CASH	3,903	0.101	0.059	0.094	0.135	0.065
TOBIN'S Q	3,903	1.321	0.788	1.069	1.650	0.838
RET	3,903	0.151	-0.091	0.123	0.341	0.445

Note: Variable definitions are included in Appendix A.

Pearson correlation (untabulated) indicates that CEO inside-debt variables (*INSIDE_DEBT*) and investment variables (*INVESTMENT* and *OVERINVESTMENT*) are significantly negative correlated. *INSIDE_DEBT* and *RINVEST* are insignificantly negative correlated. The remaining correlations are consistent with the hypothesized relationships.[4]

Main Results

H1 predicts that CEO inside debt is negatively associated with firm investment (*INVESTMENT*, *RINVEST*, and *OVERINVESTMENT*). Table 3 presents the OLS regression results of Eq. (2) by examining the effect of CEO inside-debt ratio (*INSIDE_DEBT*) on firm investment (*INVESTMENT*). Column (1) presents the full sample results. Column (2) presents results for firms with low CEO inside-debt ratio. Column (3) presents results for firms with high CEO inside-debt ratio. Firms with low (high) CEO inside-debt ratio are defined as those with below (above) median CEO inside debt in each year. To derive the t-statistics for our regressions, we adjust Huber-White robust standard errors. We control for both industry and year fixed effects in all regressions.

INSIDE_DEBT in both Columns (1) and (3) exhibits significantly a negative relation with firm investment. On average, firms with high CEO inside-debt ratio tend to invest less in the contemporaneous year. This result is mainly driven by firms with above-median CEO inside debt. For firms with below-median CEO inside debt (Column 2), the coefficient on *INSIDE_DEBT* is negative but insignificant. For the full sample, *INVESTMENT* significantly increases with firm size, cash flow, Tobin's Q, and decreases with stock returns.

TABLE 3
CEO INSIDE-DEBT RATIO AND FIRM INVESTMENT: NET CAPITAL EXPENDITURE

	Dependent Variable: $INVESTMENT_{i,t}$		
	(1)	(2)	(3)
	Full Sample	Low *INSIDE_DEBT*	High *INSIDE_DEBT*
$INSIDE\_DEBT_{i,t}$	-0.0005***	-0.0011	-0.0005**
	(-2.69)	(-0.27)	(-2.47)
$VEGA/DELTA_{i,t}$	-0.0031***	-0.0055***	-0.0017
	(-2.66)	(-2.70)	(-1.17)
$SIZE_{i,t}$	0.0006*	0.0001	0.0012***
	(1.67)	(0.13)	(2.65)
$LEVERAGE_{i,t}$	-0.0044	-0.0008	-0.0136**
	(-1.22)	(-0.17)	(-2.30)
$TENURE_{i,t}$	0.0003	0.0004	-0.0005
	(0.53)	(0.49)	(-0.58)
$FIRMAGE_{i,t}$	-0.0006	0.0015	-0.0029***
	(-0.83)	(1.35)	(-3.10)
$SALESGRTH_{i,t}$	0.0002	-0.0010	-0.0004
	(0.06)	(-0.21)	(-0.09)
$CASH_{i,t}$	0.0712***	0.0770***	0.0532***
	(5.54)	(4.15)	(3.29)
TOBIN'S $Q_{i,t}$	0.0056***	0.0054***	0.0060***
	(5.60)	(3.68)	(4.64)
$RET_{i,t}$	-0.0072***	-0.0068***	-0.0084***
	(-5.67)	(-3.97)	(-4.65)
Constant	-0.0107**	-0.0122*	-0.0116*
	(-2.21)	(-1.73)	(-1.76)
Industry and year fixed effects	Yes	Yes	Yes
N	3,903	1,954	1,949
adj. R^2	40.23%	41.22%	42.59%

Note: This table presents the OLS regression results of firm investment on CEO inside-debt ratio ($INSIDE\_DEBT_{i,t}$) and control variables. The dependent variable is the contemporaneous firm investment measured as the net capital expenditure ($INVESTMENT_{i,t}$). Column (1) presents the full sample results. Column (2) presents results for firms with low CEO inside-debt ratio. Column (3) presents results for firms with high CEO inside-debt ratio. Firms with low (high) CEO inside-debt ratio are defined as those with below (above) median CEO inside debt in each year. Industries are defined by Fama and French (1997) 48 industry classifications. Statistical significance of the reported coefficients is based on Huber-White robust standard errors. ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively. T-statistics are shown in parentheses.

Table 4 presents the OLS regression results of Eq. (2) by examining the effect of CEO inside-debt ratio (*INSIDE_DEBT*) on residual investment (*RINVEST*). *RINVEST* is estimated by using model specification in Eq. (3). Columns (1) and (2) present the full sample results. Column (3) presents results for firms with low CEO inside-debt ratio. Column (4) presents results for firms with high CEO inside-debt ratio. Firms with low (high) CEO inside-debt ratio are defined as those with below (above) median CEO inside debt in each year. *INSIDE_DEBT* in Columns (1) and (2) from the full sample regressions has significantly negative coefficients (-0.0003 and -0.0003). These results indicate that CEO inside debt is also negatively related to those unobservant factors that could drive investment decisions. These results

are consistent with findings in Eisdorfer et al. (2013). Similar to results in Table 3, the coefficient on *INSIDE_DEBT* for firms with low CEO inside debt is insignificant (Column 3). However, for firms with high CEO inside debt, the coefficient on *INSIDE_DEBT* is significantly negative (coeff.=-0.0005, t-stat.=-2.15) at the 5% level (Column 4). This result confirms our prior findings that investment spending decreases with CEO inside debt (Cho et al., 2015).

TABLE 4
CEO INSIDE-DEBT RATIO AND FIRM INVESTMENT: RESIDUAL INVESTMENT

	Dependent Variable: $RINVEST_{i,t}$			
	(1)	(2)	(3)	(4)
	Full Sample	Full Sample	Low *INSIDE_DEBT*	High *INSIDE_DEBT*
$INSIDE\_DEBT_{i,t}$	-0.0003*	-0.0003*	0.0032	-0.0005**
	(-1.77)	(-1.75)	(0.83)	(-2.15)
$VEGA/DELTA_{i,t}$	-0.0009	-0.0009	-0.0032	0.0005
	(-0.81)	(-0.80)	(-1.58)	(0.35)
$SIZE_{i,t}$	-0.0001	0.0000	0.0001	-0.0000
	(-0.44)	(0.10)	(0.29)	(-0.09)
$TENURE_{i,t}$	-0.0002	-0.0000	-0.0004	0.0002
	(-0.29)	(-0.00)	(-0.54)	(0.23)
$FIRMAGE_{i,t}$	-0.0011*	-0.0012*	0.0012	-0.0035***
	(-1.79)	(-1.92)	(1.20)	(-3.94)
$LEVERAGE_{i,t}$		0.0035	0.0091**	-0.0021
		(1.20)	(2.42)	(-0.44)
$SALESGRTH_{i,t}$		-0.0087***	-0.0081*	-0.0105**
		(-2.58)	(-1.70)	(-2.24)
$CASH_{i,t}$		-0.0040	0.0024	-0.0123
		(-0.34)	(0.14)	(-0.79)
TOBIN'S $Q_{i,t}$		0.0020**	0.0026**	0.0018
		(2.31)	(2.07)	(1.55)
$RET_{i,t}$		-0.0002	0.0001	-0.0010
		(-0.18)	(0.04)	(-0.69)
Constant	0.0035	-0.0003	-0.0111**	0.0102**
	(1.04)	(-0.09)	(-2.18)	(2.15)
Industry and year fixed effects	No	No	No	No
N	3,903	3,903	1,954	1,949
adj. R^2	0.04%	0.38%	0.61%	0.78%

Note: This table presents the OLS regression results of firm investment on CEO inside-debt ratio ($INSIDE\_DEBT_{i,t}$) and control variables. The dependent variable is the contemporaneous firm investment measured as the residual value ($RINVEST_{i,t}$) estimated from the investment model:

$$INVESTMENT_{i,t} = \alpha_0 + \alpha_1 LEVERAGE_{i,t-1} + \alpha_2 SALESGRTH_{i,t-1} + \alpha_3 CASH_{i,t-1} + \alpha_4 TOBIN'S\ Q_{i,t-1} + \alpha_5 RET_{i,t-1} + \sum INDUSTRY + \sum YEAR + \varepsilon_{i,t}.$$

Columns (1) and (2) present the full sample results. Column (3) presents results for firms with low CEO inside-debt ratio. Column (4) presents results for firms with high CEO inside-debt ratio. Firms with low (high) CEO inside-debt ratio are defined as those with below (above) median CEO inside debt in each year. Industries are defined by Fama and French (1997) 48 industry classifications. Statistical significance of the reported coefficients is based on Huber-

White robust standard errors. ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively. T-statistics are shown in parentheses.

Table 5 presents the logit regression results of the overinvestment likelihood on CEO inside-debt ratio (*INSIDE_DEBT*) and control variables. The dependent variable *OVERINVESTMENT* is an indicator variable that takes a value of one for positive residual value (*RINVEST*) estimated from the investment model in Eq. (3). Column (1) presents the full sample results. Column (2) presents results for firms with low CEO inside-debt ratio. Column (3) presents results for firms with high CEO inside-debt ratio. Firms with low (high) CEO inside-debt ratio are defined as those with below (above) median CEO inside debt in each year. For the full sample, the coefficient on *INSIDE_DEBT* is significantly negative (coeff.=-0.040, t-stat.=-2.23), indicating that firms with higher CEO inside-debt ratio are less likely to engage in overinvestment activities. Similar to results in Tables 3 and 4, the coefficient on *INSIDE_DEBT* is insignificant for firms with low CEO inside-debt ratio (Column 2) but significantly negative for firms with high CEO inside-debt ratio (Column 3). That is, firms with higher CEO inside debt are less likely to deviate from their optimal investment level as predicted from the investment model.

Although the abovementioned evidence supports our prediction in H1—that overall CEO inside debt is negatively associated with overinvestment inside-debt ratio—this relation is driven by those firms with CEO inside-debt ratio higher than the median in each year.

TABLE 5
CEO INSIDE-DEBT RATIO AND OVERINVESTMENT

	Dependent Variable: $OVERINVESTMENT_{i,t}$		
	(1) Full Sample	(2) Low *INSIDE_DEBT*	(3) High *INSIDE_DEBT*
$INSIDE\_DEBT_{i,t}$	-0.0400**	0.0156	-0.0504**
	(-2.23)	(0.06)	(-2.36)
$VEGA/DELTA_{i,t}$	-0.0427	-0.1076	-0.011
	(-0.48)	(-0.75)	(-0.10)
$SIZE_{i,t}$	0.0876***	0.1015***	0.0769**
	(4.11)	(3.39)	(2.48)
$LEVERAGE_{i,t}$	-0.3547	0.0002	-0.7086*
	(-1.51)	(0.00)	(-1.85)
$TENURE_{i,t}$	-0.0693*	-0.1202**	-0.0190
	(-1.72)	(-2.15)	(-0.32)
$FIRMAGE_{i,t}$	-0.1455***	0.0437	-0.3291***
	(-2.81)	(0.58)	(-4.32)
$SALESGRTH_{i,t}$	-0.3610*	-0.4543	-0.2791
	(-1.69)	(-1.58)	(-0.86)
$CASH_{i,t}$	0.2913	0.1884	0.6327
	(0.43)	(0.21)	(0.60)
$TOBIN'S\ Q_{i,t}$	-0.0410	0.0162	-0.0833
	(-0.75)	(0.21)	(-1.04)
$RET_{i,t}$	0.0511	0.1055	-0.0499
	(0.68)	(1.03)	(-0.45)
Constant	-0.1865	-1.0135***	0.5885
	(-0.70)	(-2.66)	(1.48)
Industry and year fixed effects	No	No	No

N	3,903	1,954	1,949
pseudo R^2	0.70%	0.86%	1.30%

Note: This table presents the logit regression results of the likelihood of overinvestment on CEO inside-debt ratio ($INSIDE\_DEBT_{i,t}$) and control variables. The dependent variable *OVERINVESTMENT* is an indicator variable that takes a value of one for positive residual value ($RINVEST_{i,t}$) estimated from the investment model:

$$INVESTMENT_{i,t} = \alpha_0 + \alpha_1 LEVERAGE_{i,t-1} + \alpha_2 SALESGRTH_{i,t-1} + \alpha_3 CASH_{i,t-1} + \alpha_4 TOBIN'S\ Q_{i,t-1} + \alpha_5 RET_{i,t-1} + \sum INDUSTRY + \sum YEAR + \varepsilon_{i,t}.$$

Column (1) presents the full sample results. Column (2) presents results for firms with low CEO inside- debt ratio. Column (3) presents results for firms with high CEO inside-debt ratio. Firms with Low (High) CEO inside-debt ratio are defined as those with below (above) median CEO inside debt in each year. Industries are defined by Fama and French (1997) 48 industry classifications. Statistical significance of the reported coefficients is based on Huber-White robust standard errors. ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively. Z-statistics are shown in parentheses.

H2 tests whether the negative relation between CEO inside debt and investment is more pronounced when firms overinvest. We classify firms into overinvestment and underinvestment groups according to the residuals (*RINVEST*) estimated from Eq. (3). Table 6 presents the OLS regression results of firm investment on CEO inside-debt ratio (*INSIDE_DEBT*) and control variables for firms with overinvestment and underinvestment, respectively. The dependent variables are the contemporaneous net capital expenditure (*INVESTMENT*) (Columns 1 and 2) and the residual investment (*RINVEST*) (Columns 3 and 4). Columns (1) and (3) present results for firms with overinvestment (positive *RINVEST*). Columns (2) and (4) present results for the firms with underinvestment (negative *RINVEST*). Statistical significance of the reported coefficients is based on Huber-White robust standard errors. We find significantly negative coefficients on *INSIDE_DEBT* (-0.0006 and -0.0005) in both Columns (1) and (3). If firms overinvest, the higher CEO inside debt can curb value-destroying managerial activities, such as empire building in firms with ample capital. For firms with underinvestment, the relation between CEO inside-debt and firm investment is insignificant (Columns 2 and 4).

TABLE 6
CEO INSIDE-DEBT RATIO AND FIRM INVESTMENT: OVERINVESTMENT VERSUS UNDERINVESTMENT

	Dependent Variable: $INVESTMENT_{i,t}$		Dependent Variable: $RINVEST_{i,t}$	
	(1)	(2)	(3)	(4)
	Overinvestment	Underinvestment	Overinvestment	Underinvestment
$INSIDE\_DEBT_{i,t}$	-0.0006**	-0.0000	-0.0005**	0.0002
	(-1.98)	(-0.15)	(-2.46)	(1.01)
$VEGA/DELTA_{i,t}$	-0.0002	-0.0038***	-0.0024**	0.0017
	(-0.12)	(-3.76)	(-2.09)	(1.54)
$SIZE_{i,t}$	-0.0015***	0.0021***	-0.0019***	0.0006**
	(-3.18)	(6.94)	(-7.33)	(2.09)
$LEVERAGE_{i,t}$	-0.0024	-0.0113***	0.0158***	-0.0055**
	(-0.47)	(-3.88)	(5.24)	(-2.00)
$TENURE_{i,t}$	0.0000	0.0012**	-0.0006	0.0015***
	(0.02)	(2.45)	(-1.03)	(3.01)
$FIRMAGE_{i,t}$	0.0003	-0.0011*	0.0022***	-0.0017***

	(0.27)	(-1.82)	(3.20)	(-2.80)
$SALESGRTH_{i,t}$	0.0080	-0.0014	0.0056	-0.0140***
	(1.64)	(-0.48)	(1.43)	(-4.74)
$CASH_{i,t}$	0.0769***	0.0440***	0.0696***	-0.0880***
	(4.17)	(4.55)	(5.49)	(-8.95)
$TOBIN'S\ Q_{i,t}$	0.0087***	0.0028***	0.0006	0.0046***
	(6.05)	(3.86)	(0.57)	(6.69)
$RET_{i,t}$	-0.0079***	-0.0051***	-0.0034***	0.0016
	(-3.87)	(-4.60)	(-2.81)	(1.64)
Constant	-0.0085	-0.0144***	0.0186***	-0.0162***
	(-0.89)	(-3.35)	(5.08)	(-5.21)
Industry and year fixed effects	Yes	Yes	No	No
N	1,719	2,184	1,719	2,184
adj. R^2	58.38%	55.40%	10.33%	6.78%

Note: This table presents the OLS regression results of firm investment on CEO inside-debt ratio ($INSIDE\_DEBT_{i,t}$) and control variables for firms with overinvestment and underinvestment, respectively. The dependent variables are the contemporaneous net capital expenditure ($INVESTMENT_{i,t}$) (Columns 1 and 2) and the residual value ($RINVEST_{i,t}$) (Columns 3 and 4) estimated from the investment model:

$$INVESTMENT_{i,t} = \alpha_0 + \alpha_1 LEVERAGE_{i,t-1} + \alpha_2 SALESGRTH_{i,t-1} + \alpha_3 CASH_{i,t-1} + \alpha_4 TOBIN'S\ Q_{i,t-1} + \alpha_5 RET_{i,t-1} + \sum INDUSTRY + \sum YEAR + \varepsilon_{i,t}.$$

Columns (1) and (3) present results for firms with overinvestment (positive *RINVEST*). Columns (2) and (4) present results for firms with underinvestment (negative *RINVEST*). Industries are defined by Fama and French (1997) 48 industry classifications. Statistical significance of the reported coefficients is based on Huber-White robust standard errors. ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively. T-statistics are shown in parentheses.

In order to further test H2, we add an interaction term of *INSIDE_DEBT * OVERINVESTMENT* and a dummy variable *OVERINVESTMENT* in Eq. (2). Table 7 reports the OLS regression results of firm investment on CEO inside-debt ratio (*INSIDE_DEBT*) and control variables after including an interaction term of *INSIDE_DEBT ×OVERINVESTMENT* and a dummy variable *OVERINVESTMENT*. The dependent variables are the contemporaneous net capital expenditure (*INVESTMENT*) (Column 1) and the residual investment (*RINVEST*) (Column 2). We find that, after controlling for CEO inside debt and overinvestment, the coefficient on the interaction term in Column (1) is -0.0009 (t-stat.=-2.73), which is statistically significant at the 1% level. This result indicates that the negative relation between CEO inside debt and investment is more pronounced for those firms that engage in overinvestment. We find similar results in Column (2) when we substitute *INVESTMENT* with *RINVEST* as the dependent variable. The coefficient on the interaction term in Column (2) is -0.0010 (t-stat.=-3.34), which is statistically significant at the 1% level. The coefficient on *INSIDE_DEBT* is statistically insignificant in Column (1) and is marginally significantly positive at the 10% level in Column (3). These results are consistent with those in Table 6 and indicate that the negative relation between the CEO's inside-debt ratio and investment activities is mainly driven by firms with overinvestment.

TABLE 7
CEO INSIDE-DEBT RATIO AND FIRM INVESTMENT: CONTROLLING FOR OVERINVESTMENT

	Dependent Variables:	
	(1)	(2)
	$INVESTMENT_{i,t}$	$RINVEST_{i,t}$
$INSIDE\_DEBT_{i,t}$	0.0002	0.0004*
	(0.82)	(1.88)
$INSIDE_{i,t}$×$OVERINVESTMENT_{i,t}$	-0.0009***	-0.0010***
	(-2.73)	(-3.34)
$OVERINVESTMENT_{i,t}$	0.0299***	0.0376***
	(30.84)	(47.93)
$VEGA/DELTA_{i,t}$	-0.0029***	-0.0006
	(-2.93)	(-0.67)
$SIZE_{i,t}$	0.0003	-0.0008***
	(0.98)	(-3.66)
$LEVERAGE_{i,t}$	-0.0043	0.0065***
	(-1.44)	(3.01)
$TENURE_{i,t}$	0.0009**	0.0006
	(1.97)	(1.62)
$FIRMAGE_{i,t}$	-0.0004	0.0001
	(-0.67)	(0.19)
$SALESGRTH_{i,t}$	0.0017	-0.0056**
	(0.57)	(-2.20)
$CASH_{i,t}$	0.0652***	-0.0063
	(5.98)	(-0.72)
$TOBIN'S\ Q_{i,t}$	0.0053***	0.0024***
	(6.34)	(3.73)
$RET_{i,t}$	-0.0068***	-0.0007
	(-6.10)	(-0.88)
Constant	-0.0125**	-0.0173***
	(-2.29)	(-7.04)
Industry and year fixed effects	Yes	No
N	3,903	3,903
adj. R^2	57.15%	45.85%

Note: This table presents the OLS regression results of firm investment on CEO inside-debt ratio ($INSIDE\_DEBT_{i,t}$) and control variables after including an interaction term of *INSIDE_DEBT*×*OVERINVESTMENT*. The dependent variables are the contemporaneous net capital expenditure ($INVESTMENT_{i,t}$) (Column 1) and the residual value ($RINVEST_{i,t}$) (Column 2) estimated from the investment model:

$$INVESTMENT_{i,t} = \alpha_0 + \alpha_1 LEVERAGE_{i,t-1} + \alpha_2 SALESGRTH_{i,t-1} + \alpha_3 CASH_{i,t-1} + \alpha_4 TOBIN'S\ Q_{i,t-1} + \alpha_5 RET_{i,t-1} + \sum INDUSTRY + \sum YEAR + \varepsilon_{i,t}.$$

Industries are defined by Fama and French (1997) 48 industry classifications. Statistical significance of the reported coefficients is based on Huber-White robust standard errors. ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively. T-statistics are shown in parentheses.

CONCLUSING REMARKS

Theoretical studies (i.e., Childs et al., 2005) suggest that equity holders' desire to shift wealth from debt holders drives overinvestment, while equity holders' desire to prevent the enhancement of debt-holder wealth drives underinvestment. Therefore, debt holders have a stronger incentive to eliminate overinvestment than to eliminate underinvestment. As inside debt aligns CEO incentives with those of debt holders, we expect a nonlinear relation between firm investment and CEO inside debt in cases of overinvestment and underinvestment.

We find that, after controlling for factors that drive investment activities and inside debt, industry and year fixed effects, and heteroscedasticity, firms with higher inside-debt ratios have overall lower investments and are less likely to overinvest. This negative effect is driven by firms with above-median CEO inside-debt ratio and/or firms that overinvest. However, we do not find a negative relation between inside-debt ratio and firm investment for firms that underinvest. These results support our expectation that firms with higher inside debt tend to not deviate their investment from its optimal level and that CEO inside debt serves as a curb on overinvestment in order to prevent the wealth shift from debt holders to equity holders. Our research provides further contributions to the existing inside-debt literature on the relationship between managerial compensation and firm investment decisions, and in particular, the overinvestment problem. Our study suggests that debt-like compensation instruments help rebalance the power between debt holders and shareholders and can reduce the agency cost of debt, thus mitigating value-destroying activity, such as overinvestment. Our research can serve as direct empirical proof for the theory proposed by Childs et al. (2005). We also provide additional evidence that firms with relatively high inside debt drive the negative relation between the CEO debt compensation component and overinvestment (Eisdorfer et al., 2013).

ENDNOTES

1. We adopt this terminology from Jensen and Meckling (1976) for this research. Following previous studies, we calculate total inside debt as the sum of cumulative defined pension benefits and deferred compensation.
2. A tax-qualified component of CEOs pension is the same as the ordinary defined benefit (DB) plan for all other employees. Effective January 1, 2012, the limitation on the annual benefit under a defined benefit plan under section 415(b)(1)(A) of U.S. IRS code was increased from $195,000 to $200,000 per executive. This part is protected from other creditors and insured by the Federal Pension Benefit Guaranty Corporation (PBGC). The PBGC insures participant benefits in qualified single-employer DB plans up to a maximum guarantee amount of $54,000 (in 2011) per year for a retiree at age 65 if a company defaults on its pension obligation. The remaining vast amount in a CEO's pension plan is called the supplemental executive retirement plan or SERPs as explained in Sundaram and Yermack (2007). The amount of SERPs far exceeds the maximum federally insured amounts available to most ordinary employees under ordinary tax-qualified pension plans. If firms become bankrupt, then SERPs stand in line with other creditors. CEOs do not face tax liability until they receive the SERPs payments.
3. Please refer to Dr. Kenneth French website for details: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/changes_ind.html
4. We follow the same design of the CEO inside-debt-to-equity-to-firm-debt-to-equity ratio as in Cassell et al. (2012). They argue that the negative relationship between this ratio and firm leverage should be explained with caution. Because the firm's leverage appears in the denominator of the CEO debt-to-equity-to-firm-debt-to-equity ratio, the association between CEO inside-debt holdings and financial leverage could be driven by a mechanical relationship.

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Appendix A
Variable Definitions

Variables	**Definitions**
Dependent Variables:	
INVESTMENT	Capital expenditure from cash flow statement net of depreciation expenses (Compustat items CAPX–XDP), deflated by beginning total assets (Compustat item AT).
RINVEST	The residual value estimated from the investment model.
OVERINVESTMENT	An indicator variable that takes a value of one if the residual investment (*RINVEST)* is positive, and zero otherwise.
Variable of Interest:	
INSIDE_DEBT	CEO inside-debt ratio is the ratio of a CEO's debt portion to equity holdings to the firm's debt-to-equity ratio. The ratio of a CEO's debt portion to equity holdings ($CEO\ \frac{DEBT}{EQUITY}$) is calculated as the sum of the actuarial present value of accumulated pension benefits and deferred compensation divided by the CEO's equity holdings. The CEO's equity holdings are measured as the sum of stock value and stock options. The value of the CEO's stock holdings is measured by multiplying the number of shares held by the stock price at the end of the fiscal year. The option value is calculated using Black-Scholes' (1973) option valuation model. Firm leverage ($FIRM\ \frac{DEBT}{EQUITY}$) is calculated as total debt divided by total equity. Total debt is the sum of the current liability and long-term debt (Compustat items LCT+DLTT). Total equity is the market value of equity (Compustat items CSHO×PRCC_F).
Control Variables:	
VEGA/DELTA	CEO vega-to-delta ratio. Vega is the sensitivity of dollar change in equity wealth associated with 0.01 changes in the standard deviation of the firm's stock returns. *Delta* is the sensitivity of dollar change in equity wealth associated with one percent change in the firm's stock price. Delta and vega are calculated following Coles, Daniel, and Naveen (2013) and Core and Guay (2002). Following Cassell *et al*. (2012), we adjust the *VEGA*/*DELTA* ratio by multiplying it by the ratio of CEO debt-to-equity ratio ($CEO\ \frac{DEBT}{EQUITY}$) to ensure the measure captures the relative importance of the CEO's equity holdings.
SIZE	The natural logarithm of total assets (Compustat item AT).
LEVERAGE	The sum of long-term and current debt (Compustat items DLC+DLTT), deflated by total assets (Compustat item AT).
TENURE	The natural logarithm of the number of years since the CEO was appointed (Execucomp).
FIRMAGE	The natural logarithm of the number of years since the firm first appeared in Compustat.
SALESGRTH	The percentage changes in sales (Compustat item SALE) in each year.
CASH	The net cash flow from operations (Compustat item OANCF), deflated by beginning total assets (Compustat item AT).
TOBIN'S Q	The market value of equity plus the book value of long-term and current debt (Compustat items CSHO×PRCC_F+DLC+DLTT), deflated by the book value of beginning total assets (Compustat item AT).
RET	The compounded stock returns over the 12-month period beginning with 9 months prior to the fiscal-year end.