“Impact of CEO pensions on value relevance of R&D expenditures”

AUTHORS	Kyung Jin Park Kyoungwon Mo https://orcid.org/0000-0001-6961-982X

ARTICLE INFO	Kyung Jin Park and Kyoungwon Mo (2018). Impact of CEO pensions on value relevance of R&D expenditures. *Problems and Perspectives in Management*, *16*(4), 224-234. doi: 10.21511/ppm.16(4).2018.19
DOI	http://dx.doi.org/10.21511/ppm.16(4).2018.19
RELEASED ON	Wednesday, 21 November 2018
RECEIVED ON	Wednesday, 12 September 2018
ACCEPTED ON	Wednesday, 14 November 2018

JOURNAL	"Problems and Perspectives in Management"
ISSN PRINT	1727-7051
ISSN ONLINE	1810-5467
PUBLISHER	LLC “Consulting Publishing Company “Business Perspectives”
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
35	0	7

BUSINESS PERSPECTIVES

LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10, Sumy, 40022, Ukraine

www.businessperspectives.org

Kyung Jin Park (Korea), **Kyoungwon Mo** (Korea)

IMPACT OF CEO PENSIONS ON VALUE RELEVANCE OF R&D EXPENDITURES

Abstract

Since CEO pension is unsecured and unfunded liabilities of the firm, it induces CEOs to have long-term incentives towards minimizing their firms' default risk. Motivated by the unique characteristics of CEO pension, this study investigates the impact of CEO pension on the value relevance of R&D expenditures. Using Tobin's Q ratio to measure firm value, the empirical results show that CEO pension intensifies the relation between R&D expenditures and Tobin's Q ratio. The results remain robust in two-stage least square and propensity score matching regression analysis to address the endogeneity issues in the relation between CEO pension and the value relevance of R&D expenditures. In addition, the regression results with ROA and F-score as the alternative dependent variables also confirm that CEO pension intensifies the relation between R&D expenditures and firm value.

Keywords CEO pension, inside debt, R&D expenditures, value relevance, firm value

JEL Classification O30; M41

Received on: 12th of September, 2018
Accepted on: 14th of November, 2018

Kyung Jin Park, Professor, School of Business Administration, Myongji University, Korea.

Kyoungwon Mo, Assistant Professor of Accounting, College of Business & Economics, Chung-Ang University, Korea.

INTRODUCTION

Unlike the ordinary workers' pension plans, CEO pensions, also known as Supplementary Executive Retire Plans (SERP), are a type of defined benefits retirement plans that require a firm to make lump-sum payments, or periodic pension payments, after a CEO retires. These CEO pensions are widely used by U.S. firms as extra compensation. For example, Sundaram and Yermack (2007) found that 78% of Fortune 500 firms provide the extra pension plans to their CEOs. Wei and Yermack (2011) assessed that 84% of their sample firms provide the extra pension plans to CEOs. The size of CEO pensions also far exceeds that of ordinary pension plans. For example, Bebchuk and Jackson Jr. (2005) found that Standard and Poor (S&P) 500 firms use CEO pensions to make up on average 34% of total CEO compensation. Wei and Yermack (2011) documented from their sample firms that CEO pensions account for approximately $10 million.

CEO pensions have particular characteristics that differ from other types of CEO compensation, such as salary, bonus, stock, and option grants. As a firm is required every fiscal year-end to record future payments for retirement benefits as liabilities, CEO pensions give the CEO the same status as that of a creditor against the firm. Additionally, this status provides the right to receive debt claims with other unsecured debt holders if the firm goes bankrupt. Therefore, the unsecured and unfunded features of CEO pensions are known to align a CEO's interests with those of outside debt holders in an effort to lower the bankruptcy risk. For example, Cassell et al. (2012) find that firms with CEO pension plans are reluctant to engage in additional R&D activities, because high R&D costs increase liquidity shortages in the short term.

http://dx.doi.org/10.21511/ppm.16(4).2018.19

This study further investigates whether CEOs awarded with larger CEO pensions are more likely to engage in R&D activities with long-term perspective. Although CEOs awarded with larger CEO pensions may be reluctant to engage in additional R&D activities, because firms with high R&D costs are particularly vulnerable to liquidity shortages in the short term, CEOs are expected to carefully choose and perform less risky, but more valuable, R&D activities to increase their firm's sustainability.

Using a sample of U.S. firms listed in ExecuComp from 2006 to 2015, it was discovered that CEOs awarded with larger CEO pensions were more likely to pay R&D expenditures positively related to Tobin (1969) (Tobin's Q ratio), a proxy for long-term firm value. These results remain robust by using two approaches, two-stage least square (2SLS) regression and propensity score matching (PSM), to alleviate the endogeneity concerns that may exist in the hypothesized relationship. Furthermore, the results with return on asset (ROA) and Piotroski's (2000) *F*-score as the dependent variables, instead of Tobin's Q ratio, also confirm that CEOs awarded with larger CEO pensions intensify the relationship between R&D expenditures and long-term firm value.

1. THEORETICAL BACKGROUND AND HYPOTHESIS

Traditional agency theory provides that the optimal CEO compensation structure should have the ratio of equity-based to debt-based compensation equal to the firm's equity-to-debt ratio (Jensen & Meckling, 1976; Edmans & Liu, 2011). It reasons that, unlike equity based compensation, which aligns the CEO's interests with those of shareholders by reducing the CEO's risk averseness, debt-based compensation matches the CEO's interests with those of outside creditors to minimize the firm's default risk. However, despite the importance of debt-based compensation to the design of CEO compensation structures, prior literature has paid less attention to the debt-based compensation, as compared to equity-based compensation (Murphy, 1985; Lambert & Larcker, 1987; Morck, Schleifer, & Vishny, 1988; McConnell & Servaes, 1990; Hanlon, Rajgopal, & Shevlin, 2003; Coles, Daniel, & Naveen, 2006; Low, 2009; Brockman, Martin, & Unlu, 2010). This is likely because firms rarely offer real debt-based compensation, such as bonds and loans, to their CEOs.

However, CEO pensions have recently been introduced by many researchers as a form of debt-based compensation. These distinctive features of CEO pensions attract many researchers in examining whether CEOs who receive pensions make more conservative investment, financing, and accounting decisions to protect their insider debt from firm bankruptcy. For example, Sundaram and Yermack (2007) found that firms providing larger CEO pensions have lower bankruptcy risk than those without such pension plans. Wei and Yermack (2011) and Anantharaman, Fang, and Cong (2013) documented that firms with larger CEO pension plans are more likely to face lower cost of debt, but higher cost of equity, than those without such pension plans. Cassell et al. (2012) found that CEO pensions are negatively related to the volatility of the firm's future stock returns, R&D expenditures, and financial leverage ratio, but are positively related to the diversification and asset liquidity. Phan (2014) addressed that CEOs awarded with larger CEO pensions are less likely to perform mergers and acquisitions that may increase the firm's default risk. With respect to accounting policies, Wang, Xie, and Xin (2017) determined that firms providing larger CEO pension plans tend to have more conservative accounting policies. Chi, Huang, and Sanchez (2017) argued that firms with larger CEO pensions are less likely to engage in tax shelter transactions that may increase future cash flow volatility.

There remains a debate about the performance of R&D expenditures, and recently, researchers have considered exogenous environmental factors when evaluating the relationship between R&D investment and future performance (Jiang, Waller, & Cai, 2013; Rosenbusch, Brinckmann, & Bausch, 2011). For example, after considering firm characteristics, such as ownership, R&D expenditures are positively related to a firm's future performance (Wang et al., 2017). Although high costs

of R&D expose the firm to increased default risk, R&D activities are essential to a firm's long-term sustainability.

Therefore, even CEOs awarded with larger CEO pensions cannot stop all R&D activities to ensure the firm's long-term survival. This underpinning logic leads us to examine whether CEOs awarded with larger CEO pensions are more likely to engage in R&D activities to increase the firm's long-term sustainability:

H1: Ceteris paribus, CEO pensions intensify the positive relationship between R&D expenditures and firm's long-term sustainability.

2. MATERIALS AND METHODS

2.1. Data

Our sample selection process began with all U.S. firms on ExecuComp's database from 2006 to 2015. We chose 2006 as the starting point for the sample period, because it was the year that the Securities and Exchange Commission (SEC) forced all firms listed in U.S. stock markets to announce relevant information about CEO pension plans. Since then, ExecuComp has provided the electronic pension data. In the sampling process, financial firms, including such companies in the banking and insurance industries as Standard Industrial Classification (SIC) codes 6000-6999, are excluded, because the accounting policies and systems used in such firms are systematically different from other firms. The data on R&D expenditures and firm-specific characteristics was obtained from the COMPUSTAT database. The information about CEO characteristics was obtained from ExecuComp. Missing firm-year observations were removed from the sample when data were missing from either ExecuComp or COMPUSTAT. This sampling process yielded 8,707 firm-year observations (1,212 firms).

2.2. Research model

Following Wei and Yermack (2011), CEOs awarded with larger CEO pensions were identified by those whose ratio of CEO pension amount to equity-based compensation was greater than firm leverage. Specifically, CEO leverage is measured as the CEO pension amount divided by the CEO equity-based compensation. The CEO pension amount is the sum of the present values of the CEO pension and deferred compensation as reported in ExecuComp. The CEO equity-based compensation is calculated by adding the total values of option-based and stock-based compensation. Then, the ratio of CEO leverage to firm leverage is calculated as dividing the value of CEO leverage by firm leverage (total debt-to-equity ratio). Additionally, a dummy variable was created, *INSDEBT*, which is set to 1 when the ratio of CEO leverage to firm leverage is greater than 1, and 0 otherwise. Thus, CEOs where *INSDEBT* is equal to 1 are those awarded with larger CEO pensions.

With *INSDEBT* as the main independent variable of interest, the following ordinary least square (OLS) regression model is developed after controlling for various firm- and CEO-related characteristics:

$$\begin{aligned} TobinQ_{it} &= \beta_0 + \beta_1 R\&D_{it} + \beta_2 INSDEBT_{it} + \\ &+ \beta_3 R\&D_{it} \cdot INSDEBT_{it} + \beta_4 FSIZE_{it} + \\ &+ \beta_5 LEV_{it} + \beta_6 MTB_{it} + \beta_7 INT_{it} + \\ &+ \beta_8 CAPEX_{it} + \beta_9 CEO\ tenure_{it} + \\ &+ \beta_{10} CEO\ age_{it} + \beta_{11} CEO\ gender_{it} + \\ &+ Industry\ fixed\ effects + \\ &+ Year\ fixed\ effects + \varepsilon. \end{aligned} \quad (1)$$

The dependent variable $TobinQ$ is the Tobin's Q ratio calculated as the market value of assets divided by the book value of assets, $R\&D$ is the dollar amounts of R&D expenditures scaled by assets, $FSIZE$ is the natural log of a firm's asset size, LEV is the ratio of book equity to debt, MTB is the ratio of market value to book value of equity, INT is the inventory turnover ratio as calculated by dividing total asset by sales, $CAPEX$ is the capital expenditure scaled by assets, $CEO\ tenure$ is the number of years since the CEO started her/his current position, $CEO\ age$ is the CEOs current age, and $CEO\ gender$ is set to 1 for male CEOs and 0 for female CEOs.

In this model, if CEO pensions intensify the relationship between R&D expenditures and

http://dx.doi.org/10.21511/ppm.16(4).2018.19

firm value as hypothesized, the coefficient on $R\&D \cdot INSDEBT$, β_3, is expected to have a positive value.

The other variables are selected to control for factors that may affect the hypothesized relationship. First, *FSIZE* is included, because larger firms tend to engage in more aggressive R&D activities that have positive firm value (Shehata, 1991). *LEV* controls for the degree of a firm's financial distress (Bhagat & Welch, 1995). *MTB*, *INT*, and *CAPEX* capture a firm's capability to grow (Yermack, 1996; Myers, 1977). *CEO tenure*, *CEO age*, and *CEO gender* are included to control for CEO-specific characteristics. Finally, the effects regarding the industry and the fiscal year are also controlled. All variables are winsorized at the top and bottom 1% to eliminate the impact of outliers.

3. RESULTS

3.1. Summary statistics

Table 1 presents the summary statistics for dependent and independent variables in the final sample of 8,707 firm-year observations. The dependent variable *TobinQ* shows a mean value of 1.566, implying that the sample firms consist of relatively large firms whose market value of equity is 1.566 times greater than its book value of assets. The implication is also confirmed by the large mean value of *R&D* (0.054). The mean value of *INSDEBT* is 0.28, indicating that 28% of CEOs in the sample are classified as those awarded with larger CEO pensions. However, it is low compared to the ratios reported by both Sundaram and Yermack (2007) and Bebchuk and Jackson Jr. (2005), possibly because the sample firms taken from the ExecuComp database include S&P 500 companies, which are smaller than those used by Sundaram and Yermack (2007) or Bebchuk and Jackson Jr. (2005). The summary statistics of other variables are generally similar to those in the prior literature mentioned above.

3.2. Correlation

Table 2 presents the Pearson correlations between the dependent and independent variables in the final sample. The coefficients and *p*-values show the general expectations on the hypothesized relationships based on the univariate analysis results. Specifically, it shows that the dependent variable *TobinQ* is positively related to R&D expenditures with the *p*-values of 0.000, indicating that R&D expenditures generally increase the firm value. *INSDEBT* is negatively correlated with *TobinQ* with the *p*-values of 0.000, implying that CEO pensions negatively contribute to firm value. However, the main independent variable, $R\&D \cdot INSDEBT$, is positively correlated with *TobinQ* with the *p*-value of 0.007. These results are consistent with the hypothesis.

Table 1. Summary statistics

Variables	Mean	SD	Median	25th	75th
TobinQ	1.566	1.224	1.224	0.757	1.986
R&D	0.054	0.180	0.025	0.004	0.074
INSDEBT	0.280	0.449	0.000	0.000	1.000
FSIZE	7.328	1.720	7.185	6.103	8.415
LEV	1.887	2.495	1.078	0.575	2.186
MTB	3.421	34.323	2.451	1.573	3.867
INT	1.643	11.779	1.098	0.740	1.552
CAPEX	0.042	0.038	0.031	0.018	0.053
CEO tenure	6.886	7.001	5.000	2.000	10.000
CEO age	61.095	7.414	61.000	56.000	66.000
CEO gender	0.036	0.186	0.000	0.000	0.000

Note: This table summarizes the descriptive statistics of the dependent/independent variables in the final sample of 8,707 firm-year observations. It presents the mean, median, standard deviation, 25th percentile, and 75th percentile values. The two databases used in this study are COMPUSTAT and ExecuComp over the period 2006–2015.

Table 2. Correlations

No	Variables	1	2	3	4	5	6	7	8	9	10	11	12
1	*TobinQ*	1	0.152	–0.083	0.029	–0.221	0.227	0.049	0.045	0.073	0.095	–0.096	–0.018
		–	(0.000)	(0.000)	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.085)
2	*R&D*	–	1	–0.076	0.052	–0.182	0.052	–0.002	0.066	–0.031	0.035	–0.018	–0.022
		–	–	(0.000)	(0.000)	(0.000)	(0.000)	(0.847)	(0.000)	(0.004)	(0.001)	(0.100)	(0.038)
3	*INSDEBT*	–	–	1	0.569	0.336	–0.167	0.011	–0.028	–0.004	–0.070	0.120	0.038
		–	–	–	(0.000)	(0.000)	(0.000)	(0.302)	(0.008)	(0.699)	(0.000)	(0.000)	(0.000)
4	*R&D*INSDEBT*	–	–	–	1	0.177	–0.035	0.006	–0.009	–0.069	–0.034	0.063	–0.016
		–	–	–	–	(0.000)	(0.001)	(0.601)	(0.390)	(0.000)	(0.001)	(0.000)	(0.125)
5	*FSIZE*	–	–	–	–	1	–0.337	0.021	–0.048	–0.014	–0.104	0.036	0.043
		–	–	–	–	–	(0.000)	(0.047)	(0.000)	(0.206)	(0.000)	(0.001)	(0.000)
6	*LEV*	–	–	–	–	–	1	–0.010	0.039	–0.046	0.144	–0.013	–0.021
		–	–	–	–	–	–	(0.338)	(0.000)	(0.000)	(0.000)	(0.223)	(0.052)
7	*MTB*	–	–	–	–	–	–	1	0.000	0.005	0.002	–0.021	0.016
		–	–	–	–	–	–	–	(0.985)	(0.637)	(0.851)	(0.056)	(0.131)
8	*INT*	–	–	–	–	–	–	–	1	–0.040	0.015	0.028	–0.007
		–	–	–	–	–	–	–	–	(0.000)	(0.168)	(0.010)	(0.488)
9	*CAPEX*	–	–	–	–	–	–	–	–	1	–0.008	0.032	0.056
		–	–	–	–	–	–	–	–	–	(0.444)	(0.003)	(0.000)
10	*CEO tenure*	–	–	–	–	–	–	–	–	–	1	0.287	–0.078
		–	–	–	–	–	–	–	–	–	–	(0.000)	(0.000)
11	*CEO age*	–	–	–	–	–	–	–	–	–	–	1	–0.059
		–	–	–	–	–	–	–	–	–	–	–	(0.000)
12	*CEO gender*	–	–	–	–	–	–	–	–	–	–	–	1
		–	–	–	–	–	–	–	–	–	–	–	–

Note: This table presents the Pearson correlations among the dependent/independent variables in the final sample of 8,707 firm-year observations. The *p*-values are in parentheses.

3.3. Regression analysis

Table 3 presents the regression results to test the hypothesis[1]. Before performing regression analysis using Equation (1), subsample analysis was performed by dividing the final sample with *INSDEBT* = 1 in [Model 1] and 0 in [Model 2], respectively. This subsample analysis can alleviate concerns over the misinterpretation on the interaction term between *R&D* and *INSDEBT*. The results in [Model 1] and [Model 2] show that the coefficients on R&D are all significantly positive, indicating that R&D expenditures positively contribute to firm value. However, the coefficient on *R&D* (= 6.566) in [Model 1] is much greater than 0.579 in [Model 2], implying that R&D expenditures paid by firms with larger CEO pensions contribute more to the firm value than those firms without such pension plans. The difference is also statistically confirmed by the coefficient on the interaction term between *R&D* and *INSDEBT* in [Model 3], which is significantly positive at 1% significance level. The results remain robust in [Model 4] of Fama-MacBeth regression analysis to alleviate time-series dependence on the hypothesized relationship. Overall, these results support the hypothesis, namely that CEO pensions intensify the positive relationship between R&D expenditures and firm value.

3.4. Endogeneity issue

Although the OLS regression using Equation (1) controls for various factors that might affect the hypothesized relationship, an endogeneity issue may arise if a selection bias exists due to observed firm characteristics that were inadvertently excluded from the controls. To alleviate this endogeneity concern, 2SLS and PSM regression analysis was also performed. The regression results are presented in Table 4.

1 Since we use ordinary least square regression model which assumes residuals' normality, we examine the residuals' normality in our main regression model. The results show that D statistics from Kolmogorov-Smirnov, W2 statistics from Cramer-von Mises, and A2 from Anderson-Darling are all indicating that our residuals are normally distributed.

http://dx.doi.org/10.21511/ppm.16(4).2018.19

Table 3. Regression of Tobin's (1969) Q ratio on R&D expenditures and CEO pensions

Independent variables	Dependent variable: *TobinQ*											
	Subsample with *INSDEBT* = 1			Subsample with *INSDEBT* = 0			Full sample			Full sample		
	OLS			OLS			OLS			Fama-McBeth		
	[Model 1]			[Model 2]			[Model 3]			[Model 4]		
Intercept	1.931	(6.31)	***	2.459	(8.01)	***	2.483	(11.03)	***	1.814	(7.85)	***
R&D	6.566	(13.32)	***	0.579	(8.02)	***	0.640	(9.58)	***	3.358	(7.59)	***
INSDEBT	–	–	–	–	–	–	–0.048	(–1.38)	–	0.040	(1.13)	–
*R&D*INSDEBT*	–	–	–		–	–	3.948	(6.82)	***	2.474	(3.33)	***
FSIZE	–0.020	(–1.60)	–	–0.125	(–12.33)	***	–0.106	(–13.32)	***	–0.079	(–8.89)	***
LEV	0.090	(6.00)	***	0.067	(11.69)	***	0.073	(14.33)	***	0.080	(21.74)	***
MTB	0.001	(3.47)	***	0.001	(3.29)	***	0.002	(4.50)	***	0.005	(2.39)	**
INT	–0.208	(–5.78)	***	0.001	(1.32)		0.002	(1.65)	*	–0.003	(–0.45)	–
CAPEX	4.461	(6.31)	***	4.015	(9.62)	***	4.224	(11.81)	***	5.119	(10.37)	***
CEO tenure	–0.001	(–0.38)	–	0.017	(7.79)	***	0.013	(7.45)	***	0.012	(5.80)	***
CEO age	–0.012	(–3.64)	***	–0.013	(–6.16)	***	–0.014	(–7.86)	***	–0.012	(–7.82)	***
CEO gender	–0.319	(–3.94)	***	–0.149	(–1.75)	*	–0.200	(–3.16)	***	–0.211	(–3.61)	***
Industry fixed effect	Yes	–	–	Yes	–	–	Yes	–	–	Yes	–	–
Year fixed effect	Yes	–	–	Yes	–	–	Yes	–	–	No	–	–
R^2	0.280	–	–	0.249	–	–	0.241	–	–	–	–	–
[*F*-value]	[16.21]***	–	–	[32.21]***	–	–	[40.24]***	–	–	–	–	–
N	2,436	–	–	6,271	–	–	8,707	–	–	8,707	–	–

Note: This table reports the regression results of Tobin's Q ratio on R&D expenditures and CEO pensions based on 8,707 firm-year observations over the period 2006–2015. The *t*-statistics are reported in parentheses. ***, **, and * indicate the statistical significance at the 1%, 5%, and 10% level, respectively.

First, 2SLS regression is used to solve the endogeneity problem caused by the possibility that a hidden firm-specific characteristic simultaneously affects the relationships among R&D expenditures, CEO pensions, and firm value. Specifically, *CEO age*, *CEO tenure*, and *CEO gender* are used as instruments for CEO pensions in the first stage, because Sundaram and Yermack (2007) find that CEO characteristics are positively correlated with CEO pensions; yet, no study has found a relationship between those variables and firm value.

First stage:

$$\begin{aligned} INSDEBT_{it} &= \beta_0 + \beta_1 FSIZE_{it} + \beta_2 LEV_{it} + \\ &+ \beta_3 MTB_{it} + \beta_4 INT_{it} + \beta_5 CAPEX_{it} + \\ &+ \beta_6 CEO\ tenure_{it} + \beta_7 CEO\ age_{it} + \\ &+ \beta_8 CEO\ gender_{it} + Industry\ fixed\ effects + \\ &+ Year\ fixed\ effects + \varepsilon. \end{aligned} \quad (2)$$

Subsequently, the residual from the first stage replaces $INSDEBT$ in the second stage regression. The regression result with the projected $INSDEBT$ is presented in [Model 2] and shows that the coefficient on $R\&D \cdot INSDEBT$ remains positive.

Second, PSM analysis is performed to reduce the effect that observable firm characteristics impose systematic differences between the characteristics and the hypothesized relationship (Tucker, 2010; Shipman, Swanquist, & Whited, 2016). Following Rosenbaum and Rubin's (1983) PSM approach, firms with $INSDEBT = 1$ are matched with those having $INSDEBT = 0$. Specifically, all control variables in the main regression model are included to obtain the propensity scores similar to Li and Prabhala (2007).

Finally, in the second stage, Equation (1) is re-estimated with the matched firms to have the closest predicted value between the two scores of firms with $INSDEBT = 1$ or 0. The first and second stage regression results are presented in [Model 3] and [Model 4], respectively. Fortunately, the regression results in [Model 4] remain qualitatively the same with the main regression results in Table 3. That is, the coefficient on $R\&D \cdot INSDEBT$ is significantly positive, confirming that the main regression results are not contaminated by the endogeneity issue mentioned above.

Table 4. Addressing endogeneity

Independent variables	2SLS						PSM					
	1st step: INSDEBT			2nd step: TobinQ			1st step: INSDEBT			2nd step: TobinQ		
	[Model 1]			[Model 2]			[Model 3]			[Model 4]		
Intercept	–0.646	(–7.67)	***	2.514	(11.19)	***	–6.116	(–11.61)	***	1.545	(6.25)	***
R&D	–	–	–	0.640	(9.58)	***	–	–	–	3.387	(15.38)	***
INSDEBT	–	–	–	–0.048	(–1.38)	–	–	–	–	0.078	(2.33)	**
*R&D*INSDEBT*	–	–	–	3.948	(6.82)	***	–	–	–	1.833	(3.42)	***
FSIZE	0.075	(26.16)	***	–0.110	(–13.93)	***	0.512	(24.63)	***	–0.043	(–4.60)	***
LEV	–0.010	(–5.17)	***	0.074	(14.45)	***	–0.058	(–3.06)	***	0.093	(12.76)	***
MTB	0.000	(0.16)	–	0.002	(4.49)	***	0.000	(–0.07)	–	0.001	(3.74)	***
INT	–0.001	(–1.40)	–	0.002	(1.67)	*	–0.759	(–12.54)	***	0.008	(2.23)	**
CAPEX	–0.110	(–0.82)	–	4.229	(11.82)	***	–2.409	(–2.46)	**	4.499	(8.82)	***
CEO tenure	–0.002	(–3.26)	***	–	–	–	–0.013	(–2.87)	***	0.017	(6.99)	***
CEO age	0.006	(8.99)	***	–	–	–	0.041	(9.16)	***	–0.013	(–5.63)	***
CEO gender	0.073	(3.04)	***	–	–	–	0.433	(2.98)	***	–0.208	(–3.06)	***
Industry fixed effect	Yes	–	–	Yes	–	–	Yes	–	–	Yes	–	–
Year fixed effect	Yes	–	–	Yes	–	–	Yes	–	–	Yes	–	–
R^2	0.197	–	–	0.241	–	–	0.220	–	–	0.277	–	–
{χ2} or [*F*-value]	[32.70]***	–	–	[40.24]***	–	–	{2160.98}***	–	–	[31.38]***	–	–
N	8,707	–	–	8,707	–	–	8,707	–	–	4,802	–	–

Note: This table presents the results using two-stage least square (2SLS) and propensity score matching (PSM) regression analysis. [Model 1] and [Model 3] present the first-stage regression results of 2SLS and PSM, respectively. [Model 2] and [Model 4] present the second-stage regression results of 2SLS and PSM, respectively. The *t*-statistics are reported in parentheses. ***, **, and * indicate the statistical significance at the 1%, 5%, and 10% level, respectively.

3.5. Robustness test

As robustness tests, instead of using Tobin's Q ratio, ROA and *F*-score were used as the dependent variables to measure firm value. Since Tobin's Q ratio measures a firm's value based on stock market participants' expectation, it is known to have some negative reflection as a result of wrong expectations by stock market participants. To alleviate this concern, accounting performance measure ROA is often used as an alternative measure of firm value. Additionally, *F*-score is pervasively used to measure firm value. *F*-score is known to have several advantages over existing measures, such as Tobin's Q and ROA, because it does not depend on any corporate event, whereas Tobin's Q and ROA could be the result of the heterogeneity of corporate events (Chung et al., 2015). Specifically, *F*-score is calculated by combining three aspects of a firm's financial status: (1) profitability (net income, operating cash flow, ROA, and earnings quality); (2) liquidity (leverage, liquidity, and the absence of dilution); and (3) operating efficiency (gross margin and asset turnover).

The results with ROA and *F*-score as alternative dependent variables are presented in Table 5. Consistent with the hypothesis, it shows that the coefficients on $R\&D \cdot INSDEBT$ are all significantly positive in both [Model 1] and [Model 2], supporting the argument that CEO pensions intensify the relationship between R&D expenditures and firm value.

3.6. Additional tests

As additional tests, we examine the effect of CEO turnovers on our hypothesis relationship. Since CEO turnover often initiates CEO pension plans, small amounts of CEO pensions in the year of CEO turnovers may not have enough power to induce CEOs to engage in more R&D activities with long-term perspective.

To test this conjecture, we search and find that 793 CEO turnover cases from our sample. Then, we perform subsample analysis by dividing our sample with and without CEO turnover. The results are presented in Table 6. Consistent with our conjecture, it shows that our hypothesized relationships are only significant for the sample without CEO turnover.

http://dx.doi.org/10.21511/ppm.16(4).2018.19

Table 5. Robustness test

Independent variables	Dependent variables					
	ROA			F-score		
	[Model 1]			[Model 2]		
Intercept	–0.153	(–6.86)	***	3.894	(14.17)	***
R&D	–0.021	(–3.15)	***	–0.050	(–0.61)	–
INSDEBT	0.009	(2.76)	***	0.048	(1.14)	–
*R&D*INSDEBT*	0.314	(5.48)	***	1.292	(1.83)	*
FSIZE	0.009	(12.00)	***	0.087	(8.88)	***
LEV	0.004	(8.80)	***	0.005	(0.77)	–
MTB	0.000	(4.12)	***	0.000	(1.15)	–
INT	–0.001	(–11.16)	***	–0.003	(–2.86)	***
CAPEX	0.380	(10.72)	***	0.276	(0.63)	–
CEO tenure	0.001	(4.22)	***	0.004	(1.75)	*
CEO age	0.000	(–2.18)	**	–0.002	(–0.86)	–
CEO gender	–0.011	(–1.72)	*	–0.050	(–0.65)	–
Industry fixed effect	Yes	–	–	Yes	–	–
Year fixed effect	Yes	–	–	Yes	–	–
R*2*	0.114	–	–	0.057	–	–
[*F*-value]	[16.41]***	–	–	[7.71]***	–	–
N	8,707	–	–	8,707	–	–

Note: This table presents the regression results with return on asset (ROA) and Piotroski's (2000) *F*-score as the dependent variables. The *t*-statistics are reported in parentheses. ***, **, and * indicate the statistical significance at the 1%, 5%, and 10% level, respectively.

In addition, we examine the effect of CEO gender on our hypothesis relationship. The literature finds that women have more conservative and long-term perspective than men. Therefore, the effect of CEO pensions to induce managers to engage in more conservative but long-term R&D investment can be offset among woman managers. We examine this conjecture. The results are presented in Table 7. It reveals that our hypothesized relationships are only significant for the men sample, consistent with our conjecture.

Table 6. CEO turnover

Independent variables	Dependent variable: TobinQ					
	Subsample with CEO turnover = 1			Subsample with CEO turnover = 0		
Intercept	0.512	(0.62)	–	2.467	(10.39)	***
R&D	3.512	(5.12)	***	0.662	(9.88)	***
INSDEBT	0.183	(1.71)	*	–0.062	(–1.69)	*
*R&D*INSDEBT*	–2.200	(–1.22)	–	3.935	(6.49)	***
FSIZE	–0.050	(–2.08)	**	–0.092	(–10.80)	***
LEV	0.066	(4.36)	***	0.076	(14.00)	***
MTB	0.002	(2.79)	***	0.001	(2.45)	**
INT	–0.058	(–4.51)	***	0.010	(3.44)	***
CAPEX	5.240	(4.70)	***	4.274	(11.12)	***
CEO tenure	0.008	(0.46)	–	0.013	(6.58)	***
CEO age	–0.006	(–1.18)	–	–0.015	(–7.75)	***
CEO gender	–0.066	(–0.39)	–	–0.095	(–1.28)	–
Industry fixed effect	Yes	–	–	Yes	–	–
Year fixed effect	Yes	–	–	Yes	–	–
R^2	0.251	–	–	0.248	–	–
[*F*-value]	[3.88]***	–	–	[38.39]***	–	–
N	793	–	–	7,914	–	–

Note: This table examines the effect of CEO turnover on our hypothesis relationships. The *t*-statistics are reported in parentheses. ***, **, and * indicate the statistical significance at the 1%, 5%, and 10% level, respectively.

Table 7. CEO gender

Independent variables	Dependent variable: TobinQ					
	Women			Men		
Intercept	0.073	(0.04)	–	2.385	(10.48)	***
R&D	5.571	(3.07)	***	0.658	(9.96)	***
INSDEBT	0.204	(1.12)	–	–0.045	(–1.27)	–
*R&D*INSDEBT*	–0.108	(–0.03)	–	3.531	(6.08)	***
FSIZE	–0.045	(–0.80)	–	–0.091	(–11.17)	***
LEV	0.103	(2.84)	***	0.074	(14.27)	***
MTB	0.001	(1.05)	–	0.001	(3.27)	***
INT	0.143	(1.10)	–	0.007	(2.68)	***
CAPEX	9.292	(4.63)	***	4.244	(11.46)	***
CEO tenure	–0.015	(–0.69)	–	0.015	(8.00)	***
CEO age	0.004	(0.20)	–	–0.015	(–7.99)	***
Industry fixed effect	Yes	–	–	Yes	–	–
Year fixed effect	Yes	–	–	Yes	–	–
R^2	0.407	–	–	0.248	–	–
[*F*-value]	[3.92]***	–	–	[38.39]***	–	–
N	269	–	–	8,438	–	–

Note: This table examines the effect of CEO gender on our hypothesis relationships. The *t*-statistics are reported in parentheses. ***, **, and * indicate the statistical significance at the 1%, 5%, and 10% level, respectively.

CONCLUSION

This study proposed how debt-based CEO compensation affects CEO decisions about investment. Many researchers suggest that CEOs who receive CEO pensions make more conservative investments in order to protect their insider debt from bankruptcy and their aligned interests with creditors.

If CEOs are entitled to CEO pensions, their status and decision-making motives become similar to that of creditors, as both have a shared interest in reducing default risk. According to Cassell et al. (2012), firms that provide CEO pensions have a higher tendency to spend less on R&D expenditures; however, we considered value relevance of R&D expenditures and long-term performance. Investments, such as R&D expenditures, are necessary for long-term sustainability; therefore, we examined how to choose such investments to reduce the default risk in relation to long-term performance. Our results support our hypothesis that CEO pensions are more likely to concern R&D activities in an effort to increase long-term firm value. This implies that the CEO who receives the CEO pension is more likely to invest in the portion of the firm that is related to sustainability than the CEO who does not receive such R&D investment. In other words, CEOs appear to be more careful when choosing to invest in the necessary R&D expenditures and considering long-term performance in investment decision-making. Even when we look at the indicators ROA and *F*-score, which show short-term performance, investment in R&D, which can reduce default risk and increase sustainability, can have a positive affect similar to that of long-term performance. In that regard, CEOs attempt to select activities that sustain their firms in order to ensure they receive their own pension fund.

We did not explore other meaningful ways of investment, but instead focused on R&D activities. To further examine long-term performance, we can consider that future decisions on capital investments, such as facility investment in addition to R&D investment, may affect larger or longer-term outcomes in future research.

If the CEO pensions reduce the default risk of firms and induce decision-making to improve sustainability, there may be many future discussions about the CEO compensation system that solve the agency problem between stock-based compensation and debt-based compensation.

http://dx.doi.org/10.21511/ppm.16(4).2018.19

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

ACKNOWLEDGEMENT

This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2018S1A5A8027012).

REFERENCES

1. Anantharaman, D., Fang, V. W., & Gong, G. (2013). Inside debt and the design of corporate debt contracts. *Management Science, 60*(5), 1260-1280. https://doi.org/10.1287/mnsc.2013.1813
2. Bebchuk, L. A., & Jackson Jr, R. J. (2005). *Executive pensions* (No. w11907). National Bureau of Economic Research. https://doi.org/10.3386/w11907
3. Bhagat, S., & Welch, I. (1995). Corporate research & development investments international comparisons. *Journal of Accounting and Economics, 19*(2-3), 443-470. https://doi.org/10.1016/0165-4101(94)00391-h
4. Brockman, P., Martin, X., & Unlu, E. (2010). Executive compensation and the maturity structure of corporate debt. *The Journal of Finance, 65*(3), 1123-1161. https://doi.org/10.1111/j.1540-6261.2010.01563.x
5. Cassell, C. A., Huang, S. X., Sanchez, J. M., & Stuart, M. D. (2012). Seeking safety: The relation between CEO inside debt holdings and the riskiness of firm investment and financial policies. *Journal of Financial Economics, 103*(3), 588-610. https://doi.org/10.1016/j.jfineco.2011.10.008
6. Chi, S., Huang, S. X., & Sanchez, J. M. (2017). CEO inside debt incentives and corporate tax sheltering. *Journal of Accounting Research, 55*(4), 837-876. https://doi.org/10.2139/ssrn.2915106
7. Chung, C. Y., Liu, C., Wang, K., & Zykaj, B. B. (2015). Institutional monitoring: Evidence from the F-score. *Journal of Business Finance & Accounting, 42*(7-8), 885-914. https://doi.org/10.1111/jbfa.12123
8. Coles, J. L., Daniel, N. D., & Naveen, L. (2006). Managerial incentives and risk-taking. *Journal of financial Economics, 79*(2), 431-468. https://doi.org/10.1016/j.jfineco.2004.09.004
9. Edmans, A., & Liu, Q. (2010). Inside debt. *Review of Finance, 15*(1), 75-102. https://doi.org/10.1093/rof/rfq008
10. Gustman, A. L., Mitchell, O. S., & Steinmeier, T. L. (1994). The role of pensions in the labor market: A survey of the literature. *ILR Review, 47*(3), 417-438. https://doi.org/10.1177/001979399404700304
11. Hanlon, M., Rajgopal, S., & Shevlin, T. (2003). Are executive stock options associated with future earnings? *Journal of Accounting and Economics, 36*(1-3), 3-43. https://doi.org/10.1016/j.jacceco.2003.10.008
12. Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of financial economics, 3*(4), 305-360. https://doi.org/10.1016/0304-405x(76)90026-x
13. Jiang, L. A., Waller, D. S., & Cai, S. (2013). Does ownership type matter for innovation? Evidence from China. *Journal of Business Research, 66*(12), 2473-2478. https://doi.org/10.1016/j.jbusres.2013.05.037
14. Kalyta, P. (2009). Accounting discretion, horizon problem, and CEO retirement benefits. *The Accounting Review, 84*(5), 1553-1573. https://doi.org/10.2308/accr.2009.84.5.1553
15. Lambert, R. A., & Larcker, D. F. (1987). An analysis of the use of accounting and market measures of performance in executive compensation contracts. *Journal of Accounting research, 25,* 85-125. https://doi.org/10.2307/2491081
16. Low, A. (2009). Managerial risk-taking behavior and equity-based compensation. *Journal of Financial Economics, 92*(3), 470-490. https://doi.org/10.1016/j.jfineco.2008.05.004
17. McConnell, J. J., & Servaes, H. (1990). Additional evidence on equity ownership and corporate value. *Journal of Financial economics, 27*(2), 595-612. https://doi.org/10.1016/0304-405x(90)90069-c
18. Morck, R., Shleifer, A., & Vishny, R. W. (1988). Management ownership and market valuation: An empirical analysis. *Journal of financial economics, 20,* 293-315. https://doi.org/10.1016/0304-405x(88)90048-7
19. Murphy, K. J. (1985). Corporate performance and managerial remuneration: An empirical analysis. *Journal of accounting and economics, 7*(1-3), 11-42. https://doi.org/10.1016/0165-4101(85)90026-6
20. Myers, S. C. (1977). Determinants of corporate borrowing. *Journal of financial economics, 5*(2), 147-175. https://doi.org/10.1016/0304-405x(77)90015-0
21. Nees, A. T. (2010). Who's The Boss? Unmasking Oversight Liability Within The Corporate

Power Puzzle". *Delaware Journal of Corporate Law, 35,* 199. Retrieved from https://heinonline.org/HOL/Page?handle=hein.journals/decor35&div=7&g_sent=1&casa_token=&collection=journals

22. Opler, T. C., & Titman, S. (1994). Financial distress and corporate performance. *The Journal of Finance, 49*(3), 1015-1040. https://doi.org/10.1111/j.1540-6261.1994.tb00086.x

23. Phan, H. V. (2014). Inside debt and mergers and acquisitions. *Journal of Financial and Quantitative Analysis, 49*(5-6), 1365-1401. https://doi.org/10.1017/s0022109014000593

24. Piotroski, J. D. (2000). Value investing: The use of historical financial statement information to separate winners from losers. *Journal of Accounting Research,* 1-41. https://doi.org/10.2307/2672906

25. Prabhala, N., & Li, K. (2007). Self-selection models in corporate finance. *Handbook of corporate finance: Empirical corporate finance, 1,* 37. https://doi.org/10.2139/ssrn.843105

26. Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika, 70*(1), 41-55. https://doi.org/10.2307/2335942

27. Rosenbusch, N., Brinckmann, J., & Bausch, A. (2011). Is innovation always beneficial? A meta-analysis of the relationship between innovation and performance in SMEs. *Journal of business Venturing, 26*(4), 441-457. https://doi.org/10.1016/j.jbusvent.2009.12.002

28. Ruiqi, W., Wang, F., Xu, L., & Yuan, C. (2017). R&D expenditures, ultimate ownership and future performance: Evidence from China. *Journal of Business Research, 71,* 47-54. https://doi.org/10.1016/j.jbusres.2016.10.018

29. Shehata, M. (1991). Self-selection bias and the economic consequences of accounting regulation: An application of two-stage switching regression to SFAS No. 2. *Accounting Review,* 768-787. Retrieved from https://www.jstor.org/stable/248155?seq=1#page_scan_tab_contents

30. Shipman, J. E., Swanquist, Q. T., & Whited, R. L. (2016). Propensity score matching in accounting research. *The Accounting Review, 92*(1), 213-244. https://doi.org/10.2308/accr-51449

31. Sundaram, R. K., & Yermack, D. L. (2007). Pay me later: Inside debt and its role in managerial compensation. *The Journal of Finance, 62*(4), 1551-1588. https://doi.org/10.1111/j.1540-6261.2007.01251.x

32. Tobin, J. (1969). A general equilibrium approach to monetary theory. *Journal of money, credit and banking, 1*(1), 15-29. https://doi.org/10.2307/1991374

33. Wang, C., Xie, F., & Xin, X. (2017). CEO Inside Debt and Accounting Conservatism. *Contemporary Accounting Research*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1703478

34. Wei, C., & Yermack, D. (2011). Investor reactions to CEOs' inside debt incentives. *The Review of Financial Studies, 24*(11), 3813-3840. https://doi.org/10.1093/rfs/hhr028

35. Yermack, D. (1996). Higher market valuation of companies with a small board of directors. *Journal of financial economics, 40*(2), 185-211. https://doi.org/10.1016/0304-405x(95)00844-5

http://dx.doi.org/10.21511/ppm.16(4).2018.19