Journal of Global Economy, Business and Finance (JGEBF) ISSN: 2141-5595
DOI: 10.53469/jgebf.2024.06(12).04

Government Innovation Subsidies, Management Myopia, and Enterprises' Green Technological Innovation

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Abstract: ***Innovation in enterprise green technologies is the main engine and a key factor in promoting China to achieve high-quality economic and social development. This study investigates the effects of government innovation subsidies on Enterprises' green technological innovation using panel data of Chinese A-share listed firms in Shanghai and Shenzhen from 2010 to 2023 as a sample. The study shows that government innovation subsidies can enhance Enterprises' green technological innovation. Following some robustness tests, this conclusion remains valid. Mechanism tests show that government subsidies enhance the degree of innovation in green technologies for businesses by inhibiting managerial myopia. The heterogeneity results indicate that government innovation subsidies are more obvious on the green technological innovation level of state-owned enterprises and enterprises in the eastern region. The findings of the study enrich the theoretical analysis of government innovation subsidies and enterprises' green technological innovation and provide an essential guideline value for the formulation of government subsidy distribution methods and assessment mechanisms, the enhancement of enterprises' internal drive for green innovation, and the realization of high-quality development of enterprises.***

Keywords: Government Innovation Subsidies, Green Technological Innovation, Management Myopia**.**

1. Introduction

The primary driver of new quality productivity and the primary factor propelling China to achieve the "double carbon" target is the green technological innovation of businesses. Being the driving force behind innovative green technologies, corporations should consider their economic interests while also taking into account non-economic effects such as the environment and practicing the concept of sustainable development.

Scholarly study on the elements impacting businesses' green technological innovation is rather extensive, mainly focusing on the internal governance of enterprises and the external environment. Based on the internal governance of enterprises, scholars point out that factors such as mixed ownership reform [2-3], digital transformation [4-5], and executive team environmental concentration [6] contribute favorably to business green technology innovation. According to the outside environment， it is found that green credit policy [7], carbon trading policy [8], environmental regulation [9-10], media regulation [11], and other factors have different degrees of influence on corporate green technological innovation. However, businesses must make significant financial investments to implement green technology innovation. And the project implementation cycle is long and faces high risks. It is difficult to receive short-term returns. Enterprises, with profit maximization as their business goal, are typically hesitant to invest more in R&D for innovative green technologies [1]. At this time, the government's participation is crucial, as a macro-control of the economy. Government innovation subsidies may assist businesses in resolving their cash flow issues and facilitating the seamless development of their diverse operations.

However, recent studies on how government innovation subsidies affect corporate behavior have produced contradictory results. According to some academics, government innovation subsidies can encourage businesses to invest more in research and development to support innovative endeavors [12]. Lowering rent-seeking expenses to raise businesses' overall factor productivity [13]. Ease financing constraints to reduce the carbon intensity of industrial firms [14]. It has also been argued that government innovation grants can signal risk, increase redundancy levels, and reduce productivity [15]. Concerning how government innovation subsidies affect green innovation, most of them focus on proving the facilitating effect from the perspectives of R&D investment and financing constraints. Studies on transmission mechanisms are more homogenous and superficial. Therefore, the connection between government innovation subsidies and green technological innovation and the mechanism of action needs to be further examined.

In the process of corporate growth, the behavior of management directly affects the strategic decisions of the corporate. Therefore, it is of great significance to study managerial myopia. Managers' short-term behavior is defined as the fact that managers tend to concentrate more on the satisfaction of short-term interests rather than taking the company's overall future development into account [16-17]. Its influencing factors mostly focus on the external environment. It has been found that the concentration of financial subsidy allocation [18] and divergent ESG ratings [19] can reinforce management's short-sightedness. Managerial myopia can be reduced by the digital economy by removing financial limitations [20-21]. For the economic consequences of management myopia. Some scholars have found that managerial myopia inhibits digital transformation [22] and dual innovation [23], and reduces firms' total factor productivity [24]. While government innovation subsidies release favorable signals to corporate stakeholders, they also influence the behavior of managers, thus affecting their strategic decisions. However, no scholars have studied this influence mechanism. Therefore, this article studies the way in which government innovation subsidies encourage the

development of green technologies from the perspective of managerial myopia.

While government innovation subsidies influence firms' green technological innovation through managerial myopia, they are also influenced by the nature of the firms themselves and the regions in which they are located. Therefore, this study explores the impact of government innovation subsidies on green technology innovation and its mechanism of action using a data sample of Chinese listed companies between 2010 and 2023. Further, it analyzes the differential impact of these subsidies on green technology innovation of enterprises of different natures and regions. It aims to effectively promote the high-quality development of enterprises and realize the dual benefits of economy and environment.

2. Theoretical Analysis and Research Hypothesis

2.1 Government Innovation Subsidies and Green Technological Innovation

As an incentive mechanism, government innovation subsidies reflect the government's support and promotion of innovation in green technology for enterprises. In recent years, advances in green technological innovation have drawn interest from all across the world. A growing number of businesses are dedicating themselves to the study, creation, and use of green technologies as well as to the pursuit of excellence in green technical advances results. However, it should not be overlooked that developing green technologies necessitates a significant financial outlay.

As we all know, green technological innovation is often accompanied by higher R&D costs and longer return cycles. Numerous companies still face profitability pressure, they frequently lack sufficient funds to support the development of green technologies. At the same time, government subsidies can lower businesses' sunk costs and lessen the uncertainty around the outcomes of green innovation. Thus, it assumes part of the risk for businesses, effectively reduces the strain on businesses, and serves as a protection [1]. After that, motivate companies to participate in green technological innovation initiatives. Green innovation in technology covers many different areas, including research and development of ecologically friendly materials, green industrial methods, and energy and emission reduction. Businesses must incorporate environmental preservation and technological innovation into their operations if they are to achieve the objective of sustainable development.

Therefore, this study puts forth the following hypothesis:

H1: Government innovation subsidies positively influence the enhancement of green technological innovation levels in enterprises.

2.2 Mediating Effects of Managerial Myopia

Government innovation subsidies are mainly based on resource dependence theory and signaling theory to inhibit managerial short-termism, and then encourage businesses to engage in the development of green technologies.

According to the theory of resource dependence, enterprises rely on various types of resources to sustain their development. For projects with significant positive externalities, solid and long-term resource support is particularly important.

In this context, the government innovation subsidy not only meets this demand of enterprises but also makes enterprises enhance their dependence on the government to a certain extent. At the same time, the government has a greater say in requiring businesses to put the principles of sustainable and green growth into practice. It reduces the short-sighted behavior of the management in investment decision-making and thus promotes the green advancement process of companies more effectively.

According to the signaling theory, government subsidies, as a powerful signal, can effectively promote the positive shaping of corporate image and transmit positive expectations to the market. As a result, investors, creditors, and financial institutions of the enterprise can lower the barriers to the supply of funds to the enterprise and stabilize the cash flow position of the enterprise. This not only aids in reducing the financial pressure on enterprises, but also inhibits the short-sightedness of managers to a certain degree, and improves the capacity and willingness of firms to undertake green technological innovation. Furthermore, the public disclosure requirements of government innovation subsidy information make enterprises receive close attention from the public, the media, and institutional investors when using these funds. This enhances the legitimacy pressure faced by enterprises and prompts them to optimize their environmental strategies and corporate governance frameworks. Especially in the field of green technological innovation, due to the decrease in managers' shortsighted behavior, enterprises are more likely to invest resources in green technological R&D and innovation with higher long-term returns. Therefore, government innovation subsidies provide a strong promotion and guarantee for green technological innovation of enterprises by suppressing the short-sighted behavior of managers.

Therefore, this study puts forth the following hypothesis:

H2: By restraining managers' short-sighted behaviors, government innovation subsidies foster green technological innovation within firms.

3. Research Design

3.1 Definition of Variables

3.1.1 Explained variable

Enterprise Green Technological Innovation (Green_1) is measured following the methods of Dong Cong [25]. Specifically, we obtain the sum of an enterprise's green invention patent applications and green utility model patent applications for the current period from the China Research Data Service Platform (CNRDS). To this sum, we add one (to avoid the logarithm of zero issues) and then take the logarithm to compute the final value.

3.1.2 Explanatory variable

Government innovation subsidies (Sub), refer to Guo Yue's practice [26]. Based on the selected keywords of innovation subsidy projects, search the "government subsidy details" under the "non-operating income" account of the company's annual financial statements to determine the amount of innovation subsidies received by the company, and sum up the logarithm for measurement.

3.1.3 Mediating variable

Managerial Myopia (Myopia), as referenced by Nan Hu [27] Myopia was measured as the ratio of the total word frequency of the 43 selected "short-term horizon" words to the total word frequency of MD&A × 100.

3.1.4 Control variables

In addition to the primary explanatory variable of government innovation subsidies, enterprises' green technological innovation is also influenced by corporate financial performance, internal governance, and other factors. To make the results of the empirical studies objective, reference is made to the practice of Yufeiyang Zeng [28]. Therefore, this study selects the following control variables: firm size, firm age, size of the board of directors, leverage ratio, shareholding proportion of the largest shareholder, management's shareholding ratio, dual-role positions (dual-position), and the nature of property rights. Detailed definitions of these variables can be found in Table 1.

Table 1: List of Variable Definitions

Variable type	Variant	Variable Symbol	Variable Definition
Dependent variable	Enterprise green technological innovation	Green_1	Ln (green invention-based patent applications + green utility-based patent applications + 1)
Independent variable	Government innovation grants	Sub	Ln (total government innovation grants)
Mediating variable	Managerial myopia	Myopia	Total word frequency of "short-term horizon" terms as a proportion of total MD&A word frequency × 100
Control variables	Enterprise size	Size	Ln (total business assets)
	Founding Years	Age	Ln (number of years the enterprise has been in existence as of the end of the year)
	Board size	Board	Ln (number of board members)
	gearing	Lev	Total liabilities/total assets of the enterprise
	The shareholding ratio of the largest shareholder	Top1	Number of shares held by the largest shareholder/total number of shares of the company
	Management shareholding	M share	Number of shares held by management/total number of shares in the enterprise
	two jobs in one	Dual	Chairman and Managing Director both take the value of 1, otherwise 0
	Nature of property rights	Soe	State-owned enterprises take the value of 1, otherwise 0

3.2 Model Construction

In order to examine how government innovation subsidies affect businesses' innovation in green technologies, this research builds the following model:

$$Greeni,t = ß0 + ß1\ Subi,t + ß2\ Controlsi,t + \Sigma Year + \Sigma Industry + Ɛi,t \quad (1)$$

$$Myopiai,t = ß0 + ß1 Subi,t + ß2 Controlsi,t + \Sigma Year + \Sigma Industry + Ɛi,t \quad (2)$$

$$Greeni,t = ß0 + ß1 Myopiai,t + ß2 Subi,t + ß3 Controlsi,t + \Sigma Year + \Sigma Industry + Ɛi,t \quad (3)$$

Hypothesis 1 is tested using Model (1), while Hypothesis 2 is tested using Model (2) (3). And Greeni,t denotes the level of green technological innovation of firm i in year t; Subi,t denotes the government subsidy of firm i in year t; Myopiai,t denotes managerial myopia of firm i in year t; Controls denotes the ensemble of control variables; and Year is the time fixed effect; Industry is industry fixed effects; Ɛi,t is the error term.

3.3 Sample Selection and Data Sources

In this paper, China's A-share listed companies are selected as samples from 2010-2023, and the following sample data are excluded: (1) financial industry; (2) ST and ST*; (3) important financial data are seriously missing; and (4) there are outliers. To eliminate the impact of extreme values of data, continuous variables are shrink-tailed up and down by 1%, and 16,859 valid data are obtained. The data were obtained from the China Research Data Service Platform (CNRDS) and Cathay Pacific Database (CSMAR).

3.4 Descriptive Statistics

Table 2 shows the descriptive statistics of the variables. The mean and median of enterprise green technological innovation (Green_1) are 0.389 and 0.000, and the maximum and minimum values are 4.025 and 0.000, indicating that the level of green technological innovation of most of the enterprises is less than the average, reflecting the overall low level of green technological innovation of enterprises in China and the obvious differences between enterprises. The average value of government innovation subsidies is 13.974, the median is 14.111, the maximum value is 18.340, and the minimum value is 8.006, indicating that there are differences in government innovation subsidies among different enterprises. In addition, the mean and median values of the control variables are close to each other, indicating that the processed sample data are reasonable.

Table 2: Descriptive Statistics

Variable	Obs	Mean	median	Std. Dev.	Max	Min
Green_1	16859	0.389	0.000	0.779	4.025	0.000
Green_2	16859	0.308	0.000	0.655	3.638	0.000
Sub	16859	13.974	14.111	1.840	18.340	8.006
Myopia	16859	3.900	3.055	3.462	21.196	0.000
Size	16859	22.051	21.911	1.136	25.890	19.711
Age	16859	2.873	2.944	0.362	3.638	1.099
Board	16859	2.116	2.197	0.188	2.708	1.609
Lev	16859	0.396	0.388	0.195	0.889	0.024
Top1	16859	0.324	0.301	0.140	0.730	0.071
M share	16859	15.264	2.772	19.991	72.082	0.000
Dual	16859	0.301	0.000	0.459	1.000	0.000
SOE	16859	0.338	0.000	0.473	1.000	0.000

4. Empirical Results and Analysis

4.1 Baseline Regression Analysis

Table 3 shows the benchmark regression results of model (1). When no control variables are added and industry and year are controlled, the results of empirical analysis are shown in columns of Table 3 (1), which shows that the regression coefficient of government innovation subsidies and enterprises' green technological innovation is 0.0677, which is significant at 1% level. When control variables are added and industry and year are controlled, the results of the empirical analysis are shown in columns of Table 3 (2), which shows that the regression coefficient of government innovation subsidies and enterprises' green technological innovation is 0.0390, which is significant at 1% level. The above empirical data show that government innovation grants can encourage the improvement of enterprise green technological innovation level, and hypothesis 1 is verified.

Table 3: Benchmark Regression Results

	(1) Green_1	(2) Green_1
Sub	0.0677***	0.0390***
	(21.4271)	(11.7989)
Constant	-0.8223***	-3.1732***
	(-12.2298)	(-21.2106)
Control variables	No	Yes
Year fixed effect	Yes	Yes
Ind fixed effect	Yes	Yes
N	16859	16859
adj. R^2	0.103	0.143

Note: Values in parentheses are t-statistics, ***, **, and * denote 1%, 5%, and 10% significance levels, respectively, below.

4.2 Intermediation Test

According to Wen Zhonglin's [29] mediation effect, the mediation effect of management myopia between government innovation subsidies and corporate green technological innovation is analyzed and tested, and the results are shown in Table 4. Table 4(2) shows that the correlation coefficient between government innovation subsidies and management myopia is -0.0838, which is negatively correlated at the 1% level, indicating that government innovation subsidies can significantly inhibit management myopia. Column (3) of Table 4 presents that the correlation coefficient between management myopia and firms' green technological innovation is -0.0049, which is negatively correlated at the 1% level, indicating that suppressing management myopia promotes firms' green technological innovation. Meanwhile, the correlation coefficient between government innovation subsidies and enterprises' green technological innovation in column (3) of Table 4 is positive 0.0386, which is significant at the 1% level, indicating that managerial myopia as a mediator of government innovation grants to enhance the level of enterprises' green technological innovation is established, and Hypothesis 2 is verified.

Table 4: Intermediation Test Results

	(1) Green_1	(2) Myopia	(3) Green_1
Sub	0.0390***	-0.0838***	0.0386***
	(11.7989)	(-5.5277)	(11.6669)
Myopia			-0.0049***
			(-2.9094)
Constant	-3.1732***	4.5622***	-3.1509***
	(-21.2106)	(6.6450)	(-21.0386)
Control variables	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Ind fixed effect	Yes	Yes	Yes
N	16859	16859	16859
adj. R^2	0.143	0.087	0.144

4.3 Robustness Tests

4.3.1 Substitution of dependent variable

This paper uses green patent acquisition plus one logarithm as a proxy variable for enterprises' green technological innovation and again conducts regression analysis with government innovation subsidies, and the results are listed in Table 5(1). The correlation coefficient between government innovation grants and green technological innovation proxy variables is 0.0292, and it is significantly positively correlated at the 1% level. This aligns with the earlier findings, so the conclusion of hypothesis 1 is robust.

4.3.2 Lag test

The results are lagged when firms innovate with green technological innovation after receiving government innovation subsidies. To exclude this effect, government innovation subsidies lagged one period and then regressed, and the results are shown in Table 5(2). The correlation coefficient among government innovation funding and enterprises' green technological innovation in the lagged period is 0.0387, which is established at the 1% level, indicating that government innovation funding can indeed promote enterprises' green technological innovation, and the conclusion of hypothesis 1 is robust.

Table 5: Robustness Test Results

	(1) Substitution of the dependent variable	(2) One period lagged the independent variable
	Green_2	Green_1
Sub	0.0292***	
	(10.5408)	
L1.Sub		0.0387***
		(9.3313)
Constant	-2.7214***	-3.2424***
	(-21.7041)	(-17.6859)
Control variables	Yes	Yes
Year fixed effect	Yes	Yes
Ind fixed effect	Yes	Yes
N	16859	12009
adj. R^2	0.148	0.145

5. Heterogeneity Analysis

5.1 Heterogeneity of Property Rights

Relative to non-SOEs, to start with, SOEs have a stricter regulatory environment and greater governmental supervision of SOEs. Moreover, due to their special political status, SOEs are naturally endowed with a public social mission [30] as well as a more onerous policy mandate and social responsibility [31]. In the face of large-scale investment projects with high-risk coefficients, SOEs are more willing to use innovation subsidies for green technological innovation. Therefore, this paper speculates that the significance of government innovation funding in encouraging green technological innovation in SOEs is more evident. Based on this, group regression is conducted according to the nature of property rights of enterprises, and the regression results are shown in columns (1)(2) of the table. The correlation coefficient between the two in non-state enterprises is 0.0413, which is established at a 1% level. The correlation coefficient between the two in state-owned enterprises is 0.0368, and it is established at a 1% level, which shows that the promotion of

government innovation subsidies on enterprises' green technological innovation is stronger in state-owned enterprises, which is in line with the theoretical expectation.

5.2 Regional Heterogeneity

Influenced by multiple factors such as geographic location, institutional concepts, and policies, China's economic development shows distinctive differences among different regions, and this geographical development imbalance has a heterogeneous consequence for the correlation between government innovation support and green technological advances. In contrast to the center and western areas, the eastern area has an advantage in acquiring various innovation factors and resources under its unique geographical location, rich talent reserves, and low transportation and transaction costs [32]. The eastern region also has the advantage of having more innovative factors and resources than the mid-west region. At the same time, the eastern area also has a more favorable business environment and a more standardized market economic order [33]. This provides a solid guarantee for intellectual property protection, which greatly enhances the willingness and motivation of companies to implement innovative green technologies. Therefore, this paper speculates that government innovation subsidies play an additional visible part in promoting green technological innovation in companies in the Eastern area. As shown in Table 6(3)(4), the correlation coefficient between government innovation funding and green technological innovation of companies in mid-west China is 0.0390, which is established at a 1% level; while the correlation coefficient between government innovation subsidies and green technological innovation of companies in eastern China is 0.0398, which is established at 1% level, showing that the enabling influence of government innovation subsidies on green technological innovation of enterprises is stronger in enterprises in eastern China, which is consistent with the theoretical expectation. In the eastern region, which is in line with the theoretical expectation.

Table 6: Results of Heterogeneity Analysis

	(1) state enterprise	(2) non-state enterprise	(3) Mid-west	(4) the east
Sub	0.0413***	0.0368***	0.0390***	0.0398***
	(6.8741)	(9.3412)	(6.6820)	(9.8623)
Constant	-3.6621***	-2.8170***	-3.3630***	-3.1961***
	(-13.8611)	(-14.9539)	(-13.8356)	(-16.6473)
Control variables	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Ind fixed effect	Yes	Yes	Yes	Yes
N	5705	11154	4993	11862
adj. R^2	0.164	0.128	0.146	0.144

6. Research Findings and Policy Recommendations

Government innovation grants significantly motivate and encourage enterprises to enhance their green technological innovation levels. This study empirically investigates the effects and underlying mechanisms of government innovation subsidies on firms' green technological innovation. The findings reveal that these grants promote green technological innovation by curbing managers' short-term behaviors. Further analysis indicates that the stimulating effect of government innovation grants on green technological innovation is more pronounced in state-owned enterprises and companies located in the eastern region.

As a result, the paper makes the following policy recommendations:

(1) Optimizing subsidy strategies to curb managerial myopia.

First, strengthen the mechanism linking subsidies to long-term performance. When designing innovation subsidy policies, governments should focus more on the relationship between subsidies and businesses' future achievements in the development of green technological innovation. For example, it should set up an incentive mechanism based on long-term green technological innovation results to encourage managers to focus on firms' steady growth and sustainable growth. Second, improve the transparency and openness of subsidies. Increasing the transparency of the subsidy process by publicizing the application, approval and subsequent use of subsidies can successfully curb managers' opportunistic actions. At the same time, this can enhance the social supervision of subsidy use to further inhibit managerial short-sightedness.

(2) Differentiated subsidy strategies for different ownership systems and regions.

First, increase support for green technological innovation in state-owned enterprises. Given that state-owned businesses are more vulnerable to government funding for innovation, the government should further optimize subsidy policies for state-owned enterprises, such as providing more favorable financing conditions and setting up special research and development funds, to encourage them to invest more in the development of green technologies. For non-state-owned enterprises, the government should understand their specific needs in green technological innovation and design more precise and flexible subsidy policies. For example, the government can provide special subsidies for R&D projects in specific green technological areas to reduce the R&D costs and risks of enterprises. In the meantime, non-state-owned enterprises are encouraged to cooperate with universities and research institutes to conduct green technological innovation projects. Through the sharing of resources and collaborative R&D, the R&D and application process of green technologies can be accelerated.

Secondly, enhancing the leading role of green technological innovation in the eastern areas. Companies in the eastern areas are more efficient in utilizing government innovation subsidies due to their relatively outstanding economic foundation and innovation capacity. Therefore, the government ought to enhance the assistance for businesses in the eastern region and incentivize them to play a leading demonstration effect. Enterprises in the eastern region drive the efficient growth of green technological innovation in the mid-west areas through diversified modes such as technological transfer and cooperative research and development. For companies in the mid-west regions, due to the differences in scale and technological strength, the government should give different amounts of subsidies depending on the specific implementation of innovations in green technological, to incentivize more businesses to engage

in green technological innovation. In the meantime, strengthens inter-regional exchanges and cooperation. The government actively builds a green technological innovation exchange platform to provide a platform for enterprises in the mid-west areas to display, exchange, and cooperate, to promote the exchange and cooperation between enterprises in the mid-west areas and enterprises in other areas.

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