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COMPETITION, RELATIVE PERFORMANCE EVALUATION, AND EXECUTIVE COMPENSATION CONTRACTS

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Abstract - This paper hypothesizes that the use of relative performance evaluation (RPE) as an incentive mechanism varies positively with the degree of competition a firm faces. I utilize the model proposed by Holmstrom and Milgrom (1987) and Aggarwal and Samwick (1999) to show that the level of competition affects RPE use. While previous research tends to focus on the characteristics of top executives, implying that CEOs are in the driver's seat in their relationship with firms, this paper examines firm characteristics since CEO characteristics may reflect firm needs and current condition. The tests use two alternative measures of CEO compensation: cash compensation and total compensation. By focusing on firm characteristics, I find evidence that partially supports the hypothesis. The evidence shows strong supports for RPE use in CEOs' cash compensation.

I. INTRODUCTION AND LITERATURE REVIEW

The main premise of relative performance evaluation (RPE) holds that the compensation of a risk-averse executive should only depend on the component of firm performance that is unrelated to peer firms' performance (Holmstrom, 1979, 1982 and Diamond and Verrecchia, 1982). Executives should be insulated from shocks outside their control. Otherwise, they would need to be compensated for bearing the additional risk. Implementation of RPE thus requires an understanding of the correlation of firm performance with peer performance. In this paper I seek to examine if this co-movement depends on firm-specific characteristics, such as the level of competition a firm faces in its industry.

1.1 RPE and CEO Compensation

Holmstrom (1982) suggests that the market or industry component of a firm's returns should be removed from the compensation package since executives cannot affect the overall market by their actions and it is costly for executives to bear the related risks.

Jensen and Murphy (1990) find that RPE is not an important source of managerial incentives. Barro and Barro (1990), Joh (1999), and Janakiraman, Lambert, and Larcker (1992) find that compensation increases with peer firm performance. Aggarwal and Samwick (1999) find the compensation of executives in more competitive industries exhibits less relative performance evaluation. Although they take competition level into account, they find very surprising results.

Aggarwal and Samick (1999) argue that the extent of RPE use is limited by strategic interactions. They demonstrate that the optimal contract compensates the manager positively for both individual as well as peer firm performance; and this contract has the effect of softening competition. They argue that including RPE in the incentive plan will encourage rival managers to engage in excess competition and therefore decrease the returns to shareholders, as such. This implies that RPE use should be lower in oligopolistic industries.

Garvey and Milbourn (2003) focus on the ability of executives to "undo" excessive market risk. Although there is little RPE for the average executive, they find strong evidence of RPE for younger executives and executives with less financial wealth. Oyer (2004) posits a similar conclusion that an absence of RPE is optimal if the CEO's reservation wages from outside employment opportunities vary with the economy. Rajgopal, Shevlin, and Zamora (2006) find support for Oyer's theory. They argue that the absence of RPE in compensation contracts of respected CEOs is because firms don't want to take the risk of losing those CEOs to their rivals. Their conclusions are based solely on the executive's perspective. A complete story needs to take into account the company's perspective also.

When board members make the CEO hiring decision, they are likely to consider the firm's needs and condition. For example, a large and successful firm is likely to hire a CEO with experience and reputation and pay them more than CEOs of smaller firms. So I examine whether the use of RPE is systematically related to certain firm characteristics.

1.2 RPE and Competition

There are several reasons for the paucity of evidence supporting RPE's descriptive validity. Janakiraman et al. (1992) speculate that firms may find it prohibitively costly to construct a measure that filters out the common component; for example, when it is difficult to identify the firm's peers or when the peer group changes frequently. They also suggest that firms may not necessarily consider the common factors to be noise that should be eliminated. For example, firms may find it beneficial to encourage executives to anticipate and adapt to changes in their environment that affect reported performance. Dye (1992) hypothesizes that firms may not use RPE

because it provides perverse incentives when executives are able to make investments across different industries. He shows that the use of RPE is optimal when the CEO is not allowed to invest outside of his industry, or when the number of industries (or projects) over which the CEO can choose becomes very large.

Taken together, these arguments suggest that the benefits of RPE are likely to be context specific. Kim (1996) recognizes the contextual nature of RPE and hypothesizes that the level of competition in the industry affects its usefulness. Reasoning that peer group performance in a competitive environment is more likely to yield relevant information on the common factors facing executives, he predicts that RPE is likely to be useful in the evaluation of CEOs operating in highly competitive industries. Kim (1996) finds a significant negative relation between changes in CEO compensation and changes in industry-level accounting earnings in high-competition industries, but not in low-competition industries. This finding is consistent with RPE being used to evaluate CEOs in highly competitive industries. DeFond and Park (1998) also suggest that the lack of support for RPE in prior studies results from not considering the effects of competition. In this paper, I use the Herfindal-Hirschman Index (HHI) as the proxy for degree of competition within each industry.

1.3 CEO Compensation Measures

Both total compensation and cash compensation are used to evaluate the efficacy of RPE. I use cash compensation for three reasons. First, it sidesteps the measurement error associated with valuing stock options. Second, Albuquerque (2006) studies the use of RPE across the main components of pay and finds that the strongest evidence supporting RPE comes from the salary and bonus component. Core and Guay (1999) show that stock may be granted for reasons unrelated to RPE. For example, since stock option grants require no contemporaneous cash payout, firms with cash constraints may use these forms of compensation as a substitute for cash pay (Yermack, 1995; Dechow et al.,1996). Using cash compensation has the advantage that it is paid every year, while equity compensation is paid at irregular intervals. Therefore, cash compensation arguably provides a better measure for the amount of compensation change due to RPE use.

II. MODEL AND VARIABLES

In this section, I use the mechanism based on the Holmstrom and Milgrom (1987, henceforth HM) framework and hypothesize that the level of competition affects a firm's use of RPE to compensate top executives. So the main hypothesis of this paper is that firms in more competitive industries will make more use of RPE in top executive pay.

To explain this mechanism, and as a basis for the empirical specification below, I restate the main result in HM. In HM, it is assumed that CEO compensation contract is of the form $wi=\alpha0+\alpha1z+\alpha2y$, where wi is the total compensation of firm i's CEO, z is a measure of firm i's performance, y is an equivalent performance measure for the firm's peers with variance $\sigma2y$. The constant $\alpha1$ and $\alpha2$ represent the sensitivities of compensation to own and peer performance, respectively, and $\alpha0$ is the fixed component of the contract. Firm performance is given by $z = e + x$ where e is a measure of effort and x is a random variable with variance $\sigma2x$. The effort choice e and the random variable x are unobservable and hence non-contractible. The CEO's preferences over pay and effort are given by $U(w,e) = -\exp-\gamma[w-C(e)]$, where γ is the coefficient of absolute risk aversion, and $C(e) = (ke2)/2$ is a function that describes the monetary disutility of effort. Assuming that z and y are jointly normally distributed, HM show that the optimal values of the performance sensitivities $\alpha1$ and $\alpha2$ chosen by the a firm satisfy the conditions:

$$\alpha_1 = 1 / [1 + \gamma k \sigma^2_x (1 - \rho^2)], \quad (1)$$

$$\alpha_2 = -\alpha_1 \beta, \quad (2)$$

where ρ is the correlation between firm and peer performance and $\beta = Cov(x, y) / \sigma2y$ is the slope coefficient from regressing firm performance on peer (industry) performance, referred to throughout the paper as firm-β. The first equation indicates that the optimal pay-for-performance sensitivity $\alpha1$ decreases with risk aversion, effort cost, and idiosyncratic variance. The second equation describes a firm's use of relative performance evaluation as the ratio $\alpha2 / \alpha1 = -\beta$. In particular, given $\alpha1 > 0$ and $\beta > 0$, an increase in the peer group performance that is not accompanied by an increase in firm performance leads to a decrease in CEO compensation.

I hypothesize that firm β is higher for firms in more competitive industries and, given (2) and the definition of RPE, so is RPE use. I measure the degree of competition faced by a firm inversely by the Herfindahl-Hirschman Index (HHI) of industry concentration.

A. Empirical Specification

The general empirical specification employed in the paper is:

$$W_{it} = \beta_0 + \beta_1 * Ret_{it} + \beta_2 * Ret_{pt} + \beta_3 Var_{it} + \beta_4 * Ret_{it} * Var_{it} + \beta_5 * Ret_{pt} * Var_{it} + \beta_6 * Ret_{pt} * Firm\text{-}\beta_{it} + \beta_7 * Ret_{pt} * Var_{it} * Firm\text{-}\beta_{it} + \beta_8 * Ret_{it} * Firm\ \ size_{it} + \beta_9 * Ret_{pt} * Firm\ \ size_{it} + \beta_{10} * Ret_{it} * HHI_{it} + \beta_{11} * Ret_{pt} * HHI_{it} + \beta * Control\ variables_{it} + \varepsilon_{it} \quad (3)$$

Wit represents the compensation of the CEO at firm i during time period t. Retit is firm performance, measured as the stock return. Retpt is Peer performance, measured by firm's industry average stock return (excluding firm i). Varit represents firm i's idiosyncratic variance with respect to the peer group performance at time t. I measure the degree of Competition by the Herfindahl-Hirschman Index (HHI). High (low) levels of HHI indicate high (low) industry concentration and low (high) competition. Firm-βit is the time t slope coefficient of regressing firm i's past performance on its peer performance. For firm size, I use two the natural log of total sales. I use the data from Compustat for the firm age, which is defined by the number of years since the firm has shares outstanding in the stock market. Other control variables include industry dummy and year dummy to control for the fixed effects from different industry and time period.

In Aggarwal and Samwick's (1999a):

$$W_{it} = c_0 + \alpha_1 * Ret_{it} + \alpha_2 * Ret_{pt} + \varepsilon_{it},$$

$$\text{with } \alpha_1 = \beta_1 + \beta 4 * Var_{it}, \text{ and } \alpha_2 = \beta_2 + \beta 5 * Var_{it} + \beta 6 * Firm\text{-}\beta_{it} + \beta 7 * Var_{it} * Firm\text{-}\beta_{it}.$$

According to the regression model (3), the own and peer pay-performance sensitivities for CEO of firm i at time t are α1 and α2, respectively:

$$\alpha_1 = \partial W_{it} / \partial Ret_{it} = \beta_1 + \beta_4 * Var_{it} + \beta_8 * Firm\ size_{it} + \beta_{10} * HHI_{it};$$

$$\alpha_2 = \partial W_{it} / \partial Ret_{pt} = \beta_2 + \beta_5 * Var_{it} + \beta_6 * Firm\text{-}\beta_{it} + \beta_7 * Var_{it} * Firm\text{-}\beta_{it} + \beta_9 * Firm\ size_{it} + \beta_{11} * HHI_{it}$$

And RPE is the ratio of peer to own-firm performance sensitivity:

$$RPE = \alpha 2 / \alpha 1 = [\beta_2 + \beta_5 * Var_{it} + \beta_6 * Firm\text{-}\beta_{it} + \beta_7 * Var_{it} * Firm\text{-}\beta_{it} + \beta_9 * Firm\ size_{it} + \beta_{11} * HHI_{it}] / [\beta_1 + \beta_4 * Var_{it} + \beta_8 * Firm\ size_{it} + \beta_{10} * HHI_{it}]$$

I test whether Firm-β is significantly higher for firms in highly competitive industry and also whether Firm-β impacts RPE. Formally, and as in Aggarwal and Samwick (1999a), the impact of Firm-β on RPE is tested with

$$\mathbf{H_0:}\quad \partial RPE / \partial \beta_{it} = \partial(\alpha_2 / \alpha_1) / \partial \beta_{it} = [\beta_6 + \beta_7 * Var_{it}] / [\beta_1 + \beta_4 * Var_{it} + \beta_8 * Firm\ size_{it} + \beta_{10} * HHI_{it}] \geq 0, \quad (4)$$

against the alternative hypothesis that ∂(α2 / α1) / ∂βit < 0. This alternative hypothesis states that firms with higher β are associated with a higher level of RPE. A negative derivative implies a larger negative weight on peer performance (provided α2 < 0) relative to own-firm sensitivity which corresponds to more RPE.

I have the main hypothesis of this paper tested with:

$$\partial RPE / \partial HHI_{it} = [\beta_{11}] / [\beta_1 + \beta_4 * Var_{it} + \beta_8 * Firm\ size_{it} + \beta_{10} * HHI_{it}] - \beta_{10} * [\beta_1 + \beta_4 * Var_{it} + \beta_8 * Firm\ size_{it} + \beta_{10} * HHI_{it}] / [\beta_1 + \beta_4 * Var_{it} + \beta_8 * Firm\ size_{it} + \beta_{10} * HHI_{it}]^2 \quad (5)$$

III. SAMPLE AND DATA

I use the Standard & Poor's ExecuComp database for CEO compensation data. The financial data is obtained from Compustat and the stock return data is obtained from the Center for Research in Security Prices (CRSP).

From the original sample, I remove observations with missing Compustat financial data, industry classification, peer returns, firm-βand idiosyncratic variance data (these data are defined below). The final sample contains 20400 CEO-year observations during the period from year 1994 to 2005.

3.1 Variable Definition

This section briefly defines some of the variables used in the tests. Please refer to Table 1 for a detailed definition of the variables used in the tests.

The first measure of CEO compensation is the total annual compensation. Total annual compensation is the sum of the following components: (i) cash compensation, measured as the sum of salary, bonus and other annual compensation; (ii) equity compensation, measured as the value of restricted stocks and the Black-Scholes value of stock options granted during the year. I measure total annual flow compensation in real terms (base January/1994 for CPI).

Valuing options using Black-Scholes is problematic as it assumes that CEOs can freely trade the firm's stock. As this assumption does not hold in general and in order to avoid potential measurement problems, I use the cash component of pay as an alternative measure, which includes salary, bonus, and other annual compensation. The revaluation of these securities previously granted is mostly driven by the firm's own performance and is consequently independent of relative performance (see for example Gibbons and Murphy (1990), Hall and Liebman (1998), and Aggarwal and Samwick (1999a)).

I measure annual performance for both the firm and a peer group using annual compounded stock returns from the CRSP monthly tapes. Following Albuquerque (2006) the peer group performance is the average stock return on a group of peer firms.

The firm-β and idiosyncratic variance are calculated in the following manner. Firm-β is the slope coefficient of regressing firm stock return on the firm's peer group stock return. The peer group is constructed by 2-digit SIC code from CompuStat. The idiosyncratic risk is the error variance from this regression.

The Herfindahl-Hirschman Index is calculated each year as the sum of the squared market share (using sales) for each firm in the same 2-digit primary SIC code. Firm size is measured as the natural log of sales, in constant 1994 dollars. Firm age is measured by the number of years in which the firm has shares outstanding in the public market.

Besides the firm characteristics mentioned above, I also include CEO tenure to control for CEO characteristics and two other dummy variables to control for the industry fixed effect and time effect.

IV. REGRESSION RESULTS

4.1 Descriptive Statistics

Table 2 reports descriptive statistics for the entire sample and for the subsamples of high- and low-HHI firms. High (low) HHI firms are defined as firms whose level of HHI is above (below) the median value across all firms for the year.

I first describe the characteristics of firms analyzed using the full sample. The real cash compensation (salary, bonus and other annual) and total compensation (plus long term incentive plans, stock and option grants) average $1,347,000 and $4,635,000, respectively. Table 2 shows total compensation is highly skewed with mean compensation ($4,635,000) considerably higher than median compensation ($2,145,000), with equity compensation (mean $3,288,000 / median $1,207,000) component contributing heavily to the skewness. Thus, we use the log of total compensation in the regression model. This mitigates the problems resulting from extreme skewness and from a possible nonlinear relation between pay and performance (Murphy (1999)). The average continuously compounded annual real stock return in the sample is 19.3%. The average firm has real sales of MM $501. The mean (median) level of HHI is 0.6 (0.4). The average firm has a β of 0.79, monthly idiosyncratic variance of 0.02, and firm age of 32 years.

Table 2 provides descriptive statistics for the two sub-samples: high- and low-HHI firms. Note that all the differences of means (t-test) between high and low-HHI firms are statistically significant at the one percent level, except for idiosyncratic variance.

Table 2 shows firms with high HHI have higher realized firm (mean 21%, median 11.8%) than firms in more competitive industry (mean 17.9%, median 10.3%). Hi-HHI firms have higher mean peer performance but lower median peer performance than low-HHI firms. CEOs of high-HHI firms receive more cash compensation (mean $1,405,000 median $951,000) than low-HHI firms (mean $1,291,000, median $931,000).

High-HHI firms exhibit higher firm-β than low-HHI firms. This difference, which suggests that low-HHI firms have less informative benchmarks to capture external shocks, is inconsistent to our hypothesis. This difference in firm-β across firms with different levels of HHI is inconsistent to our mechanism connecting HHI to RPE use. Below we will test the impact of firm-β on RPE.

4.2 Regression Results

Panel A of Table 3 shows the results of estimating equation 3 and Panel B presents the tests to

hypotheses above. The regression model is estimated using OLS.

Panel A reports the coefficient estimates when the CEO compensation is defined in two ways: the total compensation and cash compensation. In both regressions, we have controlled for CEO characteristics, industry fixed effect, and time fixed effect. We look at the regression results using total compensation as dependent variable at first. We focus first on the coefficients of own-firm performance interacted with. The coefficient of firm size is statistically significant but shows sign inconsistent to our hypothesis. The coefficient of own-firm performance interacted with HHI shows a negative sign but statistically insignificant. The coefficients of peer group performance interacted with firm size, and HHI are all statistically insignificant. Firm age, as a control variable, shows a predicted positive effect on total compensation and is statistically significant. Similar results are realized from the regression using cash compensation as the measure for CEO compensation.

4.3 Test of Hypothesis

The significance of the estimated coefficients associated with peer performance (p−value of 0.01 in row 2 of Panel B) reveals that firm characteristics are significant in determining the weight firms put on peer performance.

In panel B, if using total compensation, the test results show no evidence consistent with our hypothesis. However, if we use cash compensation as the dependent variable, the results provide strong support to our hypothesis.

The last column in panel B of Table 3 shows a negative relationship (-0.45) between firm-β and RPE. It shows that there is a strong correlation between firm-βand RPE use. This relationship is significant at 1% level (p-value 0.004) and consistent with our hypothesis. Test results from equation (5) shows that HHI level is negatively correlated with RPE use. HHI effect on RPE use is significant at 5% level (p-value = 0.05). It supports our hypothesis that RPE use is positively correlated with degree of competition. When estimating a predicted value of RPE use, it is negative (-8.93) and significant at 10% level. The huge difference in significance between using cash compensation and total compensation is consistent with Core and Guay's (1999) finding.

By examining the correlation between RPE use and cash compensation, the test results provide partial support for the use of RPE. These results also show that the level of competition is a determining factor to the RPE use.

CONCLUSION

By following HM (1987) and Aggarwal and Samwick (1999) models, I test the relationship between RPE use and the level of competition. The model reveals evidence showing firms in highly competitive industry are likely to use more RPE in their CEO compensation plans. The RPE use is significant in CEO's cash compensation, while it is not significant in the CEO's equity compensation. A possible explanation is equity compensation can be granted for reasons unrelated to RPE. (Core and Guay, 1999).

In considering future research, although it may be very time consuming to collect CEO data such as CEO age and wealth, including such CEO characteristics in the regression would help us to have a better control on CEO characteristics. Furthermore, as we have seen, the firm size and CEO equity compensation is surprisingly larger in the low-HHI group than those in the hi-HHI group. I will further explore the difference in firm characteristics.

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APPENDIX

Table 1: Definition of Variables Used in the Empirical Tests

Variable	Variable Definition
Total Flow Compensation	Cash compensation includes cash, bonus and other annual compensation (SALARY, BONUS, OTHANN). Total compensation includes the sum of the following ExecuComp's acronyms: SALARY, BONUS, OTHANN (other annual compensation) (e.g., gross-ups for tax liabilities, perquisites, preferential discounts on stock purchases), LTIP (long-term incentive pay-outs) and ALLOTHTO (all other compensation)(e.g., payouts for cancellation of stock options, 401K contributions, signing bonuses, tax reimbursements), RSTKGRNT (the value of restricted stocks granted during the year), and BLK_VALU (the value of stock options granted using the Black-Scholes formula). I measure total annual flow compensation in real terms (base Jan/1994 for CPI) and deflate the compensation by the value of the CPI index of the corresponding fiscal month. I use the variable BECAMECEO (from ExecuComp) to identify CEOs in the database.
Firm Performance	Firm performance is measured using stock returns as the natural logarithm of the annual real stock return assuming that dividends are reinvested (i.e., ln((1+ retann/100) /(1+CPIANN)) where 'retann' is the annual (compounded) stock return obtained from the CRSP monthly tapes and CPIANN is the annual rate of CPI inflation from CRSP-Indexes- US Treasury and Inflation). In the sensitivity analysis section, I use both accounting and market measures of performance.
Peer Performance	The peer group performance is constructed by 2 digit SIC codes.
Firm Size	The natural log of sales (DATA12 from Compustat) in constant 1992 dollars.
Firm-β	Firm-β is the slope coefficient of regressing firm stock return on the firm's peer group stock return.
Competition	The Herfindahl Index is calculated each year as the sum of the squared market share (using sales) for each firm in the same 2-digit SIC code.
Firm Age	Defined as the number of years when the firm has shares outstanding in the public market.

Table 2 Descriptive Statistics (all dollar values are in thousands)

Variables	All firms N = 20400			High HHI firms (low competition) N = 10193			Low HHI firms (high competition) N = 10207			High vs. Low HHI Differences in the
	Mean	Std Dev	Median	Mean	Std Dev	Median	Mean	Std Dev	Median	Mean T-stat
Total compensation	4635.472	11778.8	2145.468	4432.032	11469.65	2072.817	4851.691	12126.71	2217.364	-3.0659
Cash compensation	1346.804	1798.613	937.5	1405.192	2132.076	950.9864	1291.235	1386.815	931.0945	3.8078
Firm stock return	.1931415	.6551046	.1081531	.2106762	.6183584	.1182417	.1793435	.6911778	.1025644	2.7494
Industry-size portfolio return	.1782132	.333366	.129172	.2013422	.3361965	.1255096	.1590098	.3282217	.1355612	7.5367
Herfindahl Index	.0597516	.0571646	.0414199	.0911426	.0669045	.067634	.0282879	.0096814	.0287389	93.0694
Beta	.7857032	2.948726	.6602895	.8353607	1.842687	.7110868	.7339112	3.758809	.5978028	2.2972
Idiosyncratic variance	.0205207	.0371156	.0116001	.0199721	.042712	.012671	.0209098	.0304142	.0101789	-1.3687
Firm size (sales)	501389.4	410143.2	513481.7	307091	379523.9	175509	699916.4	340254.7	700374.6	-78.1732
Firm size (log of sales)	12.60646	1.213933	13.14897	11.96364	1.242114	12.07545	13.25813	.7578046	13.45937	-89.8471
Firm age	32.24676	15.03944	33	31.51329	15.1199	31	33.00484	14.92419	33	-7.1498

Table 3 Regression Estimating the Impact of Firm Characteristics on RPE

Panel A. Regression Results

Independent Variables	Total Compensation	Cash Compensation
Ret_{it}	.5721***	.6574***
	(.007)	(.000)
Var_{it}	-1.1733***	-2.2617***
	(.000)	(.000)
$Ret_{it}*Var_{it}$	-.6618**	-.8142***
	(.012)	(.000)
$Ret_{it}*Firm\ Size_{it}$	-.0344**	-.0412***
	(.028)	(.001)
$Ret_{it}*HHI_{it}$	-.0852	.3356
	(.821)	(.272)
Ret_{pt}	-.0155	-.0602
	(.969)	(.853)
$Ret_{pt}*\beta$	-.0654***	-.088***
	(.001)	(.000)
$Ret_{pt}*Var_{it}$	-1.099	-2.1398***
	(.27)	(.008)
$Ret_{pt}*Var_{it}*\beta$	.3453	.8189***
	(.189)	(.000)
$Ret_{pt}*Firm\ Size_{it}$	.0031	.0125
	(.916)	(.605)
$Ret_{pt}*HHI_{it}$	.6082	.2118
	(.35)	(.688)
Firm Age	.01329***	.0144***
	(.000)	(.000)
_cons	7.2961***	5.9855***
	(.000)	(.000)
R^2	0.1279	0.1607
Number of Observations	17209	17241

Table 3 (Continued) Regressions Estimating the Impact of Firm Characteristics on RPE
Panel B. Tests of Hypothesis (p-value in the bracket)

Hypotheses tests evaluated at the mean of the variables	Total Compensation (p-value)	Cash Compensation (p-value)
Joint test on Ret_{it} and interaction terms	(0.00) ***	(0.00) ***
Joint test on Ret_{pt} and interaction terms	(0.01) ***	(0.00) ***
Estimated Derivative Value	-0.03	-0.45***
H_0: $\partial RPE / \partial \beta_{it} = \partial(\alpha_2 / \alpha_1) / \partial \beta_{it} \geqslant 0$	(0.85)	(0.004)
Estimated Derivative Value	-5,679.29	480,693.2**
H_0: $\partial RPE / \partial HHI_{it} = \partial(\alpha_2 / \alpha_1) / \partial HHI_{it} \leqslant 0$	(0.86)	(0.05)
Estimated α_1: own-firm sensitivity	0.06***	0.09***
H_0: $\alpha_1 = 0$	(0.00)	(0.00)
Estimated α_2: peer-firm sensitivity	0.11***	-0.04***
H_0: $\alpha_2 = 0$	(0.00)	(0.00)
Estimated RPE Value	6.76	-8.93*
H_0: $\alpha_2 / \alpha_1 \geqslant 0$	(0.9)	(0.09)

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