How Excess Goodwill Affects Firms' Green Innovation Capacity: A Firm Life Cycle-Based Perspective

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Abstract. Based on the 2016-2021 Chinese A-share listing data, this paper empirically explores the impact of corporate excess goodwill on the level of green innovation and its mechanism of action, taking into account the life cycle status of enterprises. It is found that excess goodwill has a significant negative impact on the level of corporate green innovation, and this conclusion still holds after the robustness test using multiple methods. The adjustment analysis shows that the enterprise life cycle delay weakens excess goodwill's inhibitory effect on green innovation. Heterogeneity analysis shows a more significant negative effect of excess goodwill on corporate green innovation among companies that are not heavy polluters, in the eastern region, and with high technology. The research in this paper is instructive for promoting corporate reform and governance to achieve peak carbon attainment and carbon neutrality.

Keywords: Excess Goodwill, Green Innovation, Firm Life Cycle.

1. Introduction

Green innovation, as an essential development model, aims to realize the organic combination of economic advancement and environmental conservation under the leadership of the concept of sustainable development. Currently, it is the critical period and window period for China's carbon peak, and green innovation will be the vital force to improve the large carbon emission base of enterprises, transition to ecological environment governance and development, and build an environmentally friendly resource allocation system. According to the "Implementation Plan on Further Improving Market-Oriented Green Technology Innovation System (2023-2025)" issued in December 2022, accelerating the transition of the market to an environmentally friendly system and accelerating the construction of a new pattern of green innovation that can promote an excellent environmental trend is the mainstay of promoting economic growth and focusing on maintaining the ecological balance and reducing the burden on the environment. As enterprises are receivers of natural resources, the development process of green innovation firms, which is an important factor in planning economic development and protecting the environment, is affected by industrial systems, government subsidies, knowledge transfer, and environmental constraints [1].

In addition to the impacts that can be measured with the help of analytical theories and valuation tools, the factor of the potential value of the enterprise on the innovation of green inventions and technology will be more valuable to study. As an unverifiable estimate of fair value, Goodwill reflects the enterprise's scientific and technological, branding, and talent advantages. In recent years, impaired operating performance, reduced innovation output, lower innovation efficiency, and the emergence of more extraordinary audit expenses [2] due to surplus goodwill have presented fresh hurdles for corporate green innovation. Surplus goodwill's effect on corporate green innovation is gaining increased focus.

Based on the existing literature, excess goodwill negatively affects firms' innovation, mainly by increasing the cost of debt financing [3] or the extent of analysts' optimism bias. Improvements in firms' overall accounting robustness and disclosure quality can reduce information inequality to some extent, reducing the negative impact of excess goodwill on innovation performance. Excess goodwill inhibits the fulfillment of corporate social responsibility by, among other things, reducing information

transparency [4]. It wastes scarce resources, triggering enterprises' financing constraints and short-sighted management behavior.

In the context of green innovation, most existing research on the factors influencing green innovation focuses on the internal characteristics of firms, external resources, external governance mechanisms, and environmental regulations [5]. Due to its high degree of uncertainty, the process creates an imbalance of power in the transaction and is more costly to regulate; it is prone to severe external financing constraints, inhibiting firms' innovative activities. Moreover, the intrinsic roots of the drive for green innovation are not entirely under corporate control. External stakeholders beyond the organization also play a governance role in the film's green advancement.

In summary, existing studies on excess goodwill affecting corporate green innovation have yet to reach a unified conclusion. Given this, starting from the perspective that excess goodwill exacerbates financing constraints and dramatic information asymmetry under different life cycles of enterprises, this paper empirically demonstrates the impact of excess goodwill on corporate green innovation and its intrinsic mechanism by establishing the life cycle level of the enterprise, utilizing the data of China's A-share listed companies from 2016 to 2021.

The marginal contributions of this paper are: (1) Unlike the existing literature that suggests reducing corporate innovation, this paper is based on the perspective of the unverifiable potential value of enterprises, dynamically examines the impact of changes in multiple indicators of internal and external characteristics of enterprises on green innovation under different goodwill sizes. It offers a fresh theoretical foundation for the unresolved query regarding the impact of excess goodwill on eco-friendly innovation within corporations. (2) The influence of the corporate life cycle on green innovation is investigated in this paper. It encompasses the effects of funding limitations, capital outlays, retained earnings, and policy incentives in the analytical framework. The research in this paper broadens the exploration of how the life cycle of enterprises impacts green innovation mechanisms and approaches by incorporating the effects of the enterprise's financing constraints, capital expenditure, retained earnings, and policy incentives in each stage of the enterprise life cycle into the analytical framework. (3) Provides an empirical basis for enterprises to control excess goodwill appropriately according to their life cycle. It aims to help enterprises enhance green innovation performance and ensure stability in green transformation and technological progress.

2. Theoretical analysis and research hypotheses

This paper proposes that excess goodwill affects corporate green innovation in two main ways.

First is the uncertainty of financing.

Goodwill, as potential value, can enhance the future profitability of enterprises and bring excess earnings, but the excess of goodwill implies a high impairment risk that is difficult to determine; it results in the depletion of merger and acquisition costs, undermines the enthusiasm and trust of investors, exacerbates the expense associated with debt financing and intensifies the challenge of corporate funding limitations, impairs the future operating performance of enterprises, and increases the risk of triggering a "Goodwill Bubble". Direction-shifting innovations brought about by green innovation will require firms to invest more capital [6]. Financing constraints will be more likely to result in firms potentially falling into the predicament of being unable to green innovate or being afraid to implement green innovation, significantly dampening green innovation.

Second, the agency costs of internal and external activities of the enterprise

Excessive goodwill results in the expansion of the company's scale, organizational redundancy [7], and external and internal supervisory bodies' difficulty restraining management's behavior, exacerbating the information asymmetry between the company and investors and increasing management's business risk. External stakeholders will monitor and govern the greening of firms, and governments will also support them [8]. These may induce opportunistic management behavior, even if strengthening investment activities such as R&D and increasing corporate R&D inputs. However, it is difficult to maintain the correlation between R&D inputs and outputs, leading to less efficient

innovation outputs and thus distorting the optimal allocation of funds, leading to a decrease in the allocation of resources to sectors that generate both corporate value and corporate social responsibility and cause the crowding out of green innovations [9]. So, the paper proposes hypotheses:

H1: Excess goodwill inhibits corporate green innovation.

It has been found that the situation at each stage of the business life cycle has different characteristics, with growth-stage firms focusing on the number and speed of hiring, R&D investment, and efficiency to achieve incremental targets and sales revenue growth. However, at the level of endogenous financing, growth firms have yet to reach a steady state in the industry, have poor profitability or even failed to make a profit yet [10], and do not have a stable green innovation capability. However, the cumulative goodwill of expanding companies significantly surpasses that of mature and declining enterprises, which deviates from the economic substance of goodwill.

Meanwhile, the financing constraints of growth-phase firms are higher, so the green innovation ability of growth-phase firms could be more robust and more stable, and the impact of excess goodwill on them will be more significant. Enterprises in the maturity period shift from pioneering orientation to guarding orientation, with a slower innovation speed, focusing on maintaining profit margins and profit contribution, and with relatively stable business operations and higher goodwill, excess goodwill will impact the level of slow-growth innovation. Enterprises in the decline period, because of their difficulty in adapting to changes in the industry environment and cash flow gradually reduced, the operation is increasingly passive, and the gradual erosion of the enterprise's social image will diminish the extent of surplus goodwill. Excess goodwill will have a minor impact on enterprises in the decline period. It is hypothesized that the excess goodwill of enterprises during their growth phase surpasses that of the maturity and decline phases. Furthermore, the capacity for green innovation in companies during the decline phase is inferior to that observed during the growth period. The marginal impact of the inhibitory influence stemming from excess goodwill on green innovation is even more modest during the maturity phase. This circumstance gives rise to the hypothesis:

H2: Firm life cycle accentuates the adverse correlation between excess goodwill and green innovation efforts of firms., i.e., the more a firm tends to be in the growth phase of the life cycle stage, the stronger the inhibitory effect of excess goodwill on firms' green innovation.

3. Research design

3.1. Sample selection and data sources

This paper selects China's A-share listed companies from 2015 to 2021 as the initial sample. All the data are from CSMAR and CNRDS. The representatives of ST and *ST, the financial industry, and enterprises with missing economic indicators are excluded, and a 1% indent is performed before and after continuous variables.

3.2. Definition and interpretation of variables

3.2.1 Explained variable--green innovation level (GInv)

This paper uses the natural logarithm of the number of green invention patent applications added by one to measure enterprises' green innovation level, denoted as GInv. As the quantity of green invention patent applications increases, so does the caliber and technological depth of enterprises' green innovation, consequently bolstering the core competitiveness of these enterprises.

3.2.2 Explanatory variable - excess goodwill (GW_excess)

Drawing on the research [11], this paper uses the regression residuals of the goodwill expectation model to measure excess goodwill, i.e., Several indicators, including attributes of mergers and acquisitions, industry-level goodwill, company-specific characteristics, industry classification, and year-based variables, are employed to conduct a regression analysis on the firm's goodwill level. The variance between the realized goodwill size and the anticipated goodwill is a proxy for excess goodwill. (GW_excess).

3.2.3 Moderating variable - firm life cycle (Score)

According to the research [12], In this paper, revenue growth rate, retained earnings rate, capital expenditure rate, and firm age are ranked separately, where the sales revenue growth rate and capital expenditure rate are arranged in descending order from high to low. In contrast, the retained earnings rate and firm age are ordered in ascending order from low to high. The final assignment yields an overall score (Score) for each sample firm.

3.2.4 Control Variables

Following existing studies, this paper controls for firm-level characteristics such as firm size (Size), gearing ratio (Lev), net profit margin on total assets (ROA), management shareholding (Mshare), accounts receivable ratio (REC), inventory ratio (INV), and proportion of independent directors (Indep). The specific variables are defined in Table 1.

Table 1: Variable definitions

Characteristic	Name	Notation	Description
Explained variable	Level of green innovation	GInv	Ln (number of patent applications for green inventions + 1)
Explanatory variable	Excess goodwill	GW_excess	Residuals from goodwill regression
Regulating variable	Enterprise Life Cycle	Score	Textual analysis
Control variable	Enterprise size	Size	Ln (total annual assets of the enterprise)
	Asset-liability ratio	Lev	Total liabilities at year-end/total assets at year-end
	Net profit rate on total assets	ROA	Net profit/average balance of total assets
	Management shareholding ratio	Mshare	Management shareholding data/total share capital
	Accounts receivable ratio	REC	Net accounts receivable/total assets
	Inventory ratio	INV	Net inventory/total assets
	The proportion of independent directors	Indep	Number of independent directors/directors

3.3. Model Setting

First of all, to examine the influence of excess goodwill on the extent of green innovation in enterprises, this study establishes the subsequent baseline regression model:

$$\mathrm{GInv}_{i,t} = \alpha_0 + \alpha_1 \mathrm{GW_excess}_{i,t} + \sum_k \gamma_k Control_{k,i,t} + Year, Industry\ fixed\ effects + \varepsilon_{i,t} \quad (1)$$

In equation (1), $\mathrm{Green_Inv}_{i,t}$ denotes the level of green innovation of firm i in year t, and $\mathrm{GW_excess}_{i,t}$ denotes the size of excess goodwill of firm *i* in year *t*. If the model (1) is valid, then the regression coefficient α_1 is significantly negative. Secondly, to test the critical role of firm life cycle in excess goodwill affecting firms' green innovation level, this paper constructs the following moderating effect model by adding the total firm life cycle score $\mathrm{Score}_{i,t}$ and its interaction term with the size of excess goodwill $\mathrm{GW_excess}_{i,t} \times \mathrm{Scores}_{i,t}$to the base of equation (1):

$$\mathrm{GInv}_{i,t} = \beta_0 + \beta_1 \mathrm{GW_excess}_{i,t} \times \mathrm{Scores}_{i,t} + \beta_2 \mathrm{GW_excess}_{i,t} + +\beta_3 \mathrm{Score}_{i,t} + \sum_k \gamma_k Control_{k,i,t} + Year, Industry\ fixed\ effects + \varepsilon_{i,t} \quad (2)$$

Where $\alpha_1, \beta_1, \beta_2, \beta_3$ are the regression coefficients, $Control_{k,i,t}$ are the other control variables affecting the level of green innovation of the enterprise, $\varepsilon_{i,t}$ are the random errors,

$Year, Industry\ fixed\ effects$ are the temporal fixed effects and industry fixed effects to avoid the effect of omitted variables. If model (2) holds, the coefficient β_1 of the interaction term $\mathrm{GW_{ex}cess}_{i,t} \times \mathrm{Scores}_{i,t}$ is also significantly negative, indicating that the life cycle of firms exerts a dampening influence on the relationship between excess goodwill and firms' green innovation.

4. Empirical results and analysis

4.1. Benchmark regression analysis

Table 2 reports the results of the benchmark regression of excess goodwill on firms' level of green innovation. Column (1) in the table shows the regression results without adding control variables. Columns (2) and (3) present the regression results with year and industry fixed effects and control variables added individually. From the results in column (3) of the table, after controlling for a series of factors that may have an impact on the level of corporate green innovation, the regression coefficient of GW_excess is significantly negative at the 1% level, indicating that the level of corporate green innovation decreases as the size of excess goodwill continues to increase, verifying hypothesis H1.

Table 2: Excess goodwill and the size of firms' green innovations: benchmark regression results

	GInv		
	(1)	(2)	(3)
GW_excess	0.274*** (-2.948)	0.087 (0.969)	-0.533*** (-5.335)
Size			0.401*** (26.021)
Lev			-0.184*** (-3.269)
ROA			-0.162* (-1.736)
Mshare			0.067 (1.298)
REC			0.502*** (3.848)
INV			-0.193** (-2.321)
Indep			0.207 (1.465)
Constant	0.655*** (44.071)	0.126 (0.648)	-8.553*** (-23.508)
YEAR/IUS	NO	YES	YES
Observations	19,592	19,592	19,592
Number of stkcd	3,835	3,835	3,835
R-squared	0.0016	0.0736	0.0951

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

4.2. Impact mechanism test

The role of the firm life cycle in the influence of excess goodwill on firms' green innovation level is reported in Table 3, where column (1) presents the regression results without adding any control variables. Year and industry fixed effects are added in column (2), and column (3) presents the regression results with further control variables. The negative coefficients of $\mathrm{GW_{ex}cess}_{i,t} \times \mathrm{Scores}_{i,t}$ pass the 5% significance level in column (1) and the 5% significance level in column (3),

indicating that the closer firms are to the growth period, the more pronounced is the inhibitory effect of excess goodwill on the level of green innovation, which verifies hypothesis H2.

Table 3: Moderating affects test results

	GInv		
	(1)	(2)	(3)
$GW_{ex}cess_{i,t} \times Scores_{i,t}$	-1.663*** (-5.271)	-0.602* (-1.807)	-0.771** (-2.300)
GW_excess	3.867*** (5.626)	1.377* (1.896)	1.130 (1.552)
Score	-0.013 (-0.517)	0.054** (2.023)	0.011 (0.419)
Size			0.392*** (25.982)
Lev			-0.194*** (-3.532)
ROA			-0.204** (-2.120)
FIXED			-0.124 (-1.568)
REC			0.493*** (3.847)
Big4			0.132** (2.243)
Occupy			-0.527** (-2.074)
Constant	0.683*** (12.686)	0.013 (0.111)	-8.261*** (-23.404)
YEAR/IUS	NO	YES	YES
Observations	19,583	19,583	19,583
Number of stkcd	3,834	3,834	3,834
R-squared	0.0034	0.0743	0.0954

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

4.3. Heterogeneity analysis

4.3.1 Heterogeneity analysis based on the pollution level of enterprises

Green innovation is distinguished by substantial investment, elevated risk, and an extended development cycle, and the economic and social pressure on enterprises to carry out innovation by themselves is excellent. Non-heavily polluting enterprises are in a relatively favorable position regarding environmental compliance and have a higher degree of social acceptance. Policy incentives have no significant effect on innovation inputs of heavily polluting enterprises [13]. However, they can improve innovation outputs, which will reduce the cost of enterprise financing, alleviate financing constraints, and reduce the likelihood that enterprises will fall into stagnation or even regression of green innovation capability under the influence of excess goodwill. On the other hand, managers of heavy-polluting enterprises tend to reduce the natural surplus management to meet the needs of cash flow, and this upward surplus management reduces the impact of goodwill on enterprises and indirectly reduces the impact of excess goodwill on green innovation. Non-heavily polluting enterprise centers faceless green innovation pressure; they will use the improved performance more for executives' compensation, debt repayment, expanding the production scale, etc., and ignore the non-essential green innovation of the enterprise even more. Therefore, the effect of excess goodwill

on the green innovation of non-heavy polluting firms is more significant. The relevant regression results are shown in column (1)(2) of Table 4. The outcomes presented in the table indicate that the coefficient of surplus goodwill concerning green innovation in lightly polluted enterprises is notably and significantly negative at the 1% significance level. Conversely, the coefficient in heavily polluted enterprises is not statistically significant, aligning with the anticipated pattern. This means that the less polluted enterprises should be cautious to prevent and actively reduce excess goodwill to avoid the negative impact on green innovation.

4.3.2 Heterogeneity analysis based on the geographical distribution of enterprises

The eastern region of China shows spatial solid agglomeration. Hence, the economy, development quality, infrastructure, and institutional development in the eastern region are more comprehensive than in the central and western regions. The superiority of the coastal trade environment and natural conditions reduces the pressure on enterprises' green innovation. Enterprises in the eastern region confront more significant competitive pressure than those in the central and western regions, and the risk attributes of the innovation process are more likely to be magnified. Excessive goodwill brings in capital, which makes enterprises focus more on short-term performance rather than investing in riskier green innovation for long-term growth. In contrast, enterprises in the central and western regions function within smaller markets or are amid rapid growth. They are more likely to use their resources for green innovation to help them grow. The eastern part is densely populated with firms, and the exact size of excess goodwill will impose higher financing constraints on firms in the east region, which will have a more pronounced dampening effect on green innovation than in the central and western regions. Research shows that cities in the western region have weaker green innovation awareness [14] and are less willing to innovate in the face of short-term gains and long-term risks associated with excess goodwill. The tax burden in the western region is lower and supported by the policy. Hence, the collection of environmental protection tax is lower than the enterprises in the central and eastern regions and does not significantly enhance the green innovation awareness of enterprises. It is hypothesized that the green innovation ability of enterprises in the western region will have a more significant inhibitory effect in the face of excess goodwill than in the central area. The results are shown in columns (3) (4) (5) of Table 4. The results in the table show that the coefficient of excess goodwill on green innovation of enterprises in the eastern region is significantly negative at the 1% level. The coefficient for enterprises in the western part is statistically significant, displaying a negative correlation at the 5% significance level. At the same time, it lacks significance within the central area by the anticipated outcome.

4.3.3 Heterogeneity analysis based on the degree of high-tech enterprises.

Enterprises that accelerate green innovation need to bear higher risks; research shows that high-tech enterprises, through mergers and acquisitions, achieve joint to ensure that in the competition ahead of the same industry [15], but also result in the predicament of dual high, involving the initial recognition of goodwill and subsequent impairment, resulting in a greater possibility of excess charity. High-tech enterprises have a more significant advantage in technological innovation. However, the rapid iteration of technical updates, subject to the substantial impact of policy characteristics, is forming a "goodwill bubble" of the most brutal hit. The risk brought by the "goodwill bubble" threatens the interests of investors, increases financing constraints, and makes the company increase audit costs to avoid audit risks. Financing constraints and increased audit costs reduce the green innovation ability of high-tech enterprises. Subjective factors influence the measurement of goodwill in non-high-tech companies, and most of them come from factors such as brand and market share, which are less related to green innovation, so the impact of excess goodwill on green innovation of high-tech companies will be more significant. The results are shown in columns (6)(7) of Table 4. From the results in the table, it can be seen that the coefficient of excess goodwill on firms' green innovation is significantly negative at a 1% level in high-tech firms. In contrast, the non-high-tech firms' coefficient is significantly negative at 10%.

Table 4: Heterogeneity test results

	Corporate pollution heterogeneity		Geographical distribution heterogeneity			High-tech degree of heterogeneity	
	GInv		GInv			GInv	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Non-heavily polluting enterprises	Heavily polluting enterprises	Western region	Central region	Eastern part	Non-high tech	High tech
GW_excess	-0.658*** (-5.720)	-0.165 (-1.109)	-0.661* (-1.942)	-0.203 (-0.786)	-0.582*** (-5.093)	-0.249* (-1.715)	-0.651*** (-5.266)
Size	0.406*** (22.439)	0.372*** (16.615)	0.402*** (9.694)	0.369*** (10.321)	0.407*** (23.224)	0.302*** (15.901)	0.483*** (23.672)
Lev	-0.148** (-2.249)	-0.288*** (-3.200)	-0.122 (-0.936)	-0.107 (-0.785)	-0.180*** (-2.662)	-0.244*** (-3.189)	-0.168** (-2.259)
ROA	-0.162 (-1.610)	-0.022 (-0.139)	-0.075 (-0.284)	-0.264 (-1.089)	-0.162 (-1.544)	-0.047 (-0.278)	-0.223** (-1.962)
Mshare	0.004 (0.069)	0.182** (2.104)	0.144 (0.823)	0.241 (1.425)	0.043 (0.758)	0.022 (0.250)	0.124** (1.989)
REC	0.329*** (2.595)	0.494* (1.838)	0.738 (1.506)	0.621* (1.887)	0.430*** (3.190)	0.171 (0.875)	0.604*** (4.269)
INV	-0.332*** (-3.678)	0.399** (2.106)	0.070 (0.329)	0.216 (0.920)	-0.345*** (-3.582)	-0.296*** (-3.164)	0.061 (0.404)
Indep	0.113 (0.701)	0.331 (1.371)	0.648* (1.945)	-0.157 (-0.399)	0.253 (1.531)	0.412** (2.041)	0.149 (0.788)
Constant	-8.614*** (-20.540)	-7.510*** (-14.203)	-9.055*** (-9.844)	-7.477*** (-8.665)	-8.684*** (-20.422)	-6.403*** (-14.748)	-10.577*** (-23.104)
YEAR/IUS	YES	YES	YES	YES	YES	YES	YES
Observations	14,610	5,669	2,508	2,967	14,117	7,671	11,921
Number of stkcd	2,947	1,146	471	587	2,809	1,515	2,466
R-squared	0.0925	0.0919	0.146	0.1032	0.0869	0.0843	0.0959

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

5. Robustness Tests

To further validate the strength of the conclusions above, this study also performs the subsequent robustness tests:

First, replace the explanatory variables, the existing literature in addition to employing the count of green invention patent applications as a gauge for assessing the extent of enterprise green innovation, but also widely utilized to portray the number of authorized green invention patents, indicating the enterprise's tangible green innovation technology and the magnitude of its significance in the realm of green innovation technology, the higher the count of authorized green invention patents, the higher the level of enterprise green innovation, this paper at the same time using this indicator as a proxy for the explanatory variables, the regression results are shown in Table 5, column (1). The outcomes of the regression analysis are shown in column (1) of Table 5. Secondly, replacing the explanatory variables, the excess goodwill is adjusted by the industry median and the industry mean as the alternative indicator of the explanatory variables, and the regression results are shown in columns (2) and (3) of Table 5. Third, the combination of control variables is replaced, and the results are shown in column (4) of Table 5. Fourth, considering the continuity and persistence of the impact of excess goodwill on corporate green innovation, the explanatory variables are lagged by one period, and the outcomes of the regression analysis are shown in column (5) of Table 5. From the results in Table 5, it can be seen that the regression coefficients of excess goodwill are significant at the 1% level in the robustness tests using the above methods, and the basic conclusions of the model have not been substantially changed, which further illustrates the robustness of the findings of this study.

Table 5: Robustness test results

	(1)	(2)	(3)	(4)	(5)
	GInv_Grant	GInv	GInv	GInv	GInv
GW_excess	-3.647***			-0.586***	-0.575***
	(-3.922)			(-5.851)	(-5.264)
GW_excess1		-0.533***			
		(-5.538)			
GW_excess2			-0.551***		
			(-5.642)		
Control variable	YES	YES	YES	YES	YES
YEAR/IUS	YES	YES	YES	YES	YES
Observations	20,279	20,279	20,279	20,279	16,308
Number of stkcd	3,971	3,971	3,971	3,971	3,500
R-squared	0.006	0.091	0.0911	0.0901	0.0786

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

6. Conclusion and Implications

Taking the data of Chinese A-share listed enterprises from 2016 to 2021 as the research sample, this paper empirically explores the impact of corporate excess goodwill on the extent of green innovation and its operational mechanisms in conjunction with the enterprises' life cycle. The main conclusions are:(1) Excess goodwill significantly inhibits corporate green innovation. (2) The results of the mechanism test based on the moderating effect model show that the relationship between the corporate life cycle on excess goodwill and corporate green innovation, i.e., the more a company tends to be in the growth phase of the life cycle stage, the stronger the constraints of excess goodwill on corporate green innovation. (3) Heterogeneity analysis shows that excess goodwill exerts a notable impact on constraining the green innovation capabilities of lightly polluted enterprises, the eastern region, and high-tech enterprises, and the influence on impeding the green innovation capabilities of heavily polluted enterprises, the central and western geographical areas, and non-high-tech enterprises is not significant.

The following policy insights can be obtained from the findings of this paper:

First, for growth-stage enterprises, green innovation can help them rapidly develop technology and markets. However, it is limited by the significant negative impact of excess goodwill, which inhibits the incentive effect of green innovation on enterprises. Consequently, the government must devise policies and incentives related to strengthening green innovation and develop more targeted policies for growth-stage firms to support them in overcoming the constraints of excess goodwill based on the life cycle of the firms. Secondly, for enterprises to better adapt to green innovation, they should develop governance mechanisms and investment decisions that align with their enterprises' development trends, considering the differences in their types of enterprises, regions, and life cycle stages.

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