

An Empirical Study on the Impact of Dual Credit Policy on Enterprise Innovation Performance

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Abstract: With the increasing global awareness of environmental protection and the accelerated transformation of energy structures, the new energy vehicle (NEV) industry has become a crucial strategic choice for governments worldwide to promote green economic development and achieve carbon reduction goals. In China, the "dual-credit" policy and other measures have been implemented to actively drive technological advancements and market expansion in the NEV industry. This study employs the difference-in-differences (DID) method to systematically examine the mechanism by which the "dual-credit" policy impacts firms' innovation performance through empirical analysis. Furthermore, it incorporates R&D investment as a mediating variable to explore the indirect effect of policy incentives on firms' innovation performance. The findings reveal that the "dual-credit" policy significantly promotes corporate innovation and effectively enhances innovation performance by increasing firms' R&D investment levels, thereby amplifying the policy's effectiveness. This research provides empirical support for the optimization of NEV industry policies and offers theoretical and practical references for advancing industrial technological upgrades and achieving green economic development goals.

Keywords: "Dual Credit" Policy; NEV; Innovation Performance; Difference-in-Differences; R&D Investment.

1. Introduction

The automotive industry, as a vital pillar of steady growth in the industrial economy, has long received significant attention from the state. The development of new energy vehicles (NEVs) is not only a key pathway for China to transition from being a major automobile producer to a global automotive powerhouse but also an essential measure to combat climate change and promote green development. Since the release of the "Energy-Saving and New Energy Vehicle Industry Development Plan (2012–2020)" in 2012, China's NEV industry has achieved remarkable progress but continues to face challenges such as a lack of core technologies, lagging infrastructure, and intensified market competition. Since 2015, China's NEV market has risen rapidly, surpassing the United States to become the largest NEV market globally. By 2023, China's NEV production and sales reached an impressive 9.587 million and 9.495 million units, respectively, with year-on-year growth rates of 35.8% and 37.9%. These figures represent over 60% of the global market share, maintaining China's leadership in the global NEV market for the ninth consecutive year. This remarkable growth not only reflects the steady increase in NEV penetration rates but also highlights consumers' growing preference for environmentally friendly and efficient modes of transportation. By the end of 2023, the number of NEVs in China had reached 20.41 million, accounting for 6.1% of the total vehicle ownership, underscoring the widespread acceptance and adoption of NEVs in the Chinese market.

Under the dual pressures of global climate change and energy shortages, the new energy vehicle (NEV) industry is regarded as a key sector for achieving sustainable development and transforming energy structures. Governments worldwide have introduced a series of policies aimed at promoting NEV production, expanding markets, and advancing technological innovation through policy incentives.

As the world's largest automobile market, China has intensified its policy support for the NEV industry in recent years. Specifically, through tools such as government subsidy policies and the "dual-credit" policy, China has actively facilitated NEV adoption and industrial upgrading. Government subsidies provide direct financial support, reducing R&D costs and market entry barriers, thereby encouraging firms to increase their R&D investments in the NEV sector. The "dual-credit" policy, as a market-oriented regulatory tool, employs a system of rewards and penalties to guide manufacturers toward prioritizing the production of NEVs that meet policy requirements while curbing excessive production of traditional fuel vehicles. Through this combination of policies, the government seeks to establish a balance between market forces and policy interventions, fostering the healthy development of the NEV industry. Although these policies have, to some extent, promoted NEV production and technological advancements, their specific effects on firms' innovation performance require further investigation. Therefore, this study employs a difference-in-differences (DID) model to conduct an empirical analysis. Using a research sample of 21 A-share publicly listed NEV manufacturers from 2011 to 2023, this paper systematically explores the impact of the "dual-credit" policy on firms' innovation performance. The findings aim to provide theoretical insights for optimizing government policies and contribute research results to support the sustainable development of the NEV industry.

2. Literature Review

2.1. A Study on the Factors Influencing Enterprise Innovation

Innovation is the primary driving force behind development and the cornerstone of a company's survival and growth. As a national-level development strategy, the critical

importance of innovation to enterprises is self-evident. Scholars both domestically and internationally have extensively studied the factors influencing corporate innovation, which can be broadly categorized into two aspects: external environmental factors and internal corporate factors. In terms of external environmental factors, the characteristics of innovation activities—such as high costs, long cycles, positive externalities, and significant uncertainty—make them particularly sensitive to changes in the external environment. The government's "dual-credit" policy, as a typical external factor, serves as an important tool for supporting corporate innovation.

(1) The Impact of External Factors on Corporate Innovation Performance

Government subsidies, as a policy tool that directly supports corporate R&D funding, fall under the category of direct R&D subsidies. Scholars have extensively studied whether such subsidies can enhance firms' innovation performance. L. C et al. (2022) ^[1], through empirical analysis of 246 listed new energy companies in China, found that government subsidies positively promote green innovation performance in enterprises. Similarly, the study by H. C et al. (2022) ^[2] demonstrated that government subsidies significantly increase innovation investment in patent-intensive firms and improve their innovation performance.

In the study of policies for the new energy vehicle (NEV) industry, the role of subsidy-based policies has been extensively analyzed in the literature. However, these policies face challenges in incentivizing innovation, making the introduction of non-subsidy policy tools increasingly urgent. A dual-track approach that combines subsidy and non-subsidy policies has emerged as a prevailing trend ^[3]. In China, non-subsidy policies for the NEV industry primarily involve market access regulations, the "dual-credit" policy, and government procurement, with each policy serving distinct functions ^[4].

W. L (2023) ^[5], using the grey relational analysis method and breakpoint regression theory, concluded that the "dual-credit" policy, implemented since 2018, has significantly promoted the innovation performance of NEV firms. Gary J (2024) ^[6] employed the difference-in-differences (DID) method and dynamic panel data from 2013 to 2022 to examine the impact of the "dual-credit" policy on the innovation capabilities of NEV enterprises. Additionally, some studies have explored the combined use of the "dual-credit" policy with other policies. J. Z et al. (2019) ^[7], by constructing a three-stage game model, found that when the R&D spillover rate exceeds a critical threshold, an increase in the price of positive credits may lead firms to reduce R&D investment. The study suggests combining R&D subsidies with the "dual-credit" policy to better promote technological innovation in firms.

(2) The Impact of Internal Factors on Corporate Innovation Performance

In addition to external factors, a firm's internal attributes also play a crucial role in shaping its innovation activities, including variables such as firm age, business model, ownership structure, size, and executive compensation incentives. These factors significantly impact corporate R&D and innovation efforts. Z. B (2016) ^[8], utilizing data from Chinese manufacturing firms between 1999 and 2007, examined the effects of firm age on innovation. The study found that new firms demonstrate consistent innovation incentives during their first nine years in the market, serving

as a key driver of market innovation. However, this effect exhibits an inverted U-shaped pattern rather than continuous growth. Z. Z et al. (2021) ^[9] showed that dual-class ownership structures significantly promote innovation investment in Chinese concept stock companies, with an even greater impact observed in high-tech industries. H. D (2017) ^[10], through empirical analysis, identified firm size and short-term executive incentives as factors positively influencing sustained innovation in listed companies. Similarly, C. W et al. (2022) ^[11] discovered that executive compensation incentives—including monetary rewards, equity, and in-kind benefits—promote corporate innovation, with stronger effects seen in non-state-owned enterprises. Furthermore, such incentives positively influence R&D input in high-tech firms and R&D output in non-high-tech firms. Executives with R&D experience enhance innovation quality by mitigating managerial short-sightedness and alleviating financial constraints ^[12]. C. X et al. (2021) ^[13] found that equity pledges affect substantive innovation through their influence on managerial risk preferences. S. Z et al. (2019) ^[14] explored the relationship between executives' academic backgrounds and corporate substantive innovation, finding that such academic experiences positively contribute to substantive innovation outcomes.

2.2. The Role of Government Subsidies and Policy Tools in Promoting R&D Investment and Innovation Performance

Government subsidies not only stimulate corporate R&D investment but also enhance technological innovation outcomes ^[15]. Similarly, restrictive industry policies effectively incentivize firms to increase R&D efforts, thereby advancing technological innovation ^[16]. X. W. (2022) ^[17], using panel data, analyzed the relationships among government subsidies, R&D investment, and innovation performance in manufacturing firms. The findings revealed that both government subsidies and R&D investment positively influence corporate innovation performance. Some scholars have explored the mediating effect of R&D investment. B. M et al. (2020) ^[18] constructed a mediation model involving government subsidies, R&D investment, and innovation performance, demonstrating that increasing R&D intensity significantly improves firms' innovation performance. J. L et al. (2020) ^[19], through an empirical study of 59 high-tech enterprises in western China, found that government subsidies promote technological innovation in manufacturing firms via the mediating role of R&D investment. Ji Z (2024) ^[20], employing the difference-in-differences (DID) method and microdata from A-share listed companies between 2010 and 2021, empirically investigated the impact and mechanisms of the "dual-credit" policy on the performance of Chinese NEV firms. The study revealed that the "dual-credit" policy significantly affects the operational and innovation performance of NEV firms. Further mediation analysis indicated that the policy enhances firm performance through increased R&D investment. Notably, the policy's effects are heterogeneous, contributing more significantly to firms in developed regions and non-state-owned enterprises. Y. S (2024) ^[21], analyzing data from 290 NEV companies listed on the Shanghai and Shenzhen A-share markets between 2017 and 2021, constructed a multiple linear regression model. The results showed that government subsidies indirectly improve innovation performance by stimulating R&D investment. Additionally, some researchers

have identified a nonlinear relationship between R&D investment and innovation performance. J. Z et al. (2019) [22], using a resource-based framework and Poisson regression analysis of 355 firms listed on the Growth Enterprise Market, found an inverted U-shaped relationship between R&D investment and innovation performance. The study also revealed that asset liquidity positively moderates this relationship, while technological accumulation exerts a negative moderating effect.

In summary, while extensive research has been conducted domestically and internationally on NEV policies and market development, technological innovation remains an essential component for NEVs, as they serve as the core direction for automotive industry transformation. To remain competitive in the market, enterprises must sustain their innovation capabilities. Consequently, it is imperative to analyze the effects of policies on corporate innovation performance. However, studies that explore the relationship between the "dual-credit" policy and technological innovation, with R&D investment as a mediating variable, are still insufficient. This highlights the need for further in-depth analysis in this area.

3. Formulation of Research Hypotheses

Schumpeter's growth theory posits that firms, by consistently generating profits, can increase R&D investment and knowledge accumulation, thereby driving technological innovation [23]. His innovation theory further suggests that innovation activities primarily occur in a perfectly competitive market environment [24]. However, in reality, market competition is not entirely free, particularly in the NEV industry, where government policies play a pivotal role.

Studies have shown that restrictive industry policies can effectively incentivize firms to increase R&D investment, thus promoting technological innovation [25]. The "dual-credit" policy, as a representative restrictive policy, fosters the development and market expansion of NEVs through limitations on traditional fuel vehicle production and credit assessments. Its effectiveness is more pronounced in a perfectly competitive market environment [26]. Li Xu et al. (2021) [27] found that the "dual-credit" policy positively impacts the operational performance and environmental outcomes of NEV firms, particularly during the early stages of policy implementation, where the incentive effects are stronger. Z. W et al. (2020) [28] also noted that although the initial activity in the credit trading market was low, firms gradually increased their investments in technological innovation as the policy matured. This suggests that the "dual-credit" policy, through its market-oriented quota mechanism, helps stimulate firms' technological innovation efforts.

Based on the above, the following research hypothesis is proposed:

H₁: The "dual-credit" policy promotes corporate innovation.

Corporate R&D investment is widely regarded as the core driving force of technological innovation. The accumulation of innovative resources depends on a firm's long-term investment in R&D. L. Y et al. (2018) [29] highlighted that increased R&D investment significantly enhances the innovation performance of NEV firms. F. Z (2023) [30] further validated the mediating role of R&D investment in the relationship between government policies and corporate innovation, demonstrating that R&D investment serves as a crucial bridge linking policy incentives to innovation outcomes. J. L et al. (2023) [31], employing a difference-in-differences (DID) model, analyzed the mediating role of R&D

investment under the "dual-credit" policy. Their results indicated that the policy encourages NEV firms to increase R&D funding and achieve technological breakthroughs by optimizing their talent structure. The "dual-credit" policy imposes higher technical requirements on firms, compelling them to intensify R&D investment to address challenges associated with new energy technologies.

Based on the above, the following research hypothesis is proposed:

H₂: R&D investment mediates the impact of the "dual-credit" policy on corporate innovation performance.

The specific approach is shown in Figure 1.

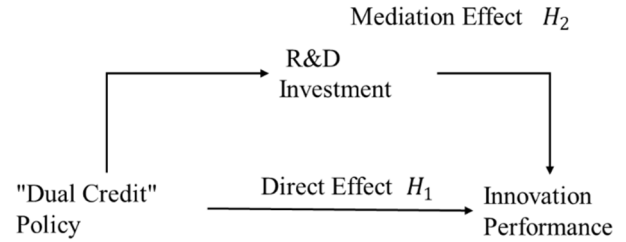


Figure 1. Theoretical Model of the Impact of the "Dual Credit" Policy on Enterprise Innovation Performance

4. Research Design

4.1. Model Design

Since the "dual-credit" policy targets only passenger vehicle enterprises, with commercial vehicle enterprises unaffected, this paper regards the implementation of the "Parallel Management Measures for Corporate Average Fuel Consumption and New Energy Vehicle Credits" (the "dual-credit" policy) as a quasi-natural experiment conducted by the Chinese government. A difference-in-differences (DID) model is constructed accordingly, as shown below:

$$Inpat1_{it} = \beta_0 + \beta_1 treat_post_{it} + \beta_2 control_{it} + v_i + u_t + \varepsilon_{it}; (1)$$

$$rd_{it} = \beta_0 + \beta_1 treat_post_{it} + \beta_2 control_{it} + v_i + u_t + \varepsilon_{it}; (2)$$

$$Inpat2_{it} = \beta_0 + \beta_1 treat_post_{it} + \beta_2 control_{it} + v_i + u_t + \varepsilon_{it}; (3)$$

The construction of the above models aims to systematically examine the mechanism by which the "Dual Credit" policy influences enterprise technological innovation. Equation (1) tests the direct effect of the policy using innovation indicators. Equation (2) is used for mediation effect analysis, exploring the mediating role of R&D investment in the impact of the "Dual Credit" policy on innovation performance. Equation (3) verifies the robustness of the policy using different innovation indicators. Here, $Inpat1_{it}$ and $Inpat2_{it}$ represent the innovation performance of enterprise i at time t , measured by the number of invention patent applications. rd_{it} denotes R&D investment, $treat_post_{it}$ captures the policy effect of the "Dual Credit" policy implementation, β_1 represents the treatment effect in the DID framework, $control_{it}$ refers to control variables, v_i indicates individual fixed effects, u_t denotes time effects, and ε_{it} represents the random error term.

4.2. Data Sources and Variable Selection

4.2.1. Data Sources

Based on the target entities of the "dual-credit" policy, specifically the passenger vehicle category defined in the "Terms and Definitions of Automobiles and Trailers", and referencing relevant literature^[31], the sample was divided into a "passenger vehicle" group and a "commercial vehicle" group. The experimental group consists of 12 passenger vehicle enterprises, which are directly affected by the "dual-

credit" policy, while the control group comprises 9 commercial vehicle enterprises, which are indirectly influenced by the policy. Details of the sample are provided in Table 1. The data for this study were obtained from the Incopat patent database and the Wind Economic Database, covering the period from 2011 to 2023. To eliminate errors caused by numerical discrepancies and inconsistent dimensions, and to avoid the influence of outliers on the research results, all continuous variables were winsorized at the 1% level.

Table 1. Composition of Research Sample for New Energy Vehicle Enterprises

Experimental Group: "Passenger Cars" (Stock Code)	Control Group: "Commercial Vehicles" (Stock Code)
Haima Automobile (000572); Changan Automobile (000625); FAW Car (000800); BYD (002594); Dongfeng Motor (600006); SAIC Motor (600104); JAC Motors (600418); GAC Group (601238); Great Wall Motor (601633); Lifan Industry (601777); BAIC BluePark (600733); Seres (601127)	Ankai Bus (000868); Zhongtong Bus (000957); Yutong Bus (600066); Asiatstar Bus (600213); King Long Motor (600686); Sinotruk (000951); CIMC Vehicles (301039); Hualing Xingma (600375); Jiangling Motors (000550)

4.2.2. Variable Selection

(1) Dependent Variable

In existing research, the measurement of corporate innovation performance often focuses on indicators such as the number of patent applications and innovation efficiency^[17,32]. Compared to metrics such as the number of new products, sales revenue from new products, and innovation efficiency, the number of patent applications more directly reflects a firm's innovation output performance^[32]. Therefore, this study adopts the number of invention patent applications as the indicator for measuring innovation performance.

(2) Independent Variable

The implementation of the "dual-credit" policy serves as the independent variable, represented by the interaction term in the DID model. The policy treatment variable indicates whether a firm is directly affected by the "dual-credit" policy, where a value of 1 denotes direct influence (passenger vehicle

group) and 0 denotes no direct influence (commercial vehicle group). For the policy time dummy variable, given that the "dual-credit" policy came into effect in 2017, this year is set as the dividing point for the policy's effect. Values are set to 0 for years before 2017 and to 1 for years from 2017 onward.

(3) Mediating Variable

Following the study by Liu Jinya et al. (2023)^[31], R&D investment is selected as the mediating variable.

(4) Control Variables

Drawing on prior research^[11,15], this study includes the following control variables: firm size (size), revenue growth rate (growth), listing age (age), debt-to-asset ratio (lev), largest shareholder ownership ratio (share), return on total assets (ROA), proportion of independent directors (indep), and ownership type (ownership). Missing data were manually supplemented, and the dataset was processed using Stata 17. Details of the variables and their definitions are provided in Table 2.

Table 2. Variable Definitions

Variable Type	Variable Symbol	Variable Description
Explained Variable	Inpat1	Ln
	Inpat2	Ln
Explanatory Variable	treat_post	0 or 1
Mediator Variable	Rd	R&D Investment / (Current) Operating Revenue
	size	Ln (Total Assets)
	growth	Operating Revenue Growth Rate
	age	Listing Age
Control Variables	lev	Debt-to-Asset Ratio
	top1	Shareholding Ratio of the Largest Shareholder
	roa	Return on Total Assets (ROA)
	indep	Proportion of Independent Directors
	soe	Ownership Nature: State-Owned = 1, Non-State-Owned = 0

5. Empirical Analysis

5.1. Descriptive Statistics and Analysis

Table 3 presents the descriptive statistics of all variables. Overall, the standard deviations of the variables are smaller than their means, indicating that the dataset does not exhibit extreme outliers. However, there is noticeable variation in corporate innovation levels. For instance, the logarithm of the

number of invention patent applications has a mean of 3.553 and a standard deviation of 2.435, suggesting a wide distribution of innovation activity levels among the sampled firms. Some firms demonstrate active engagement in technological innovation, while others lag behind.

In terms of R&D investment, the mean value is 4.409, reflecting a considerable overall commitment to R&D activities among firms. This highlights a general recognition of the importance of R&D in enhancing innovation capacity.

The mean value of government subsidies is 17.70, indicating substantial government support for enterprises.

Regarding control variables, the mean and standard deviation of indicators such as firm size, growth rate, age, and debt-to-asset ratio reveal variability in the size,

developmental stages, and financial conditions of the sample firms. These differences may influence firms' resource allocation and strategic decisions, thereby impacting their innovation activities.

Table 3. Descriptive Statistics of Variables

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
lnpat1	236	3.553	2.435	0	7.396
lnpat2	236	4.831	2.156	0	8.307
rd	236	4.409	2.116	0.580	12.16
size	236	23.96	1.506	19.73	27.64
growth	236	0.098	0.284	-0.496	1.176
age	236	16.81	7.316	1	31
lev	236	0.642	0.150	0.352	0.979
top1	236	41.10	16.73	10.89	74.30
roa	236	0.0222	0.0539	-0.158	0.150
indep	236	0.320	0.0711	0.182	0.500
soe	236	0.725	0.448	0	1

5.2. Correlation Analysis

This study employs Pearson correlation analysis to examine the relationships among the variables in the model. The results are presented in Table 4-1 and 4-2. The core independent variable, policy effect (DDD), and the mediating variable, R&D investment (MMM), both exhibit positive

correlation coefficients with the dependent variable (YYY), which are significant at the 1% level. This indicates a significant positive relationship between these variables. Additionally, the highest correlation coefficient among all independent variables does not exceed 0.543, suggesting that multicollinearity is unlikely to pose a serious issue in the empirical analysis.

Table 4-1. Correlation Analysis

	lnpat1	treat post	rd	size	growth	age
lnpat1	1					
treat_post	0.501***	1				
rd	0.275***	0.237**	1			
size	0.535***	0.495**	0.0980	1		
growth	0.0660	0.134**	0.0480	0.137**	1	
age	-0.196*	-0.0330	-0.105	-0.127*	-0.185*	1
	**				**	
lev	-0.245*	-0.108*	-0.101	-0.226*	-0.0680	0.229***
	**			**		
top1	0.121*	0.110*	-0.184*	0.287***	-0.00300	-0.166*
			**			*
roa	0.261***	-0.0820	-0.182*	0.365***	0.237***	-0.235*
			**			**
indep	0.230***	0.253**	-0.003	0.294***	0.0240	-0.214*
						**
soe	-0.209*	-0.100	-0.305*	-0.195*	-0.0970	0.426***
	**		**	**		

Continuation Table 4-2. Correlation Analysis

	lev	top1	roa	indep	soe
lev	1				
top1	-0.168***	1			
roa	-0.513***	0.244**	1		
indep	-0.0730	-0.132**	0.0810	1	
soe	0.0800	-0.00700	-0.0810	-0.193***	1

z-statistics in parentheses

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

5.3. Difference-in-Differences Estimation Results

Table 5 presents the baseline regression results for the impact of the "dual-credit" policy on the innovation performance of NEV firms. Models (1) and (2) represent the regression results without and with control variables, respectively. The results indicate that the policy effect is significant both without and with control variables, supporting the conclusion that research hypothesis **H₁** is valid. Among the control variables, firm size and firm age exhibit significant positive effects on innovation, suggesting that larger and more mature firms are generally better equipped with resources and capabilities to engage in

innovation activities. These firms are more responsive to policy incentives and can increase innovation investments effectively. In contrast, growth rate shows a negative relationship with innovation performance, potentially because rapidly growing firms may prioritize short-term market expansion over innovation investments, neglecting the development of long-term innovation capabilities. The explanatory power of the models, represented by the R-squared values, improves from 0.097 in Model (1) to 0.155 in Model (2) after including additional control variables. This indicates that the inclusion of control variables enhances the model's ability to explain variations in corporate innovation performance.

Table 5. Baseline Regression Results

VARIABLES	(1) lnpat1	(2) lnpat1
treat_post	0.853*** (5.15)	0.499** (2.22)
size		0.233* (1.92)
growth		-0.404* (-1.73)
age		0.044** (1.98)
lev		-0.172 (-0.18)
top1		0.005 (0.42)
roa		2.179 (1.10)
indep		-0.203 (-0.19)
soe		0.041 (0.09)
Constant	3.096*** (8.04)	-3.137 (-1.11)
Observations	236	236
R-squared	0.097	0.155

z-statistics in parentheses

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

As shown in Figure 2, the innovation trends of the experimental group and the control group remained approximately parallel before the implementation of the "dual-credit" policy, with relatively consistent growth patterns. This validates the parallel trend assumption, indicating that prior to the policy implementation, there were no significant differences in innovation output between the experimental and control groups. This observation satisfies the prerequisite condition for applying the difference-in-differences (DID) method.

From the placebo test results shown in Figure 3, the estimated values exhibit a density distribution that approximates a standard normal distribution, primarily

concentrated around 0. This indicates that prior to the implementation of the "dual-credit" policy, there were no significant differences between the experimental and control groups, aligning with the parallel trend assumption. Additionally, the estimated values do not significantly deviate from 0, further validating the robustness of the regression analysis results.

Thus, the positive impact of the policy on corporate innovation can be attributed to the "dual-credit" policy itself, rather than being influenced by other external or random factors. The placebo test results support the causal interpretation of the policy effect, ensuring the reliability of the study's conclusions.

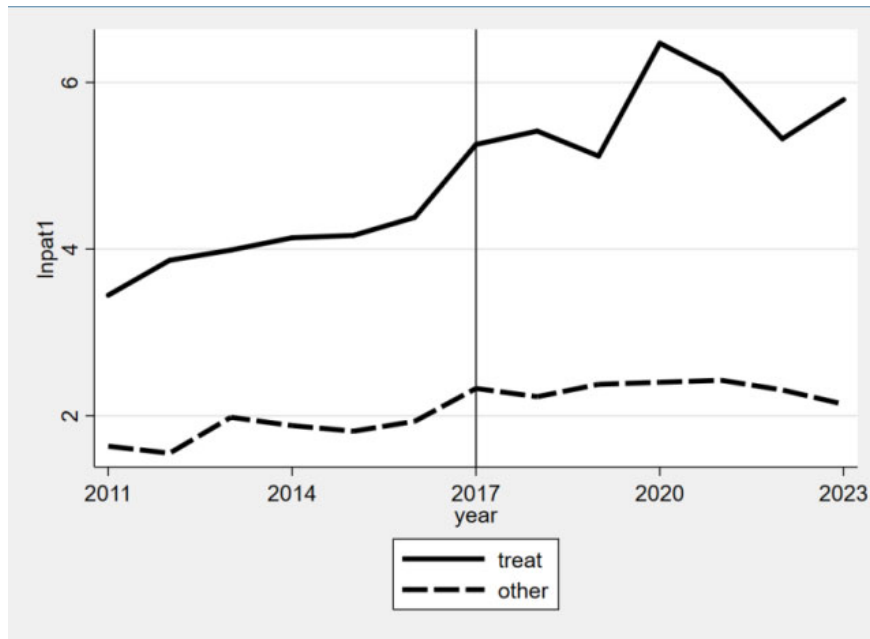


Figure 2. Parallel Trends Results

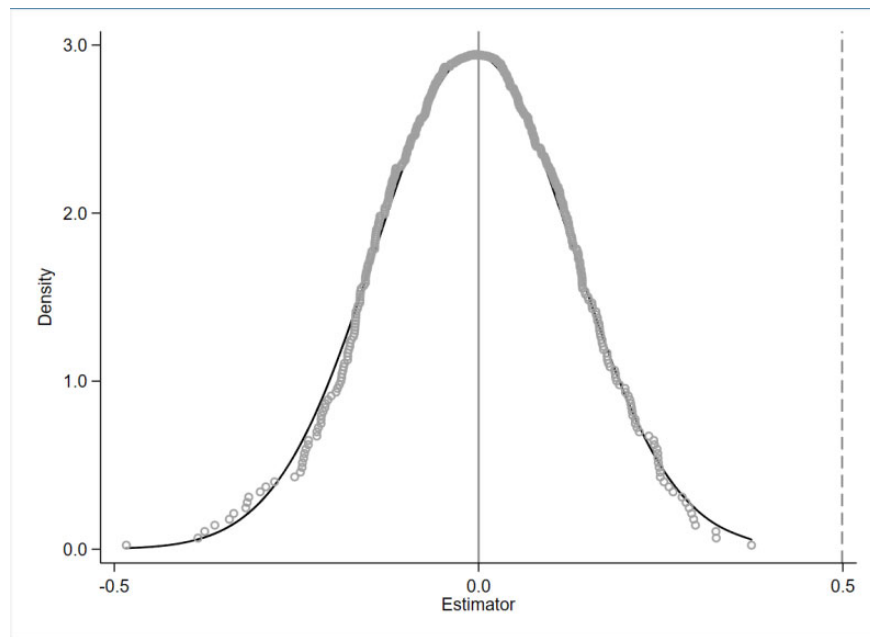


Figure 3. Placebo Test

5.4. Mediation Effect Test

The results in Table 6 indicate that the "dual-credit" policy has a significant positive impact on both patent applications and R&D investment. Specifically, at the 1% significance level, Models (1) and (3) show that the policy has a direct and significant effect on patent applications. Without control variables, the policy effect coefficient is 0.853, and after adding control variables, it remains significant with a coefficient of 0.499.

Similarly, Models (2) and (4) demonstrate the positive impact of the "dual-credit" policy on R&D investment. The policy effect coefficient is 0.904 without control variables and remains significant at 0.751 after their inclusion. These

findings highlight the significant role of R&D investment in mediating the effect of the "dual-credit" policy on corporate innovation. The policy not only directly increases the number of patent applications but also indirectly promotes innovation output by enhancing R&D investment.

The regression analysis results confirm the positive impact of the "dual-credit" policy on corporate innovation and demonstrate that R&D investment is an important mediating pathway for the policy's influence on innovation. Therefore, hypothesis H₂ is supported. This provides strong empirical evidence for policymakers, suggesting that increasing R&D investment can further enhance firms' innovation performance.

Table 6. Mediation Effect

VARIABLES	(1) lnpat1	(2) rd	(3) lnpat1	(4) rd
treat_post	0.853*** (5.15)	0.904*** (3.18)	0.499** (2.22)	0.751** (2.18)
size			0.233* (1.92)	0.187* (1.70)
growth			-0.404* (-1.73)	0.243 (0.54)
age			0.044** (1.98)	-0.015 (-0.79)
lev			-0.172 (-0.18)	-3.204*** (-3.31)
top1			0.005 (0.42)	-0.030*** (-3.72)
roa			2.179 (1.10)	-12.007*** (-3.91)
indep			-0.203 (-0.19)	-5.093*** (-2.68)
soe			0.041 (0.09)	-1.317*** (-4.32)
Constant	3.096*** (8.04)	4.167*** (12.27)	-3.137 (-1.11)	6.104** (2.39)
Observations	236	236	236	236
R-squared	0.097	0.035	0.155	0.236

z-statistics in parentheses

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

5.5. Robustness Test

The robustness test results in Table 7 show that the positive impact of the "dual-credit" policy on patent applications is significant and consistent. Regardless of whether control variables are included, the policy effect remains significant across multiple models, indicating that the policy's promotion of corporate innovation is not driven by firm size, growth, or

other characteristics, but rather by the policy itself. Additionally, firm size demonstrates a significant positive effect on patent applications, suggesting that larger firms are better equipped to leverage policy incentives to increase innovation output. Overall, the explanatory power of the models improves with the inclusion of control variables, further validating the positive effect of the policy on corporate innovation.

Table 7. Robustness Test

VARIABLES	(1) lnpat2	(2) lnpat2
treat_post	0.577*** (4.26)	0.378** (2.04)
size		0.243** (2.37)
growth		-0.258 (-1.35)
age		0.008 (0.44)
lev		0.981 (1.20)
top1		0.004 (0.43)
roa		2.350 (1.45)
indep		0.212 (0.24)
soe		-0.346 (-0.93)
Constant	4.423*** (11.81)	-2.089 (-0.88)
Observations	236	236
R-squared	0.069	0.121

z-statistics in parentheses

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

6. Conclusion

This chapter employs the difference-in-differences (DID) method to systematically analyze the impact of the "dual-credit" policy on corporate innovation performance and examine the mediating role of R&D investment. The main conclusions are as follows:

(1) The "dual-credit" policy significantly promotes corporate innovation. The findings show that patent applications by firms increased significantly after the policy's implementation. The policy effect remained consistently significant and positive, regardless of whether control variables were included. This indicates that the "dual-credit" policy, as a powerful external incentive mechanism, drives technological innovation through mandatory NEV credit requirements and market-based credit trading. The significant increase in patent applications provides strong evidence of this effect.

(2) R&D investment serves as a mediating mechanism in the impact of the "dual-credit" policy on innovation performance. The results reveal that the "dual-credit" policy not only directly enhances corporate innovation output but also indirectly boosts innovation performance by significantly increasing firms' R&D investments. This demonstrates that the "dual-credit" policy mobilizes firms' internal R&D resources, providing sustained momentum for technological innovation.

(3) Robustness of the policy effect. Control variables, such as firm size, growth, age, and financial condition, partially explain variations in firms' innovation efforts, indicating that these factors do influence innovation performance. Even after accounting for these control variables, the "dual-credit" policy's positive effect on corporate innovation remains significant. This result confirms the robustness of the policy effect, showing that the policy is broadly applicable across different types of firms and transcends the influence of internal firm characteristics. Whether for large or medium-sized firms or small and medium-sized enterprises (SMEs) at different developmental stages, the policy's incentive mechanism enables firms to further increase R&D investment and drive technological breakthroughs.

Based on the conclusions of this study, the following recommendations are proposed to promote the development of China's new energy vehicle industry and support the achievement of the "dual carbon" goals: The government should optimize the design and implementation of the "Dual Credit" policy, improve incentive and constraint mechanisms, refine credit allocation and trading rules, reduce corporate compliance costs, and minimize uncertainties during policy execution to encourage more enterprises to actively engage in technological innovation. Additionally, the government should strengthen R&D support policies through measures such as targeted subsidies, tax incentives, and R&D rewards to support enterprises in increasing investment in core technology development, overcoming technical bottlenecks, and enhancing international competitiveness. Enterprises should actively respond to policy requirements by increasing R&D investment, particularly in key technology areas such as batteries, motors, and intelligent connectivity, to strengthen innovation capabilities and improve market competitiveness. Furthermore, companies need to enhance their market adaptability by flexibly adjusting product strategies, prioritizing the research and production of new energy vehicle

models that comply with policy requirements, and expanding credit trading channels to fully leverage market mechanisms to boost revenues.

Acknowledgment

We thank A, B, and C. This work was supported in part by a grant from XYZ.

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