



The Impact of Executive Incentive on Enterprise Green Innovation Under the Background of Digital Transformation

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Abstract. In the digital economy, green innovation is an important driver for low-carbon transformation and sustainable development of enterprises, and executive incentives have a significant impact on corporate innovation. The findings suggest that short-term monetary incentives inhibit green innovation, while long-term equity incentives promote green innovation. Digital transformation positively moderates the relationship between long-term equity incentives and green innovation, while the intensity of market competition negatively inhibits the relationship between short-term equity incentives and green innovation.

Keywords: Executive Incentives; Digital Transformation; Green Innovation

1 Introduction

Within enterprises, executives, as crucial decision-makers for corporate green innovation, largely determine the sustainability of green innovation activities. In order to encourage executives to actively and responsibly participate in green innovation activities, it is essential to establish a rational and effective incentive mechanism to stimulate their enthusiasm for green innovation.

The existing literature explores the role and mechanisms of executive incentives in various economic aspects of corporations, such as financial investment and corporate performance. In terms of corporate innovation and performance, executive compensation incentives have been found to positively moderate the relationship between executive compensation and the allocation of resources to innovation and company performance.¹

Despite the extensive research in these areas, there is a limited focus on the impact of executive incentives on corporate green innovation. Given the significance of green innovation as a crucial component of corporate innovation in recent years, more attention should be paid to understanding how executive incentives influence it. Additionally, in the context of the digital economy, investigating the regulatory role of digital transformation on corporate green innovation and the impact mechanisms under different levels of market competition intensity becomes particularly important.

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2 Hypotheses

2.1 The Impact of Executive Incentives on Corporate Green Innovation

Corporate executives, as the primary decision-makers for innovation activities, are responsible for the execution and supervision of these activities. Their innovative decisions and intentions directly influence the efficiency of allocating innovation resources, subsequently affecting the extent of a company's engagement in technological innovation²⁻⁵.

Implementing incentives for corporate executives can effectively reduce the agency costs incurred in innovation resource allocation, thereby enhancing efficiency^{6,7}. Green innovation, as an activity adapted to the dual carbon context, possesses uncertainties and a more challenging-to-observe return cycle. The executives' innovative intentions based on their self-interest directly impact the allocation of resources for green innovation, subsequently influencing the performance of corporate green innovation. Due to the high investment, high risk, high uncertainty, and long payback period associated with the company's green innovation, company managers may develop strong self-interest motives, leading them to mitigate risks and reduce the company's risk exposure, thereby limiting green innovation. Based on the above analysis, the following hypotheses are proposed:

- *Short-term monetary incentives have a significantly negative impact on corporate green innovation. (H1a)*

- *Short-term monetary incentives have a significantly positive impact on corporate green innovation. (H1b)*

- *Long-term equity incentives have a significantly positive impact on corporate green innovation. (H2)*

2.2 Moderating Effect of Market Competition Intensity

Market competition intensity influences a company's technological innovation and business strategy⁸.

When market competition intensity is low, companies face less competitive pressure, and executives may lack the motivation and urgency for green innovation. Therefore, the positive impact of executive incentives on green innovation may be weak or not significant.

When market competition intensity is high, companies face greater competitive pressure, and executives may have stronger motivation and demand for green innovation. Consequently, the positive impact of executive incentives on green innovation may be strong or significant. Based on the above analysis, the following hypothesis is proposed:

Market competition intensity positively moderates the relationship between short-term monetary incentives and green innovation. (H3)

2.3 Moderating Effect of Corporate Digital Transformation

Digital transformation significantly promotes green technological innovation, with the underlying mechanism being that digital transformation enhances the level of green technological innovation by alleviating constraints and attracting government subsidies⁹.

Based on the theoretical analysis above, the following hypothesis is proposed:

The degree of digital transformation positively moderates the promotive effect of executive incentives on green innovation. (H4)

3 Data and Methodology

3.1 Data

This study utilizes data from A-share listed companies spanning the years 2015 to 2022 to investigate the relationship between executive incentives and corporate green innovation. The financial and company information used in this study primarily originates from the CSMAR database, while green patent data is sourced from the CNRDS database. The calculation method for the degree of digital transformation mainly refers to the approach proposed by¹⁰. Employing Python web scraping functionality, this study collected annual reports of all A-share listed companies on the Shanghai and Shenzhen stock exchanges. Considering the impact of industry classification on the data, abnormal data of the ST category and financial industry companies were excluded.

Finally, this study applied a 1% winsorize to the main continuous variables to eliminate the interference of extreme values.

3.2 Variable Description

Variable names, variable definitions and measurements are shown in Table 1. For ease of presentation, the formulas in this paper are uniformly represented by the abbreviation

Table 1. Variable descriptions

Variable Types	Variable Name		Definition
Independent Variable	Short-term monetary Incentives	SI	LN (Sum of salaries of the top three executives)
Independent Variable	Long-term Equity Incentives	EI	Sum of ownership ratios of the top three executives
Dependent Variable	Green Innovation	GI	LN (Sum of jointly acquired green invention and utility model patents in the current year + 1)
Moderating Variable	Digital Transformation Level	DT	LN (Total word frequency of digital transformation keywords + 1)
Moderating Variable	Market Competition Intensity	MC	Reciprocal of the Herfindahl-Hirschman Index (HHI)

Control Variable	Firm Size	Size	LN (Total assets at the end of the period + 1)
Control Variable	Total Operating Income	GOI	LN (Total operating income at the end of the period + 1)
Control Variable	Dual Leadership Role	dual	Whether the Chairman and CEO roles are combined (1 if combined, 0 otherwise)
Control Variable	Asset liability ratio	Lev	Total liabilities at the end of the year/total assets at the end of the year
Control Variable	Board size	Board	The natural logarithm of the number of directors
Control Variable	Return on assets	ROA	Net profit/average balance of total assets
Control Variable	Independent director ratio	Indep	Number of independent directors/directors

4 Model Construction and Empirical Analysis Results

4.1 Model

$$GI = \beta_0 + \beta_{11}SI + \beta_{12}EI + \beta \text{Controls} + \epsilon \tag{1}$$

ϵ is the random error term. β_0 is the intercept. β_{11} represents the direct impact of short-term executive compensation incentives on green innovation. β_{12} represents the direct impact of long-term equity incentives on green innovation.

Based on the analysis of the moderating mechanisms mentioned earlier, models (2) and (3) are constructed to test the moderating effects of market competition intensity and the degree of digital transformation:

$$GI = \beta_0 + \beta_{21}SI + \beta_{22}EI + \beta_{23}SI*MC + \beta \text{Controls} + \epsilon \tag{2}$$

$$GI = \beta_0 + \beta_{31}SI + \beta_{32}EI + \beta_{33}EI*DT + \beta \text{Controls} + \epsilon \tag{3}$$

Where: β_{23} represents the moderating effect of market competition intensity on the relationship between compensation incentives and green innovation. β_{33} represents the moderating effect of market competition intensity on the relationship between long-term equity incentives and green innovation. DT represents the degree of digital transformation. MC represents market competition intensity.

4.2 Empirical Analysis Results

Regression Analysis

This study employs fixed-effects models for regression analysis, and the results are presented in Table 2. In Model 1 of Table 2, key explanatory variables, short-term

salary incentives, and long-term equity incentives are included. According to Model 1 in Table 2, the regression coefficient for short-term salary incentives is significantly negative ($\beta=-0.061$, $p<0.1$). This implies that higher short-term salary incentives are disadvantageous for green innovation in companies. It suggests that higher short-term salary incentives may influence executives to prioritize short-term interests, thereby inhibiting decision-making and willingness for green innovation, leading to increased resource constraints for green innovation and a decrease in green innovation capabilities. Hence, Hypothesis 1 is supported. The regression coefficient for long-term equity incentives is significantly positive ($\beta=0.009$, $p<0.01$), indicating that higher long-term equity incentives are conducive to green innovation in companies. Hypotheses 2 are supported.

Table 2. Regression results.

	(1)	(2)	(3)
	GI	GI	GI
SI	-0.061*	-0.069**	-0.060*
	(-1.729)	(-1.966)	(-1.716)
EI	0.009***	0.008***	0.010***
	(4.250)	(4.205)	(4.379)
Size	-0.070	-0.064	-0.068
	(-1.645)	(-1.521)	(-1.599)
Lev	-0.429**	-0.416**	-0.437**
	(-2.483)	(-2.409)	(-2.524)
ROA	0.045	0.031	0.041
	(0.199)	(0.137)	(0.182)
Dual	-0.011	-0.008	-0.010
	(-0.273)	(-0.182)	(-0.236)
GOI	0.000***	0.000***	0.000***
	(5.964)	(6.087)	(5.953)
Indep	-0.002	-0.002	-0.002
	(-0.505)	(-0.498)	(-0.461)
Board	0.142	0.130	0.145
	(0.989)	(0.907)	(1.009)
SI*MC		-0.025***	
		(-3.053)	
EI*DT			0.001*
			(1.94)
_cons	3.259***	3.206***	3.198***
	(3.438)	(3.386)	(3.369)
N	4842.000	4842.000	4842.000
r ²	0.023	0.026	0.024
r ² a	-0.318	-0.315	-0.317

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Models 2 and 3 in Table 2 respectively examine the moderating effects of market competition intensity on short-term salary incentives and the moderating effect of digital transformation on long-term equity incentives. The regression results for interaction terms indicate that market competition intensity exhibits a negative moderating effect on the negative impact of short-term salary incentives on green innovation. Therefore, Hypothesis 3 is supported.

Digital transformation has a significant positive moderating effect on the relationship between long-term equity incentives and green innovation. Hence, Hypothesis 4 is supported.

4.3 Robust test with the alternative core explanatory variables

Table 3. Robust test

<i>GII</i>			
<i>SI</i>	-0.132*** (-5.006)	<i>Indep</i>	0.000 (0.130)
<i>EI</i>	0.003** (2.557)	<i>Dual</i>	-0.039 (-1.142)
<i>Size</i>	0.191*** (5.532)	<i>GOI_</i>	0.087*** (2.922)
<i>Lev</i>	-0.404*** (-3.433)	<i>_cons</i>	-3.495*** (-6.766)
<i>ROA</i>	-0.027 (-0.128)	<i>N</i>	4842.000
<i>Board</i>	0.086	<i>r2</i>	
		<i>r2 a</i>	

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

This paper mainly uses the replacement of core explanatory variables to test the robustness, and takes the logarithm of total executive compensation and the number of shares held by senior managers as the core explanatory variables short-term monetary incentive and long-term equity incentive. The robustness results show that the short-term compensation incentive is significantly negative at the level of 1%, and the long-term equity incentive is significantly positive at the level of 5%, which is consistent with the benchmark regression results, indicating that the short-term compensation incentive inhibits the green innovation of enterprises, and the long-term equity incentive promotes the green innovation of enterprises.

5 Conclusion

Executive incentives have a significant impact on green innovation, and digital transformation and market competition intensity are important factors affecting this relationship. In order to promote the green innovation and sustainable development of enterprises, enterprises should establish a reasonable incentive mechanism, pay attention to

the role of long-term equity incentives, and strengthen the digital transformation and market competition management to create a good innovation environment and market atmosphere.

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