

Article

CEO's Financial Background and Corporate Green Innovation

Ruibing Guo and Jun Zhao *

School of Economics and Management, Xinjiang University, Urumqi 830046, China; guoruibing@stu.xju.edu.cn

* Correspondence: zhaojun@xju.edu.cn

Abstract: Innovation is the primary driving force for development, and enterprises, as the main drivers of innovation, are an important part of implementing the national innovation strategy. This paper, combining the perspective of the enterprise lifecycle, thoroughly examines the differential impact of the CEO's financial background on green innovation in enterprises at different stages of the lifecycle. This study finds that the CEO's financial background has a significant inhibitory effect on green innovation in enterprises, and this conclusion holds true after multiple robustness tests. From the perspective of the lifecycle, it is found that when enterprises are in the mature stage, the CEO's financial background has a strong inhibitory effect on innovation output. The impact of the CEO's financial background on green innovation output in the growth stage is relatively weak, while there is no significant impact on green innovation in the declining period. Furthermore, based on the enterprise lifecycle, it is found that the CEO's financial background has a stronger inhibitory effect on green innovation in non-state-owned enterprises and high-tech industries. The research findings of this paper have important theoretical value and practical significance for promoting green innovation in enterprises and implementing the national innovation strategy.

Keywords: CEO financial background; corporate green innovation; imprinting theory; lifecycle

1. Introduction

As the global economy develops rapidly, the importance of developing countries in the global economy is becoming increasingly prominent. However, this development has been accompanied by increasingly serious environmental pollution, resource depletion, and other issues, posing huge challenges to sustainable development [1]. In this context, green innovation has become one of the key strategies for developing countries to achieve sustainable development. Developing countries face unique challenges and opportunities in achieving green innovation. On the one hand, developing countries often face more severe resource constraints and more prominent environmental pollution issues, making it more necessary for them to address issues such as resource consumption and environmental pollution through green innovation. On the other hand, developing countries often have lower innovation capabilities and technological levels and need to rely on the introduction and absorption of advanced foreign technologies to promote green innovation.

Enterprises, as an important force in economic and social development, play a crucial role. In developing countries, enterprise in green innovation can not only help reduce costs and improve efficiency but also promote environmental protection and sustainable development. Therefore, studying the performance and influencing factors of enterprises in green innovation in developing countries is of great theoretical and practical significance. China, as one of the world's largest developing countries, has attracted much attention for its performance in green innovation. Chinese enterprises have made significant progress in the field of green innovation in recent years, with some enterprises becoming leaders in global green innovation. However, at the same time, Chinese enterprises still face many challenges in green innovation, such as insufficient technological innovation capabilities and the need to improve management levels. Therefore, studying the experience and lessons of Chinese enterprises in green innovation can help other developing country



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enterprises learn from their experiences, promote green innovation, and advance the process of global sustainable development.

As decision-makers and drivers of corporate green innovation strategies, executives have a direct impact on behaviors related to corporate green innovation output, innovation quality, and innovation efficiency. According to the executive hierarchy theory, executives' experiences, values, and personalities influence organizational innovation outcomes, including strategic choices, performance levels, and innovation levels [1–3]. As the helmsmen of corporate executive departments, CEOs represent vital intellectual capital driving enterprise development. This paper aims to explore the relationship between CEOs' financial industry backgrounds and corporate green innovation. Despite the increasing number of CEOs with experience in financial institutions or holding significant financial positions, the impact of CEOs' financial backgrounds on corporate green innovation remains uncertain [4,5]. On one hand, CEOs' financial backgrounds facilitate enterprises in obtaining more financial loans, alleviating their financing constraints [6]. Moreover, they can improve the operating conditions of enterprises by lowering financing costs and optimizing their cash holdings [3,7–9]. From this perspective, CEOs' financial backgrounds can provide a stable internal environment for the innovation behavior of enterprises, thereby contributing to corporate green innovation. On the other hand, based on imprinting theory, CEOs with backgrounds in finance may transfer their experiences and professional judgments from the financial industry to the corporate management process due to the imprint of the financial industry [10–13]. CEOs may prioritize short-term financial performance to secure higher rewards, exacerbating internal agency problems within the enterprise. Additionally, given their experiences in capital market environments, financial professionals may be influenced by speculative thinking patterns, leading to a preference for speculative behavior. This inclination could potentially increase the financialization of enterprises, resulting in crowding-out effects on corporate green innovation [14–16].

Based on the analysis above, it is evident that the impact of CEOs' financial backgrounds on corporate green innovation behavior is uncertain. Further clarification of the relationship between the two is necessary. Examining how CEOs' industry backgrounds influence the level of corporate green innovation from a micro perspective holds significant practical value and theoretical significance in fully mobilizing corporate green innovation vitality and advancing the implementation of national innovation strategies. In light of this, this paper integrates the "CEO financial background—corporate green innovation" into a unified analytical framework, employing imprinting theory to study the impact of CEOs' financial backgrounds on corporate green innovation. Recognizing that the relationship between CEOs' financial backgrounds and corporate green innovation may be influenced by the different lifecycles of enterprises, this paper further embeds lifecycle considerations into the research framework, examining how CEOs' financial backgrounds influence corporate green innovation. The research findings indicate that, firstly, CEOs' financial backgrounds exert a significant inhibitory effect on corporate green innovation, demonstrating a "negative" impact on corporate green innovation. This conclusion remains robust after conducting multiple sensitivity analyses such as changing core variables, sample sizes, and endogeneity tests. Secondly, based on lifecycle analysis, it is observed that compared to enterprises in the growth and decline stages, CEOs' financial backgrounds have a stronger "negative" impact on innovation in mature-stage enterprises, particularly exhibiting a more pronounced inhibitory effect on invention patents. Thirdly, this study conducts further heterogeneous analysis based on a lifecycle perspective, revealing that, overall, CEOs with financial backgrounds exert a stronger inhibitory effect on corporate green innovation in non-state-owned enterprises and high-tech companies.

The potential contributions of this paper may be as follows: firstly, it integrates "CEO financial background—corporate green innovation" into a unified analytical framework, combining imprinting theory to explore the impact of CEOs' financial backgrounds on corporate green innovation. This is validated through empirical analysis. Secondly, it highlights that the influence of CEOs' financial backgrounds on corporate green innovation

should not be indiscriminately applied across all lifecycles. This paper focuses on the life-cycle perspective to investigate the relationship between the two and further explores the decomposition of patent types for a deeper understanding. Thirdly, building upon the life-cycle perspective, this paper conducts heterogeneous analysis to elucidate the differential impact of CEOs' financial backgrounds on corporate green innovation across enterprises with different ownership structures and technological attributes. By examining how CEOs' financial backgrounds influence corporate green innovation at various lifecycle stages within different types of enterprises, this research aims to provide theoretical foundations for devising differentiated corporate green innovation strategies more effectively.

2. Literature Review

2.1. Factors Influencing Corporate Green Innovation

Research on corporate green innovation has a long history, and its influencing factors can generally be categorized into external and internal factors. In terms of external factors influencing corporate green innovation, research based on perspectives such as bankruptcy law and intellectual property protection laws has found that enhancing legal protection for enterprises and investors can effectively promote corporate green innovation [17,18]. Scholars have also explored the impact of government subsidies on green innovation in enterprises of different ownership structures from the perspectives of resource acquisition and signal transmission. It was found that government subsidies have a more significant spillover effect on green innovation in private enterprises [19]. In the central "Five-Year Plan", a distinction is made between general encouragement and key encouragement in industrial planning. This differentiation underscores the crucial impact of industrial policies on corporate green innovation, particularly emphasizing that key encouragement industry planning contributes to enhancing innovation performance within industries [20]. Additionally, scholars have found that external stock markets also exert a significant influence on corporate green innovation [21]. It can be observed that external factors such as legal environment, government subsidy policies, industrial policies, and stock markets all have significant impacts on corporate green innovation. In terms of the internal environment influencing corporate green innovation, this paper focuses on the relationship between CEOs' financial backgrounds and corporate green innovation, with a particular emphasis on the relevant literature concerning the impact of executive backgrounds on corporate green innovation. Some scholars have pointed out that the overseas backgrounds of corporate executives, as well as the backgrounds and academic experiences of inventors, have a positive impact on corporate green innovation [22]. However, other literature suggests that female executives and mandatory changes in executive leadership have a significant inhibitory effect on corporate green innovation [23,24]. By reviewing the aforementioned literature, this paper establishes a theoretical foundation for studying the relationship between CEOs' financial backgrounds and corporate green innovation. Moreover, in recent years, CEOs with financial backgrounds have become increasingly common among listed companies in China. Zhou et al. conducted an empirical study based on data from China and found that among the 3373 CEOs of listed companies in 2015, 411 had prior experience in the financial industry. Therefore, clarifying whether the role of CEOs' financial backgrounds in corporate green innovation is empowering or inhibiting is crucial for effectively managing CEOs and thereby promoting the development of corporate green innovation [25].

2.2. Economic Consequences of Executive Financial Backgrounds

Research on the economic consequences of executive financial backgrounds currently primarily focuses on aspects such as corporate debt financing, financialization, and high-quality development of enterprises. Executives with financial backgrounds strengthen the network of relationships between companies and banks, thereby improving the financial performance of private enterprises and facilitating access to more long-term loans, thus alleviating financing constraints [26]. Particularly in environments with relatively low

levels of financial development, executives with financial industry backgrounds can assist companies in obtaining bond financing resources at lower costs [27]. If a company's cash holdings are low, the company will be more motivated to hire executives with financial backgrounds [28,29]. This measure indeed improves the company's cash holdings. However, from the perspective of corporate financialization, CEOs with financial backgrounds tend to hold more financial assets, which exacerbates the company's financialization behavior [30]. At the same time, financial industry backgrounds may also induce overconfidence in CEOs, leading to a subjective disregard for the adverse consequences of financial investment risks [31,32].

2.3. *The Impact of Executive Career Background on Corporate Green Innovation*

Executives with different career backgrounds have distinct management styles, which in turn lead to different styles of innovation decision-making within companies. The existing literature on the impact of executive career backgrounds on corporate innovation mainly focuses on executives' diversified career experiences, academic experiences, financial experiences, and other professional experiences.

Regarding diversified career experiences, Lin et al. (2019) found that the richness of CEOs' career experiences is positively correlated with corporate innovation output [33]. Among these, the promotion effects of cross-enterprise experiences, cross-industry experiences, cross-organizational experiences, cross-functional department experiences, and cross-regional experiences on corporate innovation levels decrease in that order. Wei X. (2023) found that CEOs who have worked in multiple companies can promote the innovation level of the current company, as CEOs with backgrounds in multiple companies tend to have a more aggressive decision-making style compared to those who have worked in one company for a long time [34].

In terms of academic experiences, He et al. (2019) found that CEOs who obtained degrees overseas and those with high-level academic experiences can enhance the innovation capabilities of their companies [5]. Liu B et al. (2019) found that executives with academic experiences can enhance corporate innovation levels, and the positive effect of executives' academic backgrounds on corporate innovation is stronger when executives with academic backgrounds hold key positions in the company [35].

Regarding financial experiences, Douma et al. (2016) found that the number and proportion of directors with financial backgrounds are positively correlated with a company's R&D investment. Furthermore, when the chairman also serves as the CEO, this positive relationship weakens significantly [36]. Gan et al. (2019) analyzed data from A-share listed companies in Shanghai and Shenzhen from 1999 to 2014 and found that although CEOs with financial backgrounds tend to be conservative in corporate innovation decisions, they are relatively more aggressive in financial decision-making. As a result, companies face significantly higher operational risks [37].

Overall, although domestic and foreign scholars have discussed the impact of executives' personal background characteristics on corporate innovation to a certain extent, research on the impact of executive financial backgrounds is relatively scarce. There is even less research that examines the impact of CEOs' financial backgrounds on corporate green innovation from the perspective of the company's lifecycle.

3. Research Hypothesis

3.1. *CEOs' Financial Background and Corporate Green Innovation*

The experience of working in the financial industry as a CEO leaves a more profound imprint on individuals compared to working backgrounds in other industries. This work experience significantly influences the CEO's work behavior and professional habits, aligning closely with the imprinting theory in biology. According to the imprinting theory in biology, there exists a "sensitive" period in specific environments, during which focal subjects form "imprints" adapted to that environment. These imprints possess a long-lasting inertia, resisting environmental changes and continuously influencing the focal subject [38].

In other words, the imprinting mechanism comprises three key elements: the “sensitive period”, “matching imprint”, and “impact of the imprint”. The imprinting theory was initially applied in the field of organizational behavior. Many scholars believe that in the process of organizational development, history is indelible, and the “imprints” left by history continue to exert a lasting influence on the organization, even if the external environment changes [39]. In recent years, some scholars have extended the application of the imprinting theory to the individual level. For example, Mathias et al. used the imprinting theory to explore the influence of early career imprints on entrepreneurial decisions [40]. Acs et al., based on the perspective of the imprinting theory, found that the “in-system” career imprints of private entrepreneurs prompt them to engage in real estate and other businesses to make “quick money” [41]. Zhou et al. suggest that CEOs who study or work overseas acquire special “imprints,” which influence their cognition and abilities, thereby impacting the financial behavior of companies. Therefore, applying the imprinting theory to individual-level research is reasonable [42]. Personal learning processes and work experiences are often fluid and dynamic, and the imprints they create are difficult to erase or overlay [43]. Because CEOs leave relatively strong and stable imprints on individuals, the financial industry is characterized by its long-standing association with “money” [44,45]. Individuals in the financial field have a special understanding of funds. Moreover, the financial industry is known for its intense competition, high workload, and pressure. Therefore, individuals in the financial sector develop stable imprints that enable them to adapt to this environment. This paper argues that CEOs’ work experience in the financial industry leaves them with indelible “imprints”. These imprints lead to the development of cognition and abilities aligned with the financial industry and subsequently influence the innovative behavior of enterprises.

The imprinting theory suggests that during sensitive periods of personal growth, learning, and work, executives may form psychological imprints. These imprints, including cognition and abilities, continue to influence their careers [46,47]. When corporate executives have experience in the financial industry, the historical imprints of the financial sector, characterized by its professionalism, intensity, and high risk, will impact executives’ decision-making behavior and further affect corporate innovation. Firstly, CEOs with a background in finance accumulate significant professional knowledge, leading to a deeper understanding of the company’s compensation policies. Driven by the maximization of personal interests, these CEOs may show greater interest in short-term, high-return projects, as these projects can quickly increase their compensation levels. This further exacerbates agency problems, resulting in selective neglect of high-cost, high-risk, and long-term innovative projects [48]. Secondly, the theory of behavioral consistency suggests that individuals adhere to similar behavioral patterns formed in different situations and specific circumstances. For CEOs with imprints of a financial background, they transfer their experience in the financial industry to the corporate management process, maintaining certain behavioral preferences consistent with their past financial practice. Consequently, this consistency in behavioral preferences will prompt CEOs to focus more on corporate financial conditions and financial investment behavior, thereby neglecting corporate green innovation strategies. Finally, as strategic decision-makers of the company, CEOs’ personal traits influence strategic thinking and decision-making, thereby significantly impacting corporate behavior. The relatively short history of China’s capital markets and the immaturity of investment concepts have led to the presence of many speculators who engage in short-term trading for arbitrage. Financial professionals who grow and work in such market environments are likely to be influenced by speculative dominant thinking and behavioral patterns, thus developing a preference for speculative traits. This exacerbates the negative impact of managerial short-sightedness. A financial background shapes CEOs’ tendency towards short-term investments, while innovation activities typically require long-term investment and face high risks. This may lead CEOs with financial backgrounds to exhibit conservatism in innovation activities. Just as Wang et al. found that CEOs with financial backgrounds tend to financialize enterprises, excessive financialization of real

entities can suppress corporate green innovation [49]. Moreover, arbitrage motives can exacerbate this inhibitory effect [50]. Therefore, CEOs with financial backgrounds, driven by strategic decisions in financial investment, intensify the financialization of enterprises, thereby crowding out corporate green innovation. Based on the above analysis, this paper proposes the following research hypothesis.

Hypothesis 1: *The CEO's financial background has an inhibitory effect on corporate green innovation.*

3.2. Theoretical Analysis Based on the Lifecycle Theory

Some studies have also focused on the impact of the CEO's financial background on corporate innovation. What sets this study apart from the existing research is its exploration of the relationship between the two from a novel perspective. Specifically, this study examines the differences between the two in the context of the company's lifecycle, aiming to make the conclusions more comprehensive.

The lifecycle theory posits that companies, like living organisms, go through a process from birth to death, from prosperity to decline. Previous studies have shown that the lifecycle theory plays a crucial role in the investment, financing, and allocation behaviors of companies [51]. Phelps et al. argue that in different stages of the lifecycle, the responsibilities and pressures borne by the management and ordinary employees are markedly different [52]. Moreover, the golden period of corporate development and technological innovation activities often occurs within specific stages of the company's lifecycle. Therefore, CEOs with financial backgrounds may make different managerial decisions at different stages of the lifecycle based on the characteristics of the company, further resulting in differential impacts on corporate green innovation. This specifically includes the following.

Firstly, during the growth stage, the CEO's financial background influences corporate green innovation. The growth phase is characterized by insufficient financing allocation, limitations on expenditure targets, and ambiguity in technology research and development directions [53]. Firstly, in the growth stage, companies often lack mature profit models, leading to limited net cash inflows. Consequently, internal funds cannot support research and development innovation projects [54]. Due to the smaller scale of the enterprise and its limited recognition of competitiveness in the market, investors tend to be cautious in evaluating its operational risks and may adopt a conservative wait-and-see attitude. At this stage, CEOs with financial backgrounds may leverage their past experiences in the financial industry and their network relationships to obtain external financing through their own channels. Since the enterprise currently lacks significant cash flow, the tendency towards financialization is relatively low. Secondly, during the growth phase of the enterprise, fund allocation tends to be oriented towards achieving direct financial returns. Compared to innovation investment projects that require a longer period to generate financial returns, CEOs with financial backgrounds, considering financial performance, are more inclined to prioritize investment projects that can quickly bring steady returns. These may include necessary capital expenditures for expanding production capacity to ensure the normal operation of core businesses and increase market share. Lastly, during the growth phase, due to a lack of sufficient research and development (R&D) experience as a technical foundation, enterprises face high risks of R&D failures and unusually high rates of innovation project elimination [55]. Compared to CEOs without financial backgrounds, CEOs with financial backgrounds exhibit a stronger risk-return awareness. At this stage, due to risk aversion considerations, they may reduce innovation investment, thereby affecting the overall innovation willingness of the enterprise. In summary, CEOs with financial backgrounds leverage their financial industry imprints to acquire external funding for the enterprise during the growth phase, while actively reducing investment in green innovation due to financial performance and innovation risk considerations. Based on this, this paper makes the following hypothesis 2:

Hypothesis 2: *The inhibitory effect of the CEO's financial background on green innovation in enterprises is relatively smaller during the growth phase.*

Secondly, during the mature stage, the CEO's financial background and green innovation in the enterprise come into play. As the company enters the mature stage, the CEO faces numerous challenges and decisions. At this stage, the organizational structure of the company continuously improves, the production and operation modes gradually mature, and the profit model becomes relatively stable. Cash inflows are relatively abundant, meeting the company's daily operational and developmental funding needs [56]. However, the CEO still needs to consider how to maximize the use of the ample cash flow to drive innovation and development in the company. Firstly, CEOs with financial backgrounds typically prioritize risk management and stable investment returns. They may be more inclined to invest the cash flow accumulated during the company's mature stage in financially lucrative products rather than risk it in long-term, high-risk innovation projects. This conservative investment strategy may limit the company's investment and development in innovation. Secondly, CEOs with financial backgrounds may prioritize the company's short-term profitability and shareholder returns over long-term innovation and development. In order to maintain the profitability model and market share during the mature stage, they may be more inclined to pursue short-term economic benefits while overlooking the long-term competitive advantages brought about by innovation. This pursuit of short-term gains may limit the company's investment and development in innovation. Furthermore, although CEOs with financial backgrounds may possess high professional competence in financial management, they may lack a deep understanding and experience of innovation. They are more adept at financial management and risk control, while their ability to drive and manage innovation may be relatively insufficient. This lack of innovation awareness and experience may contribute to the inhibitory effect of CEOs with financial backgrounds on corporate green innovation. Based on the above analysis, the following hypothesis is proposed in this study.

Hypothesis 3: *When companies are in the mature stage, CEOs with financial backgrounds exert a stronger inhibitory effect on corporate green innovation.*

Thirdly, during the decline stage, companies experience a deviation between the existing production output and market consumer preferences, with most market shares being monopolized by competitors. This leads to decreased sales and profit margins, resulting in deteriorating financial conditions [57]. The management loses confidence in optimizing internal management mechanisms and driving innovation and research and development. Decision-making effectiveness decreases due to organizational structure rigidity. Companies, in order to sustain their survival, seek new investment projects. However, due to a dulled sensitivity to market demand identification, they can only rely on primitive accumulation to sustain operations. Outdated technological equipment leads to poor innovation efficiency and lower levels of outcome conversion, falling behind the industry average pace. Against this backdrop, companies in the declining phase are not favored by the market, and their financial situation deteriorates rapidly. The previous financial industry experience of CEOs with financial backgrounds no longer aligns with the characteristics of the companies in decline. Consequently, during the declining phase, the impact of CEOs' financial backgrounds on corporate green innovation is not significant. Based on the above analysis, the following hypothesis is proposed in this paper.

Hypothesis 4: *The effect of the CEO's financial background on corporate green innovation is not significant when the company is in the declining phase.*

4. Empirical Design

4.1. Sample Selection and Data Sources

Considering that A-share listed companies have a high market position and representativeness and have high financial transparency, this paper selects A-share listed companies from 2011 to 2021 as the initial research sample. The data are sourced from the China Stock Market & Accounting Research Database (CSMAR), and the data are processed as follows: first, considering that financial and real estate listed companies in China have a large amount of liquid capital, which may exaggerate the conclusions, this paper excludes financial and real estate listed companies; second, it excludes risk-warning companies (ST) and companies at risk of delisting (*ST); third, it excludes samples with serious data missing issues in constructing other control variables, such as the cash flow ratio; fourth, to reduce the impact of outliers, this paper truncates all micro-level continuous variables at 1% and 99%, resulting in a final sample of 25,171 data points.

4.2. Variable Definitions

4.2.1. Dependent Variable

Innovation Output (Innovation). According to OECD, unlike measures such as the proportion of new product sales revenue, the costs incurred by firms for patent applications have a discerning effect on the green innovation output of firms [58]. Additionally, the number of patent applications is considered more reflective of the firm's actual innovation level compared to the number of patents granted [59]. Therefore, this paper uses the number of patent applications related to ecological innovation in enterprise patents as a proxy variable for innovation output. In the robustness analysis section, it further uses R&D investment to measure the intensity of enterprises' green innovation inputs, with data sourced from CSMAR.

4.2.2. Core Explanatory Variables

The core explanatory variable is a dummy variable for the CEO's financial background. It takes a value of 1 when the CEO has worked in regulatory agencies, policy banks, commercial banks, insurance companies, securities companies, fund management companies, securities registration and settlement companies, futures companies, investment banks, trust companies, investment management companies, stock exchanges, and other financial institutions; otherwise, it takes a value of 0. This variable is denoted as "FC" in this paper.

4.2.3. Control Variables

To avoid the influence of other factors, this paper further references existing studies that control for other variables that may affect corporate green innovation, specifically as follows [33,60–63]: enterprise size (Size), debt-to-asset ratio (Lev), return on assets (ROA), cash flow ratio (Cashflow), enterprise growth (Growth), Tobin's Q (TobinQ), company age (FirmAge), ownership concentration (Top1), state ownership (SOE), CEO–chairman duality (Dual), and proportion of independent directors (Indep) [64]. In addition, this study also controls for industry (Industry) and year (Year) fixed effects. The main variable definitions are presented in Table 1.

Table 1. Definitions of research variables.

Symbol	Variable	Define
Innovation	Patent applications	Number of green innovation patents; R&D expenditure/operating income
FC	CEO's financial background	1 if the CEO has a financial background, 0 otherwise
Gender	CEO's gender	1 if the CEO is male, 0 otherwise

Table 1. Cont.

Symbol	Variable	Define
Education	CEO's education	CEO's education
Age	CEO's age	CEO's age
Size	The size of the company	Natural logarithm of total assets at year-end
Lev	Capital structure	Total liabilities/total assets of the company
ROA	Return on total assets (ROA)	Net profit/total assets
Cashflow	Cash flow ratio	Net cash flow from operating activities/total assets
Growth	Enterprise growth	Operating income for the current year/operating income for the previous year—1
TobinQ	Corporate value	(Market value of outstanding shares + number of non-tradable shares × net assets per share + book value of liabilities)/total assets
FirmAge	Company age	ln (year of year—year of establishment + 1)
Top1	Concentration of shareholding	The shareholding ratio of the largest shareholder
SOE	The nature of the company's equity	For the nature of the enterprise, 1 is taken for state-controlled enterprises, and 0 for others
Dual	Dual role	The chairman of the board of directors and the general manager are the same person 1, otherwise 0
Indep	Proportion of independent directors	It is equal to the number of independent directors divided by the total number of directors

4.2.4. Lifecycle Variable

Past studies have employed various methods to classify the lifecycle of firms, including univariate analysis, comprehensive financial indicator methods, and cash flow pattern methods [65]. This study, following Chen's research, adopts the cash flow pattern method to classify listed companies based on various economic characteristics of operating, investing, and financing net cash flows, dividing them into three distinct lifecycle stages: growth period, mature period, and decline period. This classification method may be more scientific and practically meaningful [66]. The specific classification method is outlined in Table 2.

Table 2. Combination of cash flow characteristics of firms at different lifecycle stages.

	Formative Period		Mature Period		Decline Period		
	Formative Period	Growth Period	Mature Period	Decline Period	Decline Period	Decline Period	Elimination Period
Net operating cash flow	—	+	+	—	+	+	—
Net investing cash flow	—	—	—	—	+	+	+
Net financing cash flow	+	+	—	—	+	—	+

Note: From the literature by Shahfira.

4.3. Descriptive Statistics

Table 3 presents the descriptive statistics of the study variables. It can be observed that during the sample period, the mean and standard deviation of corporate patent applications (Innovation) are 1.785 and 1.637, respectively. The relatively large standard deviation indicates significant variation in innovation output among different firms. The range between the minimum and maximum values is 9.611, indicating substantial differences in innovation output across the sample period. Among them, 3444 samples have a patent

count of 0. The descriptive statistics of the CEO's financial background (FC) reveal a mean of 0.051, indicating that approximately 5.1% of CEOs in the sample have a financial background. This suggests that the majority of CEOs in the sample do not possess a financial background. The distribution of other control variables is consistent with those in the previous literature.

Table 3. Descriptive statistics.

Variable	Sample Size	Mean	Standard Deviation	Min	Median	Max
Innovation	25,171	1.785	1.637	0.000	1.792	9.611
FC	25,171	0.051	0.219	0.000	0.000	1.000
Gender	25,171	0.611	0.287	0.000	1.000	1.000
Education	25,171	16.254	2.154	9.000	12.145	23.000
Age	25,171	39.415	1.489	26.214	41.126	59.145
Size	25,171	22.160	1.280	19.525	21.972	26.430
Lev	25,171	0.409	0.200	0.031	0.400	0.925
ROA	25,171	0.041	0.069	−0.398	0.041	0.254
Cashflow	25,171	0.047	0.066	−0.200	0.045	0.257
Growth	25,171	0.170	0.391	−0.660	0.114	4.330
TobinQ	25,171	2.076	1.356	0.802	1.657	17.729
FirmAge	25,171	2.877	0.341	1.386	2.944	3.611
Top1	25,171	0.338	0.145	0.081	0.317	0.758
SOE	25,171	0.303	0.459	0.000	0.000	1.000
Dual	25,171	0.300	0.458	0.000	0.000	1.000
Indep	25,171	0.376	0.054	0.286	0.357	0.600

4.4. Model Settings

To estimate the effect of the CEO's financial background on corporate green innovation, this study adopts a similar econometric model as Quan et al. [67].

$$Innovation_{i,t} = \alpha_0 + \alpha_1 FC_{i,t} + \Sigma Control_{i,t} + Industry_{i,t} + Year_t + province_{i,t} + \mu_{i,t} \quad (1)$$

In Model (1), the subscript i denotes the firm, and t represents the year. $Innovation_{i,t}$ represents the total number of patents of listed firm i in year t , $FC_{i,t}$ denotes the CEO's financial background characteristic variable of listed firm i in year t , and $Control_{i,t}$ is a series of control variables that may affect corporate green innovation. To control for industry-level common exogenous shocks, this paper controls for industry fixed effects (Industry) and further controls for time fixed effects (Year) and provincial fixed effects to eliminate macro exogenous shocks that vary over time. $\mu_{i,t}$ represents the error term. In model (1), the sign and significance of α_1 are the key focus of this paper. If α_1 is less than 0, it indicates that CEOs with a financial background have a negative impact on corporate green innovation. Conversely, if α_1 is greater than 0, it suggests a positive impact.

5. Empirical Results of the Influence of CEO's Financial Background on Corporate Green Innovation

5.1. Benchmark Regression Analysis

Table 4 reports the core test results of the "CEO financial background—Corporate green innovation" in Model (1). In the baseline regression, a stepwise approach is adopted to gradually include control variables into the regression strategy. To examine the direct impact of the CEO's financial background (FC) on corporate green innovation, Column (1) only controls for industry, time effects, and provincial fixed effects, without adding other control variables. The results indicate that the CEO's financial background has a significant inhibitory effect on corporate green innovation. In Column (2), additional control

variables reflecting firm characteristics are included on the basis of Column (1), and the direction of the impact of the CEO's financial background on corporate green innovation remains unchanged. In Column (3), additional control variables reflecting firm ownership structure are included on the basis of Column (2). The regression coefficient is -0.180 , and it passes the statistical significance test at the 1% level. In Column (4), the remaining control variables are included. The estimated result shows a regression coefficient of -0.182 for "CEO financial background—corporate green innovation," and it passes the statistical significance test at the 1% level. The stepwise regression results above indicate that CEOs with a financial background significantly inhibit corporate green innovation, resulting in a "negative" effect, supporting the rationality of Hypothesis 1 in this study.

Table 4. Baseline regression analysis.

	(1)	(2)	(3)	(4)
Variable	Innovation	Innovation	Innovation	Innovation
FC	-0.233^{***} (-4.880)	-0.193^{***} (-4.231)	-0.176^{***} (-4.188)	-0.182^{***} (-4.236)
Gender	0.033^{***} (-5.507)	0.021^{***} (-3.446)	0.018^{**} (-2.834)	0.032^{**} (-2.418)
Education	0.018^{***} (5.130)	0.067^{***} (3.603)	0.034^{***} (3.537)	0.057^{**} (2.886)
Age	-0.016^{***} (-5.146)	-0.014^{***} (-4.215)	-0.013^{***} (-5.256)	-0.012^{***} (-5.541)
Size		0.226^{***} (18.531)	0.268^{***} (18.884)	0.239^{***} (18.582)
Lev		0.011 (0.014)	0.004 (0.091)	0.004 (0.087)
ROA		2.379^{***} (14.638)	2.323^{***} (14.202)	2.316^{***} (14.175)
Cashflow		0.883^{***} (5.659)	0.864^{***} (5.533)	0.871^{***} (5.556)
Growth		-0.173^{***} (-7.438)	-0.172^{***} (-7.349)	-0.173^{***} (-7.362)
TobinQ		-0.017^{**} (-2.177)	-0.018^{**} (-2.092)	-0.016^{**} (-2.046)
FirmAge		-0.319^{***} (-9.893)	-0.306^{***} (-9.292)	-0.305^{***} (-9.285)
Top1			0.208^{***} (2.961)	0.212^{***} (2.982)
SOE			-0.018 (-0.791)	-0.016 (-0.681)
Dual				0.016 (0.719)
Indep				-0.151 (-0.846)
Constant	0.442^{***} (5.130)	-3.665^{***} (-13.603)	-3.726^{***} (-13.537)	-3.596^{***} (-12.886)
Industry/Year/Province	Y	Y	Y	Y
Observations	25,171	25,171	25,171	25,171
R ²	0.178	0.217	0.217	0.217

Notes: **, *** respectively represent significant statistical results at the 5% and 1% levels. The T-value in parentheses. Y represents controlling for the variable in the regression.

5.2. Robustness Checks

5.2.1. Altering the Core Dependent Variable

To ensure robustness in measuring the core dependent variable, this study first conducts a robustness check by altering the core dependent variable. Specifically, in column (1), R&D expenditure/total assets are used to measure the investment in green innovation by the enterprise. In columns (2) to (4), the total number of patents is decomposed into three categories: invention patents, utility model patents, and design patents. The estimation results in column (1) of Table 5 show that the coefficient of the CEO's financial background on investment in green innovation by the enterprise is less than 0, and it passes the 1% statistical significance test. This indicates that CEOs with financial backgrounds significantly inhibit innovation investment. In columns (2) to (4), after decomposing the total number of patents, it is found that the CEO's financial background has a significant inhibitory effect on different types of patents. However, in terms of the degree of influence, the negative effect on invention patents is stronger. The possible reason is that compared to utility model patents and design patents, applying for and protecting invention patents requires a significant investment of time, resources, and capital. Additionally, it is challenging to obtain returns in the short term and involves certain risks. CEOs with financial backgrounds tend to prioritize the financial health of the company and shareholder returns. Therefore, they may adopt a relatively conservative attitude towards invention patents, which require substantial financial investment and entail high risks. This approach helps alleviate financial pressures on the company, leading to a stronger inhibitory effect of the CEO's financial background on the application for invention patents. The regression analysis conducted above, examining innovation inputs and outputs, robustly confirms the significant negative impact of the CEO's financial background on both innovation input and output types. This further supports the robustness of the fundamental research conclusion of this study.

Table 5. Replacement of explanatory variables.

Variable	(1) Innovation	(2) Innovation	(3) Innovation	(4) Innovation
FC	−0.007 *** (−5.507)	−0.123 *** (−3.446)	−0.097 *** (−2.864)	−0.071 ** (−2.428)
Gender	0.043 *** (−4.407)	0.012 *** (−3.331)	0.023 ** (−2.438)	0.035 ** (−2.814)
Education	0.017 *** (5.131)	0.076 *** (3.613)	0.024 *** (3.573)	0.034 ** (2.6688)
Age	−0.106 *** (−5.146)	−0.014 *** (−4.512)	−0.023 *** (−2.216)	−0.022 *** (−5.531)
Size	0.000 * (1.761)	0.225 *** (23.625)	0.342 *** (33.131)	0.153 *** (15.735)
Lev	−0.047 *** (−27.739)	−0.042 (−0.806)	−0.182 *** (−4.513)	0.018 (0.381)
ROA	−0.054 *** (−8.967)	1.673 *** (12.651)	0.645 *** (6.017)	1.339 *** (12.846)
Cashflow	−0.008 ** (−2.158)	0.518 *** (3.914)	0.089 (0.954)	0.458 *** (4.596)
Growth	−0.003 *** (−5.496)	−0.121 *** (−6.348)	−0.106 *** (−6.939)	−0.109 *** (−7.736)
TobinQ	0.004 *** (15.582)	0.025 *** (3.093)	0.026 *** (4.885)	0.023 *** (3.737)

Table 5. Cont.

Variable	(1) Innovation	(2) Innovation	(3) Innovation	(4) Innovation
FirmAge	−0.008 *** (−10.891)	−0.189 *** (−7.383)	−0.047 ** (−2.023)	0.019 (0.486)
Top1	−0.022 *** (−12.256)	−0.099 (−1.578)	−0.188 *** (−3.554)	0.189 *** (3.679)
SOE	−0.006 *** (−6.286)	0.075 *** (4.066)	0.088 *** (4.347)	−0.039 ** (−2.145)
Dual	0.006 *** (7.464)	0.029 (1.574)	0.038 ** (2.152)	0.109 *** (6.789)
Indep	0.027 *** (4.550)	−0.055 (−0.327)	0.349 *** (2.629)	0.206 (1.587)
Constant	0.029 *** (4.533)	−4.861 *** (−19.335)	−6.515 *** (−28.735)	−3.165 *** (−15.475)
Industry/Year/Province	Y	Y	Y	Y
Observations	25,171	25,171	25,171	25,171
R ²	0.375	0.184	0.164	0.176

Note: (1) represents R&D expenditure/total assets, (2)–(4) represent the measurement results of invention patents, utility model patents, and design patents, respectively. *, **, *** respectively represent significant statistical results at the 10%, 5% and 1% levels. The T-value in parentheses. Y represents controlling for the variable in the regression.

5.2.2. Considering the Impact of Other Shocks

The urgency and uncertainty brought by major global financial shocks and sudden public events pose significant challenges to the global economy. Faced with these uncertain shocks, CEOs with financial backgrounds may adjust their innovation strategies, proactively reducing innovation to mitigate potential risks. Because CEOs with financial backgrounds tend to be more sensitive to these events' reactions in financial markets, they may adjust their financial investment behavior, thereby influencing corporate green innovation [68]. Therefore, incorporating these external events into unified analysis may introduce certain endogeneity issues. To mitigate the impact of external disturbances on the research results, this study excludes samples affected by significant external shocks for robustness checks. Specifically, firstly, the study excluded enterprise sample data during the 2015 Chinese stock market crash. Secondly, after removing the impact of the Chinese stock market crash, the sample of enterprises in 2018 was further deleted to eliminate the influence of the China–US trade friction on economic policies and corporate green innovation behavior. Finally, further exclusions were made to eliminate the impact of the global economic turmoil since 2020 on listed companies. On this basis, considering the significant economic and political differences between municipalities directly under the central government in China and other regions, this study also excluded samples from directly governed municipalities to re-estimate the results of Model (1), ensuring the accuracy and robustness of the research findings. The regression results in Table 6 indicate that even after excluding significant exogenous shocks and removing samples from directly governed municipalities, the CEO's financial background still exhibits a significant inhibitory effect on corporate green innovation. This further confirms the robustness of the fundamental research conclusions of this study.

Table 6. Excluding exogenous event shocks.

Variable	(1) Innovation	(2) Innovation	(3) Innovation	(4) Innovation
FC	−0.189 *** (−4.123)	−0.189 *** (−4.025)	−0.191 *** (−3.812)	−0.183 *** (−3.749)
Gender	0.019 *** (−3.391)	0.031 ** (−2.478)	0.039 ** (−2.874)	0.037 ** (−3.874)
Education	0.067 *** (3.143)	0.014 *** (3.543)	0.039 ** (2.668)	0.017 *** (2.563)
Age	−0.024 ** (−2.112)	−0.024 ** (−2.226)	−0.122 *** (−3.531)	−0.013 * (−1.931)
Size	0.232 *** (17.285)	0.262 *** (17.565)	0.223 *** (15.972)	0.293 *** (17.828)
Lev	−0.062 (−0.389)	−0.071 (−0.246)	−0.063 (−0.541)	0.072 (0.432)
ROA	2.236 *** (12.143)	2.331 *** (13.446)	2.274 *** (10.768)	2.351 *** (12.834)
Cashflow	0.915 *** (5.442)	0.762 *** (4.571)	0.684 *** (3.784)	0.761 *** (4.364)
Growth	−0.169 *** (−6.864)	−0.186 *** (−7.745)	−0.189 *** (−6.664)	−0.164 *** (−6.223)
TobinQ	−0.015 * (−1.884)	−0.032 *** (−2.568)	−0.021 ** (−1.664)	−0.006 (−0.564)
FirmAge	−0.279 *** (−8.633)	−0.289 *** (−8.837)	−0.296 *** (−7.818)	−0.418 *** (−11.836)
Top1	0.231 *** (2.826)	0.241 *** (2.915)	0.198 ** (2.326)	0.252 *** (3.025)
SOE	−0.017 (−0.599)	−0.016 (−0.597)	−0.014 (−0.449)	0.055 * (1.868)
Dual	0.016 (0.546)	0.019 (0.747)	0.035 (1.395)	0.009 (0.339)
Indep	−0.282 (−1.182)	−0.156 (−0.773)	−0.246 (−1.123)	0.042 (0.196)
Constant	−3.643 *** (−12.172)	−3.817 *** (−12.349)	−3.5517 *** (−11.019)	−4.884 *** (−15.175)
Industry/Year/Province	Y	Y	Y	Y
Observations	22,338	22,382	17,500	20,522
R ²	0.222	0.219	0.218	0.233

Note: (1) Excluded samples of companies during the 2015 Chinese stock market crash; (2) deleted samples of companies in 2018; (3) excluded the impact of global economic turmoil since 2020 on listed companies; (4) excluded samples from municipalities directly under the central government. *, **, *** respectively represent significant statistical results at the 10%, 5% and 1% levels. The T-value in parentheses. Y represents controlling for the variable in the regression.

5.2.3. Leading Dependent Variables or Lagging Independent Variables

Given the possible lagged impact of corporate executive behavior on corporate green innovation, this study examines the dynamic regression results of the CEO's financial background on corporate green innovation by changing the FC observation window. Specifically, the FC variable is lagged by 1 to 2 periods to examine the lag effects of the model while also alleviating some endogeneity issues. To enhance comparative analysis, this paper further preprocesses corporate green innovation by leading it by 1–2 periods. The regression results are shown in Table 7. Columns (1)–(2) preprocess the dependent variable “Innovation”

by leading it by 1–2 periods, while columns (3)–(4) lag the core explanatory variables by 1–2 periods. Table 7 results indicate that whether preprocessing “Innovation” or lagging “FC”, the CEO’s financial background exhibits a significant inhibitory effect on corporate green innovation. This suggests that the CEO’s financial background has a certain lagged impact on corporate green innovation, further supporting the robustness of the conclusions drawn in this study.

Table 7. Estimated results of variable adjustment.

Variable	(1) F.Innovation	(2) F2.Innovation	(3) Innovation	(4) Innovation
FC	−0.156 *** (−3.079)	−0.135 ** (−2.498)		
L.FC			−0.124 *** (−2.777)	
L2.FC				−0.135 ** (−2.545)
Gender	0.031 *** (−3.704)	0.028 *** (−4.931)	0.026 ** (−2.748)	0.035 ** (−2.784)
Education	0.026 *** (3.141)	0.079 *** (3.354)	0.041 *** (3.435)	0.064 ** (2.7774)
Age	−0.036 *** (−3.146)	−0.024 *** (−3.512)	−0.033 *** (−3.216)	−0.026 *** (−3.531)
Size	0.281 *** (16.088)	0.242 *** (14.788)	0.291 *** (16.532)	0.242 *** (15.192)
Lev	0.045 (0.738)	−0.006 (−0.092)	0.051 (0.785)	0.079 (0.896)
ROA	3.717 *** (16.934)	3.470 *** (17.953)	2.404 *** (12.780)	2.247 *** (11.818)
Cashflow	1.065 *** (6.018)	0.677 *** (4.201)	0.966 *** (5.963)	1.041 *** (5.414)
Growth	−0.291 *** (−7.865)	−0.244 *** (−7.838)	−0.146 *** (−5.696)	−0.146 *** (−5.444)
TobinQ	−0.008 (−1.051)	−0.019 *** (−2.776)	−0.006 (−0.824)	−0.003 (−0.145)
FirmAge	−0.269 *** (−7.746)	−0.243 *** (−6.165)	−0.311 *** (−7.941)	−0.286 *** (−6.716)
Top1	0.186 ** (2.512)	0.232 *** (2.651)	0.241 *** (3.021)	0.271 *** (3.059)
SOE	0.003 (0.069)	0.041 (1.161)	−0.023 (−0.741)	−0.016 (−0.515)
Dual	0.008 (0.397)	−0.000 (−0.015)	−0.007 (−0.371)	−0.029 (−1.029)
Indep	−0.251 (−1.238)	−0.179 (−0.874)	−0.102 (−0.533)	−0.067 (−0.366)
Constant	−3.624 *** (−11.596)	−3.914 *** (−11.319)	−3.476 *** (−10.676)	−3.793 *** (−10.476)
Industry/Year/Province	Y	Y	Y	Y
Observations	21,317	18,386	21,317	18,386
R ²	0.215	0.216	0.214	0.213

Note: (1) and (2) respectively represent the lagged one period and two periods of the dependent variable; (3) and (4) respectively represent the lagged one period and two periods of the independent variable. **, *** respectively represent significant statistical results at the 5% and 1% levels. The T-value in parentheses. Y represents controlling for the variable in the regression.

5.2.4. Change in Estimation Method

Considering that the hiring of CEOs with financial backgrounds by companies may not be exogenously determined and could be influenced by other factors, this paper selects the number of universities within 300 km of the company's location that offer finance and accounting programs (denoted as "School") as an instrumental variable representing the CEO's financial background. Generally, the number of universities offering finance and accounting programs near the listed companies is closely related to the CEO's financial background, while also unlikely to significantly affect corporate green innovation. Estimation is conducted using the Heckman two-stage method, and the results are shown in Table 8. It can be seen that the results remain robust after addressing the issue of sample selection.

Table 8. Change in estimation method.

Variable	(1)	(2)
	Innovation	Innovation
FC		−0.202 *** (−5.876)
School	0.056 *** −2.652	
Gender	0.008 ** (−2.333)	0.032 ** (−2.328)
Education	0.033 *** −3.537	0.057 ** −2.026
Age	−0.023 *** (−5.256)	−0.032 *** (−7.532)
Size	0.268 *** −28.883	0.239 *** −28.582
Lev	0.003 −0.092	0.003 −0.087
ROA	2.323 *** −23.202	2.326 *** −23.275
Cashflow	0.863 *** −5.533	0.872 *** −5.556
Growth	−0.272 *** (−7.339)	−0.273 *** (−7.362)
TobinQ	−0.028 ** (−2.092)	−0.026 ** (−2.036)
FirmAge	−0.306 *** (−9.292)	−0.305 *** (−9.285)
Top1	0.208 *** −2.962	0.222 *** −2.982
SOE	−0.028 (−0.792)	−0.026 (−0.682)
Dual	0.015 −0.457	0.026 −0.729
Indep	−0.354 (−0.847)	−0.252 (−0.836)
Constant	−6.684 *** (−15.657)	−3.596 *** (−12.886)
Industry/Year/Province	Y	Y
Observations	25,171	25,171
R ²	0.351	0.217

Note: **, *** respectively represent significant statistical results at the 5% and 1% levels. The T-value in parentheses. Y represents controlling for the variable in the regression.

5.3. Internal Validity Handling

Given that whether a CEO possesses a financial background may not be random, and there are certain differences in firm characteristics between samples with CEOs having financial backgrounds and those without, it may lead to biases in regression results and consequently affect the conclusions of this study. To address this issue, this study employs the propensity score matching (PSM) method to find, for each company with a CEO having a financial background, a non-financial background company that is most similar. Subsequently, the matched sample is used to re-estimate Model (1). Specifically, this study selects characteristic variables such as firm size, leverage ratio, return on total assets, cash flow ratio, firm growth, firm value, company age, ownership concentration, ownership nature, dual role duality, and the proportion of independent directors. The Logit model is used to calculate propensity scores, followed by 1:1 caliper nearest neighbor matching with a caliper of 0.05. Table 8 reports the regression results after employing the PSM method in column (1).

In addition, this study further utilizes the instrumental variable method to address potential endogeneity issues. Specifically, this study employs the lagged FC and the number of companies within the same industry having CEOs with financial backgrounds as instrumental variables. Firstly, the financial industry background of the current CEO will persist into the next period, but whether the next-period CEO possesses a financial background does not influence the characteristics of the current CEO, thus fulfilling the assumptions of instrument variable relevance and independence. Secondly, within a particular industry, if companies on average have more CEOs with financial backgrounds, it is highly likely that these companies are similar to capital-intensive firms. Consequently, CEOs of these companies are also more likely to have financial backgrounds. This fulfills the relevance criterion for instrumental variables. Additionally, the number of CEOs with financial backgrounds at the industry level does not directly impact the innovation of a specific company, thus meeting the independence assumption of instrumental variables. To address this, the study conducts a robustness check on the instrumental variables using lagged FC and the average number of CEOs with financial backgrounds in the same province. The regression results are presented in Table 8. The estimation results in Table 8 indicate that even after addressing the potential issues of sample self-selection and endogeneity, the CEO's financial background still significantly inhibits corporate green innovation.

5.4. Empirical Analysis Based on Corporate Lifecycle

The lifecycle theory posits that firms resemble living organisms, experiencing phases from birth to death and from prosperity to decline. Previous studies have demonstrated its significant role in company investments, financing, distribution, and other behaviors [69]. The imprint of the CEO's financial industry background may be influenced by different life characteristics in corporate decisions regarding green innovation. Therefore, the research framework from the variable "CEO financial background—corporate green innovation" investigates the impact of the CEO's financial background on corporate green innovation across different stages of the corporate lifecycle. The regression results are presented in Table 9.

Table 9. Endogenous treatments.

Variable	(1) Innovation	(2) Innovation	(3) Innovation
FC	−0.213 *** (−3.434)	−0.206 *** (−2.917)	−0.206 *** (−2.904)
Gender	0.054 *** (−3.405)	0.017 *** (−4.248)	0.054 ** (−2.844)

Table 9. Cont.

Variable	(1) Innovation	(2) Innovation	(3) Innovation
Education	0.051 *** (3.331)	0.081 *** (3.699)	0.062 *** (3.5546)
Age	−0.124 *** (−3.412)	−0.023 *** (−3.316)	−0.017 *** (−3.431)
Size	0.188 *** (4.998)	0.223 *** (16.637)	0.223 *** (16.637)
Lev	−0.038 (−0.163)	0.039 (0.575)	0.039 (0.575)
ROA	2.416 *** (4.565)	2.393 *** (12.744)	2.393 *** (12.744)
Cashflow	1.414 *** (2.916)	0.965 *** (5.397)	0.965 *** (5.397)
Growth	−0.059 (−1.517)	−0.165 *** (−5.684)	−0.165 *** (−5.761)
TobinQ	−0.086 *** (−3.037)	−0.008 (−0.793)	−0.008 (−0.793)
FirmAge	−0.345 *** (−3.057)	−0.288 *** (−7.942)	−0.288 *** (−7.942)
Top1	0.541 ** (2.222)	0.236 *** (2.994)	0.236 *** (2.994)
SOE	0.126 (1.528)	−0.020 (−0.747)	−0.020 (−0.747)
Dual	0.049 (0.715)	−0.006 (−0.243)	−0.006 (−0.243)
Indep	−0.584 (−0.965)	−0.111 (−0.561)	−0.111 (−0.561)
Constant	−2.355 *** (−2.626)	−3.789 *** (−11.543)	−3.789 *** (−11.543)
Industry/Year/Province	Y	Y	Y
Observations	2427	21,317	21,317
R ²	0.288	0.214	0.214
Kleibergen-Paap rk LM	-	826.716 ***	826.232 ***
Cragg-Donald Wald F	-	9069.717	9076.799

Note: (1) PSM estimation results; (2) FC lagged by one period and the number of companies in the same industry with CEOs having financial backgrounds as instrumental variables; (3) FC lagged by one period and the average number of financial background executives in the same province as instrumental variables. **, *** respectively represent significant statistical results at the 5% and 1% levels. The T-value in parentheses. Y represents controlling for the variable in the regression.

In Panel A of Table 9, the results indicate that the coefficient of FC on green innovation output for mature-stage firms is -0.266 , passing a statistical significance test at the 1% level. For growth-stage firms, the regression coefficient for green innovation output is -0.116 , significant at the 10% level. However, the coefficient for the impact of FC on green innovation output for decline-stage firms did not pass the statistical significance test. The regression results on the impact of the CEO's financial background (FC) on corporate green innovation output indicate that when companies enter the growth stage, they face significant financing constraints, lack stable profit models, and encounter greater market risks. At this stage, in order to sustain until the arrival of maturity, companies need to rely on innovation strategies to gain market competitiveness. For companies with CEOs

possessing financial backgrounds, on one hand, they can leverage their financial networks to alleviate corporate financing constraints, thus having certain innovation incentives to provide financial support for corporate green innovation. On the other hand, due to risk-averse considerations, they may be more inclined towards “quick wins” investment projects to achieve better financial performance and shareholder returns. This may lead to a certain negative impact of the CEO’s financial background on innovation output during the growth stage of the company. However, compared to the mature stage, the effect is relatively weaker, thus confirming the validity of Hypothesis 2 in this study.

When a company is in the mature stage, it typically enjoys more abundant cash flow, market share, and relatively stable profitability. On one hand, CEOs with financial backgrounds may choose to allocate more cash flow into financial investments, thereby exerting pressure on corporate green innovation. On the other hand, CEOs with financial backgrounds, drawing on their financial industry experience, may opt for investment projects with expected returns and relatively short investment periods, while overlooking innovative projects with higher risks and longer investment periods. This could result in a stronger inhibitory effect of the CEO’s financial background on innovation output during the mature stage of the company, thus validating the rationality of Hypothesis 3 in this study. After the financial decline phase, companies face significant bankruptcy risks, are generally not favored by the market, and encounter operational difficulties. At this point, the financial industry experience of CEOs no longer aligns with the characteristics of companies in decline. Consequently, the impact of the CEO’s financial background on corporate green innovation during the decline phase is not significant, thus confirming the validity of Hypothesis 4 in this study.

The above analysis based on the lifecycle perspective examined the impact of the CEO’s financial background on corporate green innovation output but failed to reflect the differential effects on different types of innovation outputs. This study further analyzes the impact of the CEO’s financial background on different types of patents across different lifecycle stages. The regression results, as shown in Table 9, indicate that overall, when companies are in the mature stage, the CEO’s financial background has a significant negative impact on invention patents, utility model patents, and design patents. However, in terms of the degree of influence, the CEO’s financial background has a stronger inhibitory effect on invention patents for mature-stage companies. This could be because, compared to the other two types of innovation patents, invention patents require more financial support and involve longer research and development cycles, thus presenting greater innovation risks. Therefore, CEOs with financial backgrounds, in their innovation strategy decisions, may adopt a relatively conservative attitude towards invention patents, considering risk-return analysis, thus exerting a stronger inhibitory effect on invention patents.

5.5. Lifecycle-Based Heterogeneity Analysis

The above research confirms that the CEO’s financial background has a significant negative effect on corporate green innovation, especially exerting a stronger inhibitory effect on green innovation in mature-stage enterprises. However, the analysis of the full sample may be affected by structural differences in aspects such as corporate resource endowment, innovation potential, and innovation capabilities, thus influencing the empirical results. Furthermore, this article further explores from the perspective of the lifecycle, employing empirical strategies based on “state-owned enterprises vs. non-state-owned enterprises” and “high-tech enterprises vs. non-high-tech enterprises” to examine the differential impact of the CEO’s financial background on corporate green innovation at different lifecycle stages, under different ownership and technology attributes (see Tables 10 and 11).

Table 10. Empirical analysis based on lifecycle.

Variable	(1)			(2)		
	Formative Period	Mature Period	Decline Period	Formative Period	Mature Period	Decline Period
FC	−0.116 *	−0.266 ***	−0.144	−0.073	−0.194 ***	−0.077
	(−1.772)	(−3.554)	(−1.561)	(−1.360)	(−3.272)	(−1.064)
Controls	Y	Y	Y	Y	Y	Y
Constant	−3.210 ***	−4.462 ***	−2.152 ***	−4.723 ***	−5.540 ***	−3.264 ***
	(−7.612)	(−9.474)	(−3.096)	(−12.685)	(−13.372)	(−5.431)
Industry/Year/Province	Y	Y	Y	Y	Y	Y
Observations	11,531	8943	4601	11,531	8943	4601
R ²	0.211	0.229	0.246	0.177	0.201	0.202

Variable	(3)			(4)		
	Formative period	Mature Period	Decline Period	Formative period	Mature Period	Decline Period
FC	−0.076 *	−0.108 **	−0.013	−0.055	−0.117 **	−0.029
	(−1.827)	(−2.070)	(−0.244)	(−1.309)	(−2.349)	(−0.416)
Controls	Y	Y	Y	Y	Y	Y
Constant	−6.290 ***	−7.366 ***	−5.485 ***	−2.843 ***	−3.363 ***	−3.196 ***
	(−19.100)	(−18.193)	(−10.458)	(−9.858)	(−9.759)	(−5.889)
Industry/Year/Province	Y	Y	Y	Y	Y	Y
Observations	11,531	8943	4601	11,531	8943	4601
R ²	0.140	0.168	0.138	0.162	0.183	0.181

Note: (1), (2) (3) and (4) Representing the impact on enterprise innovation, invention patents, utility model patents, and design patents respectively. *, **, *** respectively represent significant statistical results at the 10%, 5% and 1% levels. The T-value in parentheses. Y represents controlling for the variable in the regression.

Table 11. Analysis of heterogeneity in the nature of equity.

Variable	Panel A		State-Owned Enterprises		
	Full Sample	Formative Period	Mature Period	Decline Period	
FC	0.032	0.152	−0.301 *	0.304	
	(0.342)	(1.110)	(−1.849)	(1.444)	
Controls	Y	Y	Y	Y	
Constant	−5.620 ***	−5.464 ***	−6.312 ***	−3.334 ***	
	(−10.987)	(−6.624)	(−7.770)	(−2.726)	
Industry/Year/Province	Y	Y	Y	Y	
Observations	7616	3098	3054	1430	
R ²	0.287	0.283	0.312	0.334	

Variable	Panel B		Non-state-owned Enterprises		
	Full sample	Formative period	Mature Period	Decline Period	
FC	−0.236 ***	−0.202 ***	−0.231 ***	−0.289 ***	
	(−4.925)	(−2.746)	(−2.776)	(−2.899)	
Controls	Y	Y	Y	Y	
Constant	−2.854 ***	−2.884 ***	−3.083 ***	−1.509 *	
	(−8.112)	(−5.616)	(−5.163)	(−1.695)	
Industry/Year/Province	Y	Y	Y	Y	
Observations	17,555	8433	5889	3171	
R ²	0.209	0.210	0.212	0.235	

Note: The Table uses patent counts as the dependent variable. *, *** respectively represent significant statistical results at the 10% and 1% levels. The T-value in parentheses. Y represents controlling for the variable in the regression.

The empirical results in Table 10 indicate that, overall, the regression coefficient of the CEO's financial background on state-owned enterprises is 0.032, which does not pass the test of statistical significance. However, for non-state-owned enterprises, the coefficient affecting green innovation output is -0.236 , passing the statistical significance test at the 1% level. This suggests that CEOs with financial backgrounds in non-state-owned enterprises significantly inhibit green innovation, but the impact on green innovation in state-owned enterprises is not significant. From a lifecycle perspective, when state-owned appearance design-type patents are in the mature stage, the coefficient of the CEO's financial background's impact on corporate green innovation output is -0.30 , passing the statistical significance test at the 10% level. However, for non-state-owned enterprises, across all stages of the enterprise lifecycle, the coefficient of the CEO's financial background's impact on innovation output is negative and passes the statistical significance test. The above research from a lifecycle perspective suggests that, overall, CEOs of state-owned enterprises with financial backgrounds have a relatively small impact on corporate green innovation, primarily evident in the mature stage. CEOs of non-state-owned enterprises with financial backgrounds exhibit a relatively significant inhibitory effect on corporate green innovation, which is apparent throughout the entire lifecycle of the enterprises.

In theory, whether a company belongs to the high-tech sector will affect its innovation willingness. Compared with non-high-tech enterprises, high-tech enterprises have a stronger willingness to innovate [70]. Based on this, in order to examine the impact of the CEO's financial background on green innovation in companies with different technological attributes, this paper refers to the method proposed by Wang [71]. According to the classification guidelines for listed companies in China issued by the China Securities Regulatory Commission in 2012, companies with industry classification codes belonging to C25~C29, C31~C32, C34~C41, I63~I65, and M73 are defined as high-tech industry companies, while other industry codes are classified as non-high-tech enterprises for heterogeneity analysis (see Table 11) [72–74].

As shown in Table 12, overall, the coefficient of the CEO's financial background on green innovation in high-tech enterprises is -0.219 , and the coefficient on green innovation in non-high-tech enterprises is -0.116 . Both coefficients pass the 1% level of statistical significance test, indicating that the financial background of CEOs in high-tech enterprises has a stronger inhibitory effect on corporate green innovation. Furthermore, from the perspective of the lifecycle, when high-tech enterprises are in the growth and maturity stages, the coefficient of the CEO's financial background on corporate green innovation is negative and passes the statistical significance tests at the 5% and 10% levels, respectively. For non-high-tech enterprises, only in the case of mature-stage enterprises, the CEO's financial background has a significant negative impact on corporate green innovation. The above analysis indicates that CEOs with financial backgrounds in high-tech enterprises have a stronger inhibitory effect on corporate green innovation, particularly during the growth and maturity stages. Compared to high-tech enterprises, the impact of CEOs' financial backgrounds on green innovation in non-high-tech enterprises is relatively smaller, primarily observed during the mature stage. One possible reason is that high-tech enterprises typically prioritize innovation, risk-taking, and rapid decision-making, while the financial industry places more emphasis on stability, compliance, and risk avoidance. CEOs with financial backgrounds may bring their values and experiences from the financial sector into the enterprise, leading to conflicts in the organizational culture and values, thereby inhibiting the development of innovation [75,76].

Table 12. Analysis of technological attributes and lifecycle heterogeneity.

Variable	High-Tech Enterprises			
	Panel A Full Sample	Formative Period	Mature Period	Decline Period
FC	−0.219 *** (−3.353)	−0.206 ** (−2.031)	−0.217 * (−1.855)	−0.214 (−1.612)
Controls	Y	Y	Y	Y
Constant	−4.778 *** (−9.888)	−4.399 *** (−6.871)	−5.650 *** (−6.973)	−1.212 (−1.031)
Industry/Year/Province	Y	Y	Y	Y
Observations	11,852	5520	4114	2158
R ²	0.205	0.194	0.243	0.202

Variable	Non-high-tech enterprises			
	Panel B Full sample	Formative period	Mature Period	Decline Period
FC	−0.116 ** (−2.060)	−0.014 (−0.174)	−0.275 *** (−2.831)	−0.041 (−0.321)
Controls	Y	Y	Y	Y
Constant	−3.885 *** (−10.429)	−3.285 *** (−5.799)	−5.121 *** (−8.196)	−2.839 *** (−3.257)
Industry/Year/Province	Y	Y	Y	Y
Observations	13,319	6011	4829	2443
R ²	0.262	0.259	0.259	0.327

Note: The table uses patents as the dependent variable. *, **, *** respectively represent significant statistical results at the 10%, 5% and 1% levels. The T-value in parentheses. Y represents controlling for the variable in the regression.

6. Research Conclusions and Policy Recommendations

Studying the influencing factors of corporate green innovation is of great theoretical value and practical significance for promoting corporate green innovation and accelerating the implementation of national innovation strategies. Based on this, this paper takes A-share listed companies in China from 2011 to 2021 as the research objects and investigates the impact of the CEO's financial background on corporate green innovation from the perspective of the corporate lifecycle. This study finds that, first, the CEO's financial background has a limited inhibitory effect on corporate green innovation, exerting a "negative" impact on it. This conclusion remains valid after multiple robustness analyses such as changing core variables, sample sizes, estimation methods, and endogeneity tests. Second, based on the lifecycle, compared with companies in the growth and decline stages, companies in the maturity stage are more negatively influenced by the CEO's financial background on innovation, especially in terms of invention patents. This may be because invention patents require more financial support and have longer research and development cycles, making them more prone to significant innovation risks. Third, further heterogeneity analysis based on the lifecycle reveals that, overall, CEOs with financial backgrounds in non-state-owned enterprises and high-tech enterprises have a stronger inhibitory effect on corporate green innovation, especially in the maturity stage. This may be because high-tech enterprises typically emphasize innovation, risk-taking, and rapid decision-making, while the financial industry focuses more on stability, compliance, and risk avoidance.

Based on the above research conclusions, this study offers the following policy implications: firstly, the imprinting mechanism makes CEOs with financial backgrounds susceptible to the influence of past experiences when making innovative strategic decisions. Therefore, corporate executives should adopt a more cautious and objective approach towards their past professional experiences to avoid any adverse effects on innovation strategy decision-making. Secondly, companies should diversify the diversity of executive backgrounds to fully leverage the positive influence of the imprinting mechanism, thereby promoting corporate green innovation. Moreover, when companies are in the growth phase, the financial background of the CEO may play a supportive role in promoting green innovation. However, once the company's development matures, the CEO's financial background

will significantly inhibit innovation. Therefore, at different stages of the company's lifecycle, the board of directors should pay close attention to the professional backgrounds of the corporate management. Thirdly, companies should enhance internal governance mechanisms by utilizing both internal and external governance mechanisms such as board governance, controlling shareholders governance, and proactive disclosure of information to strengthen supervision over management's short-sighted behavior. This helps to prevent the influence of executives' past professional backgrounds on their strategic decision-making.

7. Research Limitations and Future Directions

The empirical analysis did not consider the impact of unobservable factors. This may lead to biased estimates of the effect of the CEO's financial background on innovation, as not all factors that could influence innovation were controlled for. Future research could consider using more complex models or adopting more stringent control methods to reduce the impact of unobservable factors.

Excessive reliance on the imprinting theory may oversimplify decision-making complexity. Although the imprinting theory provides a useful framework for understanding the impact of the CEO's financial background on innovation, excessive reliance on this theory may lead to neglecting other potential influencing factors. Future research could consider integrating multiple theories to more comprehensively understand the impact of the CEO's financial background on innovation.

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