



Research on Green Innovation and Corporate Performance: an Empirical Study Based on Listed Companies in China

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Abstract. This study explores the relationship between green innovation and firm performance among Chinese listed companies, focusing on the moderating effects of organizational redundancy, dynamic capabilities, government subsidies, and environmental regulations^{[17][18][19]}. Using data from A-share listed manufacturing companies from 2011-2020, the research employs empirical methods to analyze the impact of green innovation on corporate performance.^{[20][21]} The findings reveal that green innovation significantly enhances firm performance, with organizational redundancy, dynamic capabilities, and environmental regulations positively moderating this relationship. Conversely, government subsidies exhibit a negative moderating effect. The study provides valuable insights for firms and policymakers aiming to promote green transformation and sustainable development.

Keywords: Green Innovation, Firm Performance, Organizational Redundancy, Dynamic Capabilities, Government Subsidies, Environmental Regulation

1 Introduction

Green innovation has emerged as a pivotal strategy for firms to reconcile environmental sustainability with economic competitiveness^[1]. While existing literature extensively examines the direct relationship between green innovation and firm performance, critical gaps persist^[14]. First, prior studies predominantly focus on unilateral effects of green innovation, overlooking the nuanced moderating roles of organizational and institutional factors^[24]. Second, the interplay between government subsidies and innovation efficiency remains underexplored, with conflicting evidence on whether subsidies incentivize or stifle long-term performance^{[6][7][8]}. Third, contextual dynamics in emerging economies like China—marked by stringent environmental regulations and rapid market shifts—are rarely integrated into theoretical frameworks^{[22][23]}.

This study advances the literature by addressing these gaps. We introduce a holistic model that evaluates how organizational redundancy, dynamic capabilities, government subsidies, and environmental regulations jointly moderate the green innova-

tion-performance nexus. By analyzing data from Chinese A-share manufacturing firms (2011–2020), we provide empirical evidence on how institutional and organizational contexts shape innovation outcomes. Our findings contribute to resource-based and dynamic capability theories, offering actionable insights for firms navigating the dual pressures of sustainability and competitiveness in regulated markets

2 Research Hypotheses

2.1 Impact of Green Innovation on Firm Performance

Green innovation, such as adopting energy-saving technologies and optimizing production processes, can reduce costs^[25], enhance efficiency, and improve market competitiveness^[2]. Studies have shown that green innovation positively impacts firm performance by reducing energy consumption, increasing productivity, and enhancing brand reputation^{[15][16]}. Therefore, we propose:

H1: Green innovation has a significant positive effect on firm performance

2.2 The Moderating Role of Organizational Redundancy

Organizational redundancy provides firms with flexibility and resources to adapt to market changes and implement green innovation strategies effectively^[3]. It enhances resource allocation and knowledge sharing, which are crucial for green innovation success^[9]. Thus, we hypothesize:

H2: Organizational redundancy positively moderates the relationship between green innovation and firm performance.

2.3 Moderating Effects of Dynamic Capabilities

Dynamic capabilities enable firms to adapt to environmental changes, integrate external resources^[26], and enhance innovation efficiency^[10]. These capabilities are essential for firms to respond to regulatory and market shifts^[29], thereby improving the effectiveness of green innovation^[4]. We propose:

H3: Dynamic capabilities positively moderate the relationship between green innovation and firm performance.

2.4 Regulatory Effects of Environmental Regulation

Environmental regulations compel firms to invest in green technologies and improve environmental management systems, which can enhance firm performance by reducing pollution^[28] and increasing resource efficiency^{[11][12]}. Therefore, we hypothesize:

H4: Environmental regulation positively moderates the relationship between green innovation and firm performance.

2.5 Moderating Effects of Government Subsidies

While government subsidies can incentivize green innovation^[27], over-reliance on subsidies may lead to resource misallocation and reduced innovation efficiency^[13]. Studies suggest that excessive subsidies can negatively impact firm performance^[5]. Thus, we propose:

H5: Government subsidies negatively regulate the relationship between green innovation and firm performance.

3 Research Design

3.1 Objects of Study and Sources of Data

The study uses data from A-share listed manufacturing companies in China from 2011-2020, sourced from the CSMAR and Wind databases. After excluding financially distressed firms and those with missing data, the final sample consists of 1,098 firms.

3.2 Measurement of Variables

The measurement methods of each variable are shown in Table 1.

Table 1. Measurement of variables

Variable type	variable name	variable measurement	variable symbol
independent variable	Level of green innovation in enterprises	Natural logarithm of the number of green patent applications	GINV
implicit variable	Corporate Performance	Net profit on sales*Asset turnover*Equity multiplier*Retained earnings ratio	FP
	Organizational redundancy	Comprehensive evaluation indicators	OS
moderator variable	dynamic capability	Comprehensive evaluation indicators	Act
	government subsidy	Comprehensive evaluation indicators	Gov
	environmental regulation	Measurement of the number of keywords in government reports	EP

3.3 Modeling

First, in order to test hypothesis 1, this paper constructs the following model to test the impact of green innovation level on the corporate performance of manufacturing enterprises in the following form:

$$FP_{i,t} = \beta_0 + \beta_1 GINV_{i,t} + \beta_2 X_{i,t} + \sum year + \sum Firm + \epsilon$$

In order to test hypotheses 2-5, this paper constructs as the following model to test the moderating effects of organizational redundancy, dynamic capabilities, government subsidies, and environmental regulations on the level of green innovation affecting the corporate performance of manufacturing firms in the following form:

$$FP_{i,t} = \beta_0 + \beta_1 GINV_{i,t} + \beta_2 Interact_{i,t} + \beta_3 X_{i,t} + \sum year + \sum Firm + \epsilon$$

4 Empirical Results and Analysis

4.1 Main Effects

As shown in Table 2, The results show that green innovation has a significant positive effect on firm performance ($\beta = 66.453$, $p < 0.01$). After controlling for firm characteristics, the effect remains significant ($\beta = 61.947$, $p < 0.01$), supporting H1.

Table 2. OLS results for main effects

	(1) FP	(2) FP
GINV	66.453*** (3.015)	61.947*** (2.866)
Growth		-3.510 (-1.090)
Lev		458.551*** (5.612)
ExecuShare		12.633*** (3.984)
Independent		0.889 (0.263)
_cons	3316.612*** (156.309)	2980.620*** (21.651)
N	10980	10980
R2	0.713	0.722
F	9.090	11.302

Note: Values reported in parentheses are robust standard errors; *, ** and *** represent significant at the 10%, 5% and 1% levels, respectively. (The same below)

4.2 Moderating Effects

- Organizational Redundancy: The interaction term between green innovation and organizational redundancy is positive and significant ($\beta = 62.320$, $p < 0.01$), supporting H2.

- Dynamic Capabilities: The interaction term is positive and significant ($\beta = 203.524$, $p < 0.10$), supporting H3.

- Environmental Regulation: The interaction term is positive and significant ($\beta = 73.740$, $p < 0.01$), supporting H4.

- Government Subsidies: The interaction term is negative and significant ($\beta = -27.461$, $p < 0.01$), supporting H5 (As shown in Table 3).

Table 3. OLS results for moderating effects

	(1) Organizational redundancy	(2) dynamic capa- bility	(3) environmental regulation	(4) government subsidy
GINV	144.031*** (6.897)	89.792*** (7.079)	142.114*** (8.492)	237.640*** (16.002)
Growth	-12.839* (-1.825)	-3.237 (-0.773)	-13.485* (-1.918)	-5.207 (-0.653)
Lev	-105.067** (-2.512)	453.115*** (15.728)	-124.906*** (-3.025)	-1078.564*** (-14.553)
ExecuShare	7.188*** (6.952)	10.680*** (7.697)	7.266*** (7.058)	2.900*** (2.756)
Independent	-12.556*** (-4.584)	1.937 (0.768)	-12.138*** (-4.431)	-11.197*** (-4.078)
Interact	62.320*** (2.968)	203.524* (1.772)	73.740*** (4.725)	-27.461*** (-3.865)
_cons	3654.828*** (34.611)	2928.153*** (30.160)	3648.874*** (34.581)	4077.346*** (37.578)
N	10980	10980	10980	10524
R2	0.029	0.721	0.030	0.044
F	51.834	59.552	54.149	78.494

Note: Values reported in parentheses are robust standard errors; *, ** and *** represent significant at the 10%, 5% and 1% levels, respectively.

5 Robustness Test

5.1 Replacing the Independent Variable

Replacing GINV with the total number of green patents (GINV2) yields a coefficient of 231.318 ($p < 0.01$), confirming the robustness of the results.

5.2 Variable-Centered Processing

As shown in Table 4, After centering the variables, the coefficient of GINV remains significant at 61.947 ($p < 0.01$), further validating the robustness of the findings.

Table 4. OLS Results for Replacement of Independent Variables and Variable Centering Treatments

	(1) FP	(2) FP	(3) FP
GINV2 (c_GINV)	61.947*** (2.866)	231.318*** (10.254)	61.947*** (4.476)
Growth	-3.510 (-1.090)	-13.045* (-1.844)	-3.510 (-0.840)
Lev	458.551*** (5.612)	-94.242** (-2.273)	458.551*** (16.050)
ExecuShare	12.633*** (3.984)	7.279*** (7.034)	12.633*** (8.787)
Independent	0.889 (0.263)	-12.609*** (-4.577)	0.889 (0.351)
_cons	2980.620*** (21.651)	3777.659*** (35.741)	3040.254*** (31.534)
N	10980	10980	10980
R2	0.722	0.018	0.722
F	11.302	36.033	69.173

Note: Values reported in parentheses are robust standard errors; *, ** and *** represent significant at the 10%, 5% and 1% levels, respectively.

(ii) Lagged independent variables

The study also tested the lagged effect of green innovation on firm performance by introducing a one-year lagged independent variable (L.GINV). As shown in Table 5, The results showed that the lagged effect of green innovation remained positive, though the coefficient decreased to 24.942 ($p < 0.10$). This suggests that while the immediate impact of green innovation may weaken over time, it still contributes to long-term firm performance.

Table 5. OLS Results for Replacement of Independent Variables and Variable Centering Treatments

	(1) FP	(2) FP	(3) FP
GINV2 (c_GINV)	61.947*** (2.866)	231.318*** (10.254)	61.947*** (4.476)
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ExecuShare	12.633*** (3.984)	7.279*** (7.034)	12.633*** (8.787)
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Note: Values reported in parentheses are robust standard errors; *, ** and *** represent significant at the 10%, 5% and 1% levels, respectively.

6 Conclusions

This study confirms that green innovation significantly enhances firm performance, amplified by organizational flexibility, dynamic capabilities, and stringent regulations. However, excessive government subsidies undermine efficiency, necessitating policy reforms. To optimize outcomes, we recommend:

- Tiered Subsidy Systems: Reward firms achieving predefined innovation milestones.

- Capability-Building Programs: Public-private partnerships to enhance R&D agility.

- Regulatory-innovation Synergy: Integrate compliance deadlines with innovation roadmaps.

- By addressing these dimensions, firms and policymakers can foster sustainable growth without -sacrificing competitiveness.

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