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The effect of long-term incentives of CEO on exploration

Gun Jea Yu[1*]

[1] College of Business Administration, Hongik University, gy52@hongik.ac.kr
* Correspondence

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Abstract: *This study investigates the effect of long-term incentives for CEOs in promoting innovation in firms. CEOs are less likely to take risks due to their less diversified wealth portfolios compared to stockholders. Long-term incentives, such as stock ownership and stock option pay, provide a financial reward for taking risks that could pay off in the future and encourage CEOs to invest in riskier innovation, such as exploration. The study also examines the moderating effects of organizational characteristics, such as firm size and slack resources, and external environment, such as competitive intensity, on the relationship between long-term incentives for CEOs and exploration. The results suggest that long-term focus incentives for CEOs can positively influence exploration efforts within a firm. In addition, we found that firm size and slack resources positively moderate the relationship between long-term incentives for CEOs and exploration and competitive intensity negatively moderates such relationship. This study helps managers understand the conditions when long-term incentives become stronger or weaker.*

Keywords: long-term incentives; CEO; exploration; slack resources; firm size; competitive intensity

1. Introduction

In today's competitive business environment, innovation is crucial for firms to remain relevant and sustainable. The role of the CEO in driving exploration efforts is essential, and research has shown that incentivizing CEOs to focus on the long-term can have a positive impact on exploration initiatives within a firm [1].

The firms that prioritize exploration and innovation are more likely to achieve long-term success. Long-term focus incentives, such as stock options, can encourage CEOs to make strategic decisions that benefit the company's long-term success [2, 3]. These studies also found that such incentives can lead to higher levels of innovation and exploration within the firm. However, we need to know the conditions when such effect can be enlarged or shrunken.

This paper aims to explore the impact of long-term focus incentives for CEOs on exploration efforts and to analyze the potential benefits and challenges associated with this approach. In addition, this paper investigates the conditions which intensifies such relations. First, a firm level moderating variables were investigated. The larger firms are more likely to have organizational inertia which may distract innovation [4]. Thus, the effect of long-term incentives for CEOs on exploration is more influential to larger firms. Slack resources, excess resources beyond what is necessary for a firm’s ordinary operations can help firm implement long-term incentives such as profit sharing and stock options. Thus, the effect of employee relations on innovation is stronger to the firms with higher slack recourse. Second, a moderating variable at the industry level was also examined. The degree of competition in the industry may negatively moderate the relationship between long-term focus incentives for CEOs and exploration because severe competition within the industry makes firms to focus on current product or service [4].

The reminder of this paper is structured as followings. First, the theoretical background is addressed, and hypotheses are suggested. Second, description about variables is made and the results of data analysis are addressed in the method and results sections. Lastly, the limitations and future studies will be addressed in the discussion and limitations sections.

2. Theoretical background and hypothesis development

As firms face more intense competition, innovation capabilities become increasingly important [5]. Thus, firms take advantage of various incentives for CEOs, such as stock option pay and stock ownership, to encourage them to invest in innovation [6, 7].

CEOs tend to be risk-averse because they have less diversified wealth portfolios compared to stockholders. Therefore, motivating managers, including CEOs, to engage in innovation for the long-term viability of a company poses a challenge for shareholders [6]. Agency theory suggests that aligning CEOs' incentives with the interests of stockholders enables managers to be oriented toward increasing the firm's value. This implies that CEOs will not take risks to involve themselves in long-term-oriented activities such as innovation in the sacrifice of short-term-oriented activities without proper incentives [6], [8].

Extensive studies have been conducted on the innovation literature regarding CEOs and top management teams as key antecedents of innovation [9]. Hambrick and Mason (1984) proposed that CEOs' behaviours are critical in a firm's choice of strategy, performance, and innovation [10]. CEOs' individual characteristics, such as personal initiative [11] and risk-taking [12], have been investigated. Additionally, CEO compensation has also been extensively examined to encourage CEOs to be risk-takers and pursue innovation [7], [13].

Long-term focus incentives, such as stock ownership and stock option pay, have been investigated as key drivers to boost CEOs' inclination for innovation [2, 3]. Long-term incentives provide a financial reward for taking risks that could pay off in the future. Thus, CEOs are encouraged to invest in riskier innovation such as exploration that may not generate immediate results but could lead to long-term benefits. Such CEOs' long-term orientation helps in developing new products or services that respond to changing business environments [5]. Finally, firms with long-term incentives for CEOs outperform their competitors in terms of sales, growth, and market capitalization [3].

Overall, these studies suggest that long-term focus incentives for CEOs can positively influence exploration efforts within a firm by encouraging risk-taking, promoting innovation, enhancing long-term performance, and aligning CEO interests with company goals.

Hypothesis 1. Long-term incentives for CEOs are positively associated with exploration

The moderating effects of organizational characteristics: firm size and slack resources

As a firm grows, its characteristics change. Large firms have clear advantages and disadvantages. The larger the firm, the more likely it is to possess various resources, including financial and human resources, and can use these resources for activities such as marketing and research and development [14]. Secondly, larger firms are more likely to achieve economies of scale and have a higher likelihood of being in a favorable position [15]. Thirdly, larger firms can possess high levels of capabilities in areas such as production processes, distribution networks, and customer service [15].

On the other hand, large firms have the following disadvantages. Firstly, they are more likely to have slow decision-making due to bureaucratization. This leads to decreased organizational flexibility [16]. Secondly, they are less likely to use resources efficiently. Larger firms have higher complexity, which limits their ability to efficiently utilize all their resources. Large firms have difficulty in pursuing exploration due to slow decision-making processes and higher complexity [16]. Therefore, the benefits of long-term incentives for CEOs on exploration are stronger for large firms.

Hypothesis 2. Firm size positively moderates the relationship between long-term incentives for CEOs and exploration

Slack resources are ones that are not currently used in a firm’s operations and are available for potential use in the future [17]. Slack resources have some advantages for firms. Firms with slack resources can use them to invest in new opportunities without considering an immediate financial return [18]. Thus, these firms are more likely to use long-term incentives for CEOs more actively to pursue innovation. This implies that firms with slack resources are more flexible in responding to unexpected events such as an economic downturn and change.

On the other hand, there are some disadvantages of slack resources. Firms with slack resources are more likely to sustain current operations even though they face competitive pressures because they are satisfied with their current status [19]. In addition, employees are more likely to pursue their own interests rather than those

of the firm when a firm has slack resources, resulting in an increase in agency costs. This implies that employees are less likely to pursue innovation.

We argue that slack resources positively moderate the relationship between long-term incentives for CEOs and exploration such that the effect of long-term incentives for CEOs on exploration becomes stronger. Firms with slack resources can use long-term incentives for CEOs to encourage them to take risks and to pursue exploration because they have abundant resources for long-term incentives as well as short-term incentives. Thus, we suggest the following hypothesis.

Hypothesis 3. Slack resources positively moderate the relationship between long-term incentives for CEOs and exploration

The moderating effects of external environment: competitive intensity

Competitive intensity is defined as the level of competition within an industry [20]. Many firms compete and offer similar products or services in a highly competitive industry and thus make efforts to reduce costs, use aggressive marketing, and pursue innovation. Therefore, such firms are more likely to have tighter margins and reduced slack resources [21]. Under a highly competitive environment, firms need to pursue exploration because improvement of current products or services is not enough to compete with competitors [22]. However, extensive risk-taking behavior such as exploration is hazardous when firms face highly competitive intensity because outcomes of exploration are easily imitated and diffused among competitors within the industry [22]. In addition, firms hold fewer resources to pursue exploration under a highly competitive industry. Thus, the pursuit of high-risk and high-cost innovation such as exploration could harm a firm's performance, and firms under a highly competitive industry are less likely to pursue exploration. This implies that the effect of long-term incentives for CEOs becomes weaker when the industry is highly competitive. We argue that competitive intensity in an industry negatively moderates the relationship between long-term focus and exploration.

Hypothesis 4. Competitive intensity negatively moderates the relationship between long-term incentives for CEOs and exploration

3. Methods and Results

We gathered a panel dataset of 2,504 firm-years from three archival data sources to test our hypotheses. Our inclusion criteria consisted of any firm listed on the S&P 500, provided that the relevant data for those firms were available from these sources. The reason for selecting firms from the S&P 500 was that it represented a diverse range of industries such as chemicals, computer equipment, and electrical equipment and components, which helped to reduce potential industry biases. We collected data on exploration and exploitation from patent citations from the National Bureau of Economic Research (NBER). CEO compensation data were obtained from the S&P ExecuComp database, which contains various information about CEOs, including base pay, stock option pay, and CEO equity. Lastly, we collected accounting and financial data from the Compustat database. The combination of these three datasets resulted in a total of 2,504 company-year observations.

Dependent variable

The dependent variable is a firm's exploration. Exploration was measured based on previous studies [23], [24]. In this study, the main dependent variable is a firm's exploration and exploitation. Based on a review of previous research that has used patents as a measure of exploration and exploitation [23, 24], To gauge innovation activity related to current knowledge or technology, we quantified each firm's exploration based on the number of prior art citations made in patent applications that did not originate from the focal firm's previous patents. This variable was changed by logs to avoid skewness.

Independent variable

The independent variable is long-term incentives for CEOs and measured by the ratio of the dollar value of restricted stocks and stock options granted to the CEO during the year (evaluated using the Black-Scholes method) to the total dollar value of pay, which included salary, bonus, and long-term income such as stock options.

Moderating and control variables

Moderating variables are three such as firm size, slack resources at the firm level and competitive intensity at the industry level. Firm size was measured by the total assets and transformed by logs due to skewness. Slack resources were measured by dividing current assets by current liabilities. Competitive intensity was measured by density of an industry the number of firms within industry. Industry was classified using two-digit SIC code of US. We also R&D intensity at the firm level was created to control the capability of R&D as control variable. R&D intensity was measured by R&D expenditure divided by total asset.

Table 1. Variable description

Variable	description
dependent variable	
Exploration (t)	Exploration is measured by the count of prior citations outside the accumulated focal domains in patents application of a firm (three-digit primary patent class is used)
Independent variable	
Long-term incentives (t)	The ratio of the dollar value of restricted stocks and stock options granted to the CEO during the year (evaluated using the Black-Scholes method) to the total dollar value of pay
Moderation and control variable	
Exploration (t-1)	Lagged variable of exploration (t)
Firm size (t)	Log transformed value of total assets
Slack resources (t)	Log transformed value of current assets divided by current liabilities
R&D intensity (t)	Log transformed value of R & D expenditures divided by total sales
Density	the number of firms within industry classified by two-digit SIC code of US

Table 2. Basic statistics and correlations

No	Variable	Mean	Std. Dev.	1	2	3	4	5	6	7
1	Exploration (t)	1.74	1.12	1						
2	Exploration (t-1)	1.85	1.11	0.45*	1					
3	Slack resources (t)	1.17	0.45	-0.034*	-0.046*	1				
4	R&D intensity (t)	0.42	10.10	-0.029*	-0.026*	0.037*	1			
5	Density (t)	73.95	97.47	-0.046	-0.048*	0.319*	0.087*	1		
6	Firm size (t)	24.84	77.32	0.065*	0.073*	-0.2*	-0.01	-0.11*	1	
7	Long-term pay focus (LTPF) (t)	0.43	0.30	0.09*	0.091*	0.09*	-0.005	0.22*	0.05	1

N=2,504 *p < 0.05; **p < 0.01.

The results of the Arellano-Bond dynamic panel data estimation, as detailed in Table 3, offer significant academic implications regarding the impact of long-term incentives for CEOs on exploration. The study found a positive and significant association between these incentives and exploration ($\beta = 0.205$, $P < 0.005$), indicating that long-term incentives are an effective method for encouraging CEOs to engage in risk-taking and explorative

activities. This finding aligns with and reinforces previous research in the exploration literature, adding robust empirical evidence to the body of knowledge.

Furthermore, the study identified two firm-level moderators—firm size ($\beta = 0.184$, $P < 0.005$) and slack resources ($\beta = 0.485$, $P < 0.005$)—that positively influence the relationship between CEO incentives and exploration. This suggests that the effectiveness of long-term incentives is contingent on specific organizational characteristics, offering nuanced insights for future academic investigations into incentive structures. Additionally, the study observed that competitive intensity at the industry level, as measured by density, exhibits a negative and marginal moderating effect on this relationship ($\beta = 0.001$, $P < 0.1$). This introduces a critical perspective on how external market conditions impact the efficacy of incentive mechanisms.

Table 3. Results of regression

DV	Exploration (t)		
	Model 1	Model 2	Model 3
Exploration (t-1)	0.318***	0.317***	0.306***
	(0.01)	(0.01)	(0.01)
Slack resources (t)	0.019	-0.001	-0.107+
	(0.02)	(0.03)	(0.06)
R&D intensity (t)	-0.002	-0.006*	-0.006*
	(0.00)	(0.00)	(0.00)
Density (t)	-0.000***	-0.000+	0.000
	(0.00)	(0.00)	(0.00)
Firm size (t)	0.001***	0.001***	0.000
	(0.00)	(0.00)	(0.00)
Long-term pay focus (LTPF) (t)		**0.205*** **	**-0.610*** **
		(0.04)	**(0.15)**
LTPF X Firm size			**0.184*** **
			(0.02)
LTPF X Slack resources			**0.485*** **
			(0.10)
LTPF X Density			**-0.001+**
			(0.00)
_cons	1.579***	1.473***	1.593***
	(0.08)	(0.09)	(0.10)
chi2	2480.789	2488.759	2504.807

N=2,504 *p < 0.05; **p < 0.01.

The main practical implications of results are as follows. Firstly, this study indicates that in larger firms, which often struggle with rigidity and slow responsiveness to environmental changes, long-term incentives for CEOs can significantly enhance flexibility and drive exploration activities. This suggests that large firms should consider structuring their CEO compensation packages to include long-term incentives, aligning executive motivations with the strategic goal of fostering innovation. Additionally, firms with high levels of slack resources, which might otherwise be content with their current operations, can benefit from implementing long-term incentives for their CEOs. This approach can shift towards more explorative and innovative activities, ensuring that these firms continue to evolve and adapt.

On the other hand, this study also notes that competitive intensity within an industry negatively moderates the relationship between CEO incentives and exploration. In highly competitive markets, where rapid imitation by rivals is common, the impact of exploration initiatives can be short, reducing the effectiveness of long-term

incentives. Therefore, Firms should aim to balance between offering long-term incentives and implementing strategies that effectively attempt immediate market challenges.

4. Discussion and Limitations

Firms make efforts to explore for new markets or additional demand in the current market, including the adoption of new organizational structures and cultures and new compensation systems [4], [26]. Among diverse ways to encourage exploration, long-term focus incentives for CEOs have been extensively used to align the interests of owners with those of CEOs [4], [6]. This paper attempts to find the moderating effect of organizational and environmental factors on the impact of long-term focus incentives for CEOs. We investigate the moderating effects using a sample of 2,504 firm-year observations.

The results suggest that long-term focus incentives for CEOs have a positive effect on exploration. Firm size and slack resources, which are organizational-level variables, positively moderate the relationship between long-term focus incentives for CEOs and exploration. This implies that the effect of long-term focus incentives becomes stronger for larger firms or firms with higher slack resources. Competitive intensity, which is an industry-level variable, negatively moderates. This means that the effect of long-term focus incentives for CEOs decreases under highly competitive industries.

The study on long-term CEO incentives and firm innovation offers valuable insights for the field of IT convergence. In larger or resource-rich IT firms, these incentives can effectively drive CEOs towards risk-taking and innovation in technology integration, crucial for advancing in areas like AI, IoT, and cloud computing. This approach is vital for fostering long-term strategic developments in IT, an industry known for rapid technological change.

Furthermore, the study highlights the need for IT companies to customize their strategies to suit their unique market environments, especially in competitive sectors. Firms with significant resources have an advantage in funding research and development for IT convergence, balancing immediate performance needs with long-term innovation goals. This suggests a future research trajectory focusing on diverse innovation metrics and the specific dynamics of the IT industry, essential for creating effective CEO incentive plans that propel forward-looking IT convergence strategies.

This study also has some limitations. First, exploration was measured using patents. While numerous research efforts have employed patents as a metric for assessing exploration, it's important to recognize the inherent limitations of this approach. A key consideration is that not all firms rely on patents to safeguard their proprietary knowledge or technology such as firms in the service industry [27]. Consequently, to enhance the applicability and relevance of future research, it is essential to explore alternative methods of measuring exploration. These new methods should aim to capture a broader range of organizational practices and innovation strategies, ensuring that the findings are more universally applicable and reflective of the diverse ways in which companies engage in exploratory activities. Second, three moderating variables were considered in this study. Competitive intensity was considered as an industry-level variable. In addition to competitive intensity, there are some important industry-level variables such as industry dynamism (the speed of change in terms of technology or knowledge). Therefore, it is worthwhile to investigate other industry-level variables as moderators. Thirdly, while the focus on CEO incentives is indeed valuable, it is also crucial to investigate the incentives for middle managers and employees. The effects of incentives at these levels may differ significantly from those at the CEO level, highlighting the need for a comprehensive understanding of incentive structures across different organizational tiers.

5. Conclusions

This study provides key insights into how long-term CEO incentives impact firm innovation. It highlights two crucial findings: firstly, in larger firms, CEO incentives are particularly effective in overcoming bureaucratic inertia and fostering innovation. Secondly, firms with abundant slack resources benefit more from these incentives, as they can better support risk-taking and explorative activities. However, the study also notes a critical moderating factor: industry competition. In highly competitive environments, the immediate pressures of performance can direct the long-term benefits of innovation, affecting the impact of CEO incentives.

In summary, while CEO incentives are generally positive for innovation, their effectiveness varies based on firm size, resource availability, and competitive landscape. The study suggests future research should extend beyond patents as innovation measures and consider other industry-level influences like market dynamism. This

offers a perspective for firms developing strategies to encourage innovation in a complex and competitive business world.

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