

Impact of CEO stock options on corporate innovation: evidence from U.S. public firms

Yin Hao

School of Economics, Central University of Finance and Economics, Beijing, China

310667732@qq.com

Abstract. In the context of an increasingly complex competitive landscape, the enhancement of innovation capabilities through the implementation of effective incentive mechanisms has emerged as a pivotal concern for enterprises. This study utilizes a sample of U.S. publicly listed companies from 1992 to 2021 to empirically investigate the influence of Chief Executive Officer (CEO) option incentives on corporate innovation capacity. The findings reveal that an increased proportion of CEO option compensation relative to total compensation significantly correlates with a rise in the number of patent applications filed by firms, thereby indicating that option incentives can effectively stimulate corporate innovation. Moreover, the impact of option incentives demonstrates heterogeneity. In growth-stage enterprises, characterized by high sales growth rates, option incentives exhibit a more pronounced facilitative effect on innovation. This observation aligns with the resource constraints, elevated growth expectations, and strategic imperatives inherent to growth-stage firms. Additionally, firms led by male CEOs experience a stronger innovation-promoting effect from option incentives, which is consistent with the generally higher risk-taking propensity observed among male executives. The risk compensation mechanism inherent in option incentives is more efficacious in amplifying the innovation drive of such managers. This study provides empirical evidence that can inform the design of effective incentive mechanisms, thereby assisting enterprises in optimizing incentive strategies, enhancing innovation capabilities, and sustaining competitive advantages across varying developmental stages and managerial backgrounds in a dynamic market environment.

Keywords: stock option, incentive, corporate innovation, poisson regression

1. Introduction

The innovation capability of an enterprise, defined as its ability to achieve breakthrough advancements or generate new value in products, services, technologies, management, or business models, is critical for survival and growth in today's dynamic business landscape [1]. As the principal decision-maker of the enterprise, the Chief Executive Officer's (CEO) strategic choices directly influence resource allocation, organizational culture, and talent management, thereby affecting the firm's capacity for innovation [2]. This study seeks to explore mechanisms to incentivize CEOs to foster corporate innovation, thereby securing a sustainable competitive edge in the long-term market competition.

It is posited here that option incentives could serve as a viable mechanism. Options represent a cost-effective incentive model by granting CEOs the future right to sell company shares at a predetermined price, thereby aligning a portion of their compensation with firm performance while mitigating corporate expenses through stock market transactions [3]. Nonetheless, the efficacy of options in genuinely motivating CEOs to advance corporate innovation remains inconclusive. Given the inherent risks of innovation—characterized by low success rates, substantial initial investments, and the challenge of translating innovations into enterprise value—CEOs might prioritize short-term enhancements in enterprise value due to factors such as limited tenure, potentially hindering innovation through option incentives.

This study employs the metric of patent applications to operationalize a company's innovation output. By compiling data on the annual patent applications of selected publicly traded companies in the United States and the ratio of CEO options to salary, the study systematically examines the influence of the latter on the former. Empirical findings indicate a positive correlation between the proportion of CEO options and the number of patent applications submitted by the company. The theoretical contribution of this study lies in elucidating the CEO's role in corporate innovation mechanisms and advocating practical approaches. Previous research predominantly focuses on the direct impact of CEO personal traits on corporate strategy or the direct effect of Research and Development (R&D) investment on innovation output [4, 5]. In contrast, this research highlights

that, relative to traditional methods such as augmenting R&D investment or recruiting high-caliber talent, option incentives can enhance corporate innovation capabilities at a lower cost. This approach is notably beneficial for small and medium-sized enterprises with constrained resources, offering a practical pathway to stimulate innovation. The study not only advances theoretical research in corporate governance and innovation but also provides novel insights and empirical evidence for optimizing executive incentive structures and informing policy measures to support innovation, underscoring its dual theoretical and practical significance.

2. Literature review and research hypothesis

The propensity for risk-taking among CEOs is influenced by a multitude of determinants. Primarily, the cognitive style exhibited by CEOs significantly impacts their propensity for strategic risk-taking. Intuitive CEOs are predisposed towards risk-taking behaviors, whereas their analytical counterparts tend to exhibit conservative decision-making tendencies [2]. The cognitive diversity and professionalism of the board of directors can serve as moderating factors in this dynamic. Additionally, personal demographic attributes, such as younger age, shorter tenure, advanced education, or a financial background, correlate positively with a CEO's likelihood to engage in high-risk decision-making [6]. Personality traits further influence this dynamic, with extroversion, high openness, and a diminished sense of responsibility attenuating conservative inclinations even in the presence of equity incentives, thereby fostering sustained risk-taking under option incentives [7]. Overconfidence in CEOs can lead to high-risk investments that potentially enhance company value, albeit at the risk of overinvestment. CEOs with engineering backgrounds exhibit a proclivity for risk-taking, attributed to their technical confidence and the influence of their professional networks [8]. In family enterprises, familial ties and professional education tend to mitigate risk-taking proclivities, whereas CEOs with extended career prospects demonstrate a greater willingness to undertake risks [9]. Corporate governance structures, such as the dual role of CEO and chairman, can attenuate personal risk-taking preferences, with board size and company size also influencing overall risk profiles [10]. In synthesis, the interplay of cognitive style, demographic and personality attributes, professional background, and organizational governance shapes the risk-taking disposition of CEOs.

The innovative capacity of enterprises is similarly affected by an array of internal and external determinants. Internally, resources such as financial capital, technology, and human capital, together with management characteristics, corporate governance frameworks, and organizational culture—particularly a culture fostering innovation—are significant catalysts for innovation [11]. The innovation orientation of management and individual attributes such as employees' innovation self-efficacy and creativity have direct implications for innovation behavior [12]. Externally, governmental support, industry-specific policies, peer effects within industries and regions, and collaborative networks with academic and research institutions substantially bolster enterprise innovation capabilities [13]. Competitive imitation among peers serves as a pivotal driver of innovation, while the innovation ambiance within industries and regions can catalyze spillover effects [14]. Trust, external resource dependency, technological advancement, and consistent financial investment emerge as crucial determinants of innovation activities [15]. Consequently, enterprise innovation emerges as the cumulative outcome of multifaceted factors, necessitating internal resource availability and cultural support, as well as external environmental and policy facilitation.

The CEO's adventurous disposition significantly influences the company's valuation, innovation capacity, and strategic investment decisions. Specifically, a CEO's propensity for risk-taking, characterized by traits such as overconfidence, can elevate the company's overall risk profile, drive high-risk investments, and foster innovation activities, thereby enhancing corporate value [7]. However, it may also result in overinvestment and inefficient resource allocation. The structure of CEO compensation, particularly incentive-based compensation like stock options, can markedly influence their risk tolerance and decision-making. A substantial proportion of option-based incentives tends to encourage CEOs to undertake strategic risks, such as increasing investments in research and development, which can indirectly improve company performance [16]. Additionally, increases in CEO compensation often correlate positively with company profitability metrics, such as Return on Equity (*ROE*), but can simultaneously elevate the company's overall risk level [17]. Importantly, the impact of compensation incentives varies across different CEO archetypes; for instance, incentive compensation tends to be more effective in steering non-overconfident CEOs towards rational risk-taking and enhancing company value. Furthermore, the performance thresholds and ceilings defined within the remuneration contracts critically influence CEO risk-taking behavior [16]. A lower performance threshold and a higher ceiling are likely to encourage risk-taking. In conclusion, the CEO's adventurous nature and the structure of their compensation package not only directly affect the company's risk-taking propensity but also indirectly shape the firm's performance and market value through their influence on innovation and investment decisions.

While existing literature extensively explores the determinants and potential consequences of CEO risk-taking behavior, the influence of CEO compensation, and factors impacting corporate innovation capability, there remains a notable gap in the empirical examination of how option incentives specifically affect innovation. This paper posits that option incentives may invigorate the CEO's risk-taking propensity and thereby stimulate corporate innovation. Hence, the main hypothesis is raised as follows.

H1: Ceteris paribus, a higher proportion of CEO compensation in the form of options is positively associated with the enterprise's innovation capability.

3. Empirical testing

3.1. Sample selection and data sources

This study utilizes annual data from U.S.-listed firms spanning from 1992 to 2021, primarily sourced from the DISCERN, ExecuComp, and Compustat databases. The industry classification adheres to the "American Standard Industrial Classification" (SIC) system. To ensure result robustness, the initial dataset undergoes the following processing steps: (1) exclusion of financial reports and selection of reports denominated in U.S. dollars; (2) elimination of samples with missing values; and (3) exclusion of firms with total assets below \$1 million, in addition to applying a 1% and 99% winsorization to the dataset to address outliers. Following these procedures, a final sample of 12,283 annual company observations is analyzed.

3.2. Variable definition and measurement

3.2.1. Explained variable – enterprise innovation (Log (Patent Application+1))

As referenced in Pan et al., this study employs the natural logarithm of the number of patent applications, incremented by one, to quantify the innovation output of enterprises [18]. The dataset is derived from the DISCERN database. The metric of patent applications is characterized by its objectivity and quantifiability. Unlike investment metrics such as R&D expenditure, patent applications provide a direct reflection of innovation output and is publicly accessible [18]. The act of filing patent applications by enterprises is a strategic endeavor to safeguard their innovative outputs and preserve competitive advantages. Patent applications not only signify the innovation intent of enterprises but also highlight their technological foundation and R&D efficiency, thus serving as comprehensive indicators for assessing innovation capabilities. Consequently, this study employs the number of patent applications submitted by a company as a surrogate measure for its innovation capacity, with higher counts indicative of stronger innovation capabilities.

Moreover, recognizing that a minority of firms possess significantly higher patent counts than the average, it is crucial to address these outliers, which may disproportionately influence regression analyses. The logarithmic transformation effectively compresses the high-value range, thereby mitigating the leverage effect of extreme values and approximating the data to a normal distribution. It is worth noting that patent datasets typically contain numerous zero entries, and the logarithm of zero is mathematically undefined. By adding one to each count, this approach circumvents potential mathematical errors and minimizes distortion of the original data.

3.2.2. Explanatory variable – proportion of CEO options in total compensation (Option Pct)

This study employs the proportion of CEO stock options relative to total compensation, calculated by dividing the income from options by the total salary income, as a measure of option-based incentives. This relative metric is chosen because it more precisely reflects the intensity of motivational incentives. The proportion of option-based compensation enables standardized comparisons across different companies. This approach more accurately delineates the significance of options within the broader framework of CEO compensation structures.

3.2.3. Control variables

Referring to previous empirical research on corporate investment behavior, control for other factors that may affect corporate innovation, including company size (logarithm of total assets, denoted as *Size*), leverage ratio (*Leverage*), cash holding ratio (*Cash Ratio*), sales growth rate (*Sales Growth*), and return on assets (*ROA*). The definitions of all variables are presented in detail in Table 1.

Table 1. Summary of model variable definitions

Variable type	Variable name	Measurement
Dependent variable	Log (Patent Application+1)	Add one to the number of patent applications filed by the enterprise and take the logarithm
Independent variable	Option Pct	Stock options income / Total income
	Size	Logarithm of total assets
Control variables	Leverage	Long-term liabilities / Total assets
	Cash Ratio	Cash and short-term investments / Total assets
	Sales Growth	Current period sales / Previous period sales
	ROA	Operating income before depreciation / Total assets

3.3. Empirical model

Considering that patent data adhere to a Poisson distribution even after a logarithmic transformation—resulting in residuals that do not follow a normal distribution—a multiple Poisson regression model is constructed based on the previously established research hypothesis. This approach aims to obtain unbiased estimates and assess the impact of CEO option incentives on corporate innovation. The regression model is specified as follows. In Equation (1), *Control Var* includes all control variables.

$$\text{Log} (\text{Patent Application} + 1)_{i,t} = \beta_0 + \beta_1 \text{Option Pct}_{i,t} + \gamma * \text{Control Var}_{i,t} + \varepsilon_{i,t} \quad (1)$$

4. Research results and analysis

4.1. Descriptive analysis

Descriptive statistical analysis was conducted to statistically characterize the basic descriptive features of each variable. Table 2 shows the descriptive statistical results of the main variables. According to the results, the mean of stock option incentives proportion (%) is 11.23%, but the median is 0%, indicating an extremely uneven distribution, with more than half of the sample companies not implementing stock option incentives, and a few companies pulling up the mean. The maximum value is 88.56%, indicating that individual companies have extremely high stock option incentives intensity. The standard deviation of logarithmic value of the number of patent applications is 2.09, with a large difference, possibly reflecting the differentiation of innovation input among industries. The range of company size is 6.96 to 12.30, spanning approximately 5 logarithmic units, indicating that the sample includes small and medium-sized to large companies. The minimum value of profitability (*ROA*) is -3.38%, indicating the presence of loss-making enterprises, but the mean of 14.14% shows that most enterprises have robust profitability. The distributions of the means and medians of all variables are relatively symmetrical. The distributions of other variables are also within a reasonable range.

Table 2. Descriptive statistical results

Variable	Sample size	Average value	Standard deviation	Minimum	Median	Maximum
Log (Patent Application+1)	12283	2.507	2.088	0.000	2.565	7.497
Option Pct	12283	0.112	0.179	0.000	0.000	0.886
Size	12283	8.565	1.218	6.959	8.204	12.300
Leverage	12283	0.233	0.158	0.000	0.218	0.733
Cash Ratio	12283	0.134	0.137	0.002	0.087	0.635
Sales Growth	12283	0.078	0.194	-0.431	0.061	0.906
ROA	12283	0.141	0.071	-0.034	0.134	0.358

4.2. Correlation analysis

In order to preliminarily determine whether there is a large correlation between the variables, a correlation analysis was performed. Table 3 shows the correlation test results between the main variables. As can be seen from the results, the correlation coefficient between option incentives and patent applications is 0.231, which initially indicates that options have a positive impact on corporate innovation capability; and the absolute values of the correlation coefficients between the variables are all below 0.5, hence, there is no obvious multicollinearity. All variables can be retained.

Table 3. Correlation analysis results

	Option Pct	Log (Patent Application+1)	Size	ROA	Leverage	Cash Ratio	Sales Growth
Option Pct	1						
Log (Patent Application+1)	0.231	1					
Size	0.051	0.424	1				
ROA	0.031	-0.023	-0.017	1			
Leverage	0.019	-0.053	0.048	-0.081	1		
Cash Ratio	0.070	0.241	-0.105	0.036	-0.248	1	
Sales Growth	-0.005	-0.015	-0.006	0.162	-0.045	0.068	1

4.3. Poisson regression analysis

4.3.1. Baseline results

Table 4. Test results for the main hypothesis

	Full sample	Lagged sample
Option Pct	0.160*** (0.031)	0.085*** (0.023)
Option Pct (lagged)	/	0.101*** (0.025)
Size	0.291*** (0.015)	0.288*** (0.015)
ROA	0.520*** (0.183)	0.556*** (0.188)
Leverage	-0.304*** (0.081)	-0.290*** (0.084)
Cash Ratio	0.582*** (0.126)	0.558*** (0.129)
Sales Growth	-0.062*** (0.023)	-0.051** (0.024)
Year	Yes	Yes
Industry	Yes	Yes
Pseudo R-squared	0.324	0.379
N	10039	9473

Note: ***, **, and * are significant at the significance level of 1%, 5% and 10% respectively.

Firstly, a Poisson regression model was developed for the entire sample, as presented in Table 4. Due to the fixed effects model of Poisson regression requiring that the dependent variable within each group (such as enterprise, industry, or year) must have non-zero variation (i.e., at least one observation is non-zero), if all enterprises in a group have zero (or identical) patents, all observations in that group would be automatically excluded. Therefore, the sample size was reduced from 12,283 to 10,039 in this section.

The coefficient for the option incentive percentage is positive and statistically significant at the 1% level. Specifically, a 1-unit increase in the option incentive ratio corresponds to a 0.164-unit increase in the logarithm of the number of patent applications by the company. This suggests that a 10% increase in CEO option incentives results in an average 4.04% increase in the company's patent output. These findings indicate that option incentives may promote innovative activities within enterprises, possibly due to the long-term binding effects and risk compensation mechanisms inherent in such incentives. Executives appear to be more focused on long-term value creation and are willing to undertake innovation-related risks, thus actively facilitating technological advancements to strengthen their firm's long-term competitive advantage. Therefore, the hypothesis H1 is supported.

Building on these findings, the study incorporates the lagged variable *Option Pct (lagged)* (defined as the ratio of option income lagged by one year to total salary), which leads to a reduction in sample size after accounting for missing values. The results indicate that the coefficient for *Option Pct* is 0.085, maintaining significance at the 1% level, while the coefficient for *Option Pct (lagged)* is 0.101, significant at the 5% level. The reduction in the coefficient for *Option Pct*, and its lower

magnitude compared to that of *Option Pct (lagged)*, suggests that some effects are captured by the lagged term. This aligns with the temporal dynamics of innovation outputs, where current option incentives drive the CEO to foster innovation within the enterprise, with the tangible outcomes of such efforts becoming more apparent in subsequent periods. This phenomenon may be attributed to option incentives functioning as a long-term motivational tool, effectively encouraging CEOs to engage in strategic planning and innovation investments, which inherently require time to manifest as measurable innovation outcomes.

4.3.2. Heterogeneity analysis

Further heterogeneity testing was conducted on the full sample to explore differences in the impact of option incentives on innovation across enterprises at various stages of their life cycles. Given that the sales growth rate is a critical indicator for assessing a company's market expansion and business growth, this study employs it as a criterion to determine the company's lifecycle stage. Specifically, the industry annual median of *Sales Growth* is calculated, and a value of 1 is assigned to those within the industry annual sample (*High Sales Growth*) that exceed this median, while a value of 0 is assigned otherwise. An interaction term between *Option Pct* and *High Sales Growth* is introduced, and its coefficient and significance are examined. Results in Table 5 demonstrate that the coefficient of the interaction term is positive and statistically significant at the 5% level, indicating that option incentives exert a more substantial promoting effect on innovation in enterprises within the growth stage (characterized by sales growth rates surpassing the industry average) as opposed to those in the mature stage. This is consistent with the dynamics of long-term enterprises during business expansion, where financial markets hold elevated expectations for the enterprise's future value and there exists expanded potential for stock price appreciation. Consequently, option returns are correlated with this potential, thereby more effectively motivating managers to engage in high-risk, high-reward innovative activities [19]. Additionally, growth-stage enterprises often face cash flow constraints, and option incentives, which do not necessitate immediate cash payments, can be linked to future revenue sharing with the CEO, thereby incentivizing the CEO to advance enterprise innovation and enhance market competitiveness. This form of incentive is more aligned with the resource constraints typical of growth-stage enterprises.

Table 5. Heterogeneity test results

	Full sample	
	Lifecycle stage moderation	CEO gender moderation
Option Pct	0.100** (0.050)	-0.233 (0.143)
High Sales Growth	-0.023* (0.012)	/
Option Pct * High Sales Growth	0.116** (0.052)	/
Male	/	-0.130** (0.062)
Option Pct * Male	/	0.411*** (0.151)
Size	0.292*** (0.016)	0.290*** (0.015)
ROA	0.522*** (0.182)	0.526*** (0.184)
Leverage	-0.304*** (0.081)	-0.308*** (0.082)
Cash Ratio	0.582*** (0.126)	0.586*** (0.125)
Sales Growth	-0.051* (0.027)	-0.062*** (0.022)
Year	Yes	Yes
Industry	Yes	Yes
Pseudo R-squared	0.324	0.325
N	10039	10039

Note: ***, **, and * are significant at the significance level of 1%, 5% and 10% respectively.

Moreover, the study investigates whether this effect varies with the gender of the CEO. A moderating variable, *Male*, is introduced, wherein a value of 1 is assigned if the CEO is male, and 0 otherwise. The interaction term *Option Pct * Male* is also

analyzed for its coefficient and significance. The findings reveal that the coefficient for *Option Pct*Maleis* positive and significant at the 1% level. This suggests that the effect of option incentives on promoting innovation is more pronounced in companies with more male CEOs, corresponding to the distinct managerial characteristics observed in companies led by CEOs of different genders. A primary reason could be that male managers generally possess a greater risk appetite, and option incentives inherently encourage innovative investment and outcomes by enhancing managers' propensity for risk-taking. Therefore, when presented with option incentives, male CEOs are more inclined to pursue high-risk, high-reward innovative projects, thereby amplifying the positive effect of option incentives on innovation.

4.3.3. Robustness check and placebo test

To assess the robustness of the model, this study replaces industry fixed effects with entity fixed effects to better address endogeneity issues. The regression results in column (1) in Table 6 indicate that the coefficient for option incentives is 0.058, which is significant at the 5% level and aligns with the primary hypothesis, demonstrating that the positive effect of option incentives on innovation is robust.

Additionally, a placebo test was conducted to validate the reliability of causal inference derived from the research findings. This study focuses on industries where option incentives are unlikely to enhance the number of patent applications or where patent counts are inadequate measures of a company's innovation capability. These industries generally have limited innovation demands and low patent activity, including low-tech manufacturing industries such as food, textiles, and wood (SIC 20-23), public utilities like electricity, natural gas, and water supply (SIC 49) under stringent regulation with minimal innovation potential, retail trade sectors that emphasize cost control (SIC 52-59), and local service industries (e.g., hotels, repairs) without research and development activities (SIC 70-79) [20]. Consequently, the subsamples from these sectors constitute the low-response industry group, while the remaining subsamples fall into other categories. The results in column (2) show that the coefficient of *Option Pct* is not significant, suggesting that these industries are indeed unaffected by option incentives. In contrast, regression outcomes for other industries, after excluding these low-response sectors, reveal that the coefficient for option incentives is positive and statistically significant, indicating that these industries are indeed influenced by option incentives. This enhances the reliability of causal inference in this study.

Table 6. Supplementary verification of hypothetical results

	(1) Robustness check - Entity effect	(2) Placebo test - Industries should not affected by stock option incentives	(3) Placebo test - Industries affected by stock option incentives
Option Pct	0.058** (0.026)	0.147 (0.378)	0.164*** (0.030)
Size	0.224*** (0.017)	0.643*** (0.041)	0.285*** (0.015)
ROA	0.304** (0.121)	2.189*** (0.740)	0.467*** (0.172)
Leverage	-0.070 (0.056)	1.076*** (0.279)	-0.349*** (0.077)
Cash Ratio	-0.071 (0.064)	1.439** (0.719)	0.559*** (0.126)
Sales Growth	-0.029 (0.021)	-0.055 (0.148)	-0.057*** (0.021)
Year	Yes	Yes	Yes
Industry	No	Yes	Yes
Firm	Yes	No	No
Pseudo R-squared	0.067	0.332	0.337
N	9690	927	9112

Note: ***, **, and * are significant at the significance level of 1%, 5% and 10% respectively.

5. Conclusion

Based on data from U.S. publicly listed companies, this paper measures stock option incentives using the proportion of CEO option income to total compensation and assesses corporate innovation through the logarithmic indicator of the number of patent applications to explore the relationship between CEO stock option incentives and corporate innovation. It further examines the differentiated effects of stock option incentives from the perspectives of the corporate life cycle and CEO gender, while also

testing the robustness of the results by excluding firm-specific factors and analyzing industries with low responsiveness. The following conclusions are drawn.

(1) Based on the CEO risk-taking spirit and the unique incentive mechanism of stock options, CEO stock option incentives promote corporate innovation. A possible explanation is that the incentive mechanism of stock options closely aligns CEO interests with the long-term value of the firm. By setting a vesting period for option exercise, it significantly curbs managerial short-termism while stimulating risk-taking behavior, making CEOs more willing to allocate resource allocation to long-cycle, high-risk innovation projects. At the same time, option-based earnings provide necessary compensation for executives undertaking innovation risks, thereby reducing concerns about career risks associated with innovation failure. This institutional design not only stimulates the management's motivation for innovation but also ensures alignment between the direction of innovation and the company's strategic objectives and long-term interests, thereby continuously strengthening the company's technological innovation capabilities and market competitive advantage. However, the impact of such incentive measures on corporate innovation output exhibits a significant time-lag effect. This is primarily because technological innovation requires essential processes such as R&D cycles and achievement transformation from input to output, and the innovation outcomes driven by stock option incentives often become fully evident in the subsequent period.

(2) Stock option incentives have a more significant effect in enhancing corporate innovation capability during the growth stage. This phenomenon aligns closely with the characteristics of a company's development stage. During periods of rapid business expansion, the capital market tends to assign higher valuations to companies with strong growth potential, leading to heightened expectations for stock price appreciation. Given that the value of stock options is directly linked to stock performance, this creates a powerful incentive alignment mechanism that encourages the management to actively engage in strategically significant innovation projects. From a financial perspective, growth-stage companies typically face cash flow constraints. The deferred payment nature of stock option incentives not only avoids immediate cash outflows, but also facilitates talent retention through future value sharing. This form of incentive is well aligned with the resource endowments and strategic needs of companies in their growth phase. More importantly, during the business expansion phase, companies need to build competitive advantage through continuous innovation. Stock option incentives effectively guide the CEO to allocate resource allocation toward innovation by aligning the management's compensation with the company's long-term value creation, thereby fostering sustainable market competitiveness.

(3) The positive effect of stock option incentives on innovation is more pronounced in companies led by male CEOs, which stems from behavioral differences between managers of different genders. Male managers generally exhibit a stronger risk appetite, and stock option incentives enhance their willingness to take risks through a risk compensation mechanism, making them more inclined to support high-risk, high-reward innovation projects, thereby strengthening the incentive effect. This risk preference, combined with the synergistic effect of the incentive mechanism, enables stock option incentives to stimulate innovation vitality and promote the enhancement of corporate innovation capability within male-dominated management teams more effectively.

Based on market realities and research findings, the following implications for corporate governance and financial regulation can be drawn. Firstly, in terms of corporate governance, this paper not only provides a low-cost and efficient compensation design solution through stock option incentives to promote innovation, offering enterprises a new option to enhance market competitiveness and accelerate value creation, but also highlights the need for companies to establish more refined and dynamic incentive mechanism. Specifically, differentiated stock option incentives schemes can be designed based on factors such as the enterprise's life cycle characteristics, industry attributes, and the composition of the management team. For innovation-driven and growth-stage enterprises, the proportion of stock options in the compensation structure can be appropriately increased, with vesting conditions linked to the quality of innovation output. For companies whose management teams exhibit significant differences in risk appetite, it is necessary to establish a composite compensation system that combines stock option incentives with other incentive mechanisms. These measures can fully leverage the unique advantages of stock option incentives in promoting innovation while effectively mitigating potential incentive distortions.

For regulatory authorities, a more comprehensive supervisory framework for stock option incentives needs to be established. On one hand, companies should be encouraged to optimize their corporate governance structures and promote diversity within the Management to avoid systemic risks that may arise from unilateral decision-making or homogeneous risk preferences. On the other hand, differentiated disclosure requirements should be developed based on industry-specific characteristics, with a focus on the alignment between stock option incentives, corporate innovation strategies, and risk management. In addition, attention should be paid to overall market investment tendencies to avoid potential risks arising from excessive R&D investment driven by stock option incentives. At the same time, regulatory authorities may consider introducing an evaluation mechanism for the effectiveness of stock option incentives, conducting regular reviews of their implementation outcomes. Through this multi-pronged regulatory approach, it is possible to both protect investor interests and provide enterprises with appropriate institutional space for innovation-driven development, ultimately achieving a win-win situation of corporate value creation and stable market growth.

References

- [1] Adewumi, A., Ewim, S. E., Sam-Bulya, N. J., & Ajani, O. B. (2024). Strategic innovation in business models: Leveraging emerging technologies to gain a competitive advantage. *Cogent Education*, 6(10), 3372-3398.
- [2] Tian, X., & Wu, L. (2025). How Does CEO Cognitive Style and Board Characteristics Impact Strategic Risk-Taking? Corporate Governance An International Review.
- [3] Papageorgiadis, N., Procopiou, A., & Sofka, W. (2023). Unintended consequences of outcome based compensation – How CEO bonuses, stocks and stock options affect their firms’ patent litigation. *Research Policy*, 52(8), 104816.
- [4] Melis, A., & Nawaz, T. (2024). The Impact of CEOs’ Personal Traits on Organisational Performance: Evidence from Faith-Based Charity Organisations. *Journal of Business Ethics*, 190, 919–939.
- [5] Jin, C., & Li, D. (2023). Study on the impact of R&D input intensity on technological innovation output - Based on data from China’s high technology industry. *PLOS One*, 8(10), e0292851.
- [6] Loukil, N., & Yousfi, O. (2022). Do CEO’s attributes increase risk-taking? Empirical evidence from France. *Asia-Pacific Journal of Business Administration*, 15(5), 721-745.
- [7] Benischke, M. H., Martin, G. P., & Glaser, L. (2018). CEO equity risk bearing and strategic risk taking: The moderating effect of CEO personality. *Strategic Management Journal*, 40, 153-177.
- [8] Dissanayake, S., Weerasinghe, A., & Dissanayake, D. (2025). Engineer CEOs and corporate risk taking. *Journal of Accounting Literature*, 47(5), 249-269.
- [9] Martino, P., Rigolini, A., & D’Onza, G. (2018). The relationships between CEO characteristics and strategic risk-taking in family firms. *Journal of Risk Research*, 23(1), 95-116.
- [10] Lin, K. J., Karim, K., Hu, R., & Dunn, S. (2022). Fifty shades of CEO duality: CEO personal risk preference, duality and corporate risk-taking. *Journal of Applied Accounting Research*, 24(3), 425-441.
- [11] Pan, X., & Xu, L. (2024). Factors Influencing Corporate Innovation: A Literature Review. *Journal of Economics, Business and Management*, 12(2), 214-218.
- [12] Yen, T. H., Minh, C. T., Diep, N. N., & Long, K. D. (2025). The impact of individual and organizational factors on employee innovative work behavior: Empirical evidence from private companies in Vietnam. *Problems and Perspectives in Management*, (1), 193-208.
- [13] Makanyeza, C., Mabenge, B. K., & Ngorora-Madzimure, G. P. K. (2022). Factors influencing small and medium enterprises’ innovativeness: Evidence from manufacturing companies in Harare, Zimbabwe. *Global Business and Organizational Excellence*, 42(3), 10-23.
- [14] Yang, X., Li, F., & Liu, Y. (2024). Industry and Regional Peer Effects on Company Innovation: An Empirical Study from Listed Companies in China. *Finance Research Letters*, 67, 105719.
- [15] Kwaśniewski, J. P. (2025). Factors Influencing Innovative Activities in Selected Enterprises. *American Journal of Management*, 25(1).
- [16] Chen, C. X., Kim, M., Li, L. Y., & Zhu, W. (2021). Accounting Performance Goals in CEO Compensation Contracts and Corporate Risk Taking. *Management Science*, 68(8), 6039-6058.
- [17] Zandi, G., Mohamad, S., Keong, O. C., & Ehsanullah, S. (2019). CEO Compensation and Firm Performance. *International Journal of Innovation, Creativity and Change*, 7(7), 316-334.
- [18] Pan, J., Lin, G., & Xiao, W. (2022). The Heterogeneity of Innovation, Government R&D Support and Enterprise Innovation Performance. *Research in International Business and Finance*, 62, 101741.
- [19] Mei, L., Hu, T., Mao, Z., & Wang, Z. (2023). Equity Incentive Characteristics, Industry Life Cycle and Corporate Innovation. *Finance Research Letters*, 58, 104556.
- [20] US Data Corporation. (2022). SIC Code Manual. Retrieved from <https://www.usdatacorporation.com/wp-content/uploads/2022/02/US-DATA-CORPORATION-SIC-CODE-BINDER-1.pdf>.