Received: 24 July 2024 | Revised: 21 November 2024 | Accepted: 24 December 2024 | Published online: 14 January 2025

RESEARCH ARTICLE

Journal of Comprehensive Business Administration Research
2025, Vol. 00(00) 1–13
DOI: 10.47852/bonviewJCBAR52023926

BON VIEW PUBLISHING

Research on the Impact of Fiscal Subsidies on High-Quality Development of New Energy Vehicle Companies Based on Threshold Effects

Zuo Leyan[1], Zhou Songlan[2,*], Wang Mengxin[3] and Zhang Siyu[4]

[1]*School of Economics and Statistics, Guangzhou University, China*

[2]*Guangzhou College of Applied Science and Technology, China*

[3]*Institute of Finance, Guangzhou University, China*

[4]*School of Economics and Statistic, Guangzhou University, China*

Abstract: In recent years, China has made significant strides in developing the new energy vehicle industry, providing substantial financial support to this sector. The production and sales of new energy vehicles have experienced explosive growth, accompanied by notable improvements in technology and product quality. However, as the industry evolved, the effectiveness of financial subsidies in enhancing the production and technological capabilities of enterprises has gradually diminished. To foster the rapid development of new energy vehicle enterprises and facilitate the rational planning of relevant government financial subsidies, this study utilizes data from listed Chinese new energy vehicle companies spanning from 2017 to 2022 to investigate the intrinsic relationship between financial subsidies and the quality development of enterprises. The study reveals several key findings. First, when fiscal subsidies are maintained within a reasonable range, they significantly enhance the quality development of state-owned enterprises (SOEs). However, once this threshold is surpassed, further increases in fiscal subsidies do not promote quality development of enterprises, a phenomenon that does not apply to non-state enterprises. Second, the threshold effect of financial subsidies on quality development is particularly pronounced between newly listed companies and those listed for more than three years. Third, for SOEs, financial subsidies play a critical role in fostering high-quality development by boosting R&D investment; this relationship is not observed in non-SOEs. Consequently, this study advocates the establishment of differentiated financial support policies for the new energy vehicle industry to maximize their effectiveness.

Keywords: financial subsidies, threshold effect, new energy vehicles, high-quality development

1. Introduction

Digitalization, green practices, and innovation play an important role in driving sustainable economic development [1]. The new energy automotive industry, as a concrete embodiment of these characteristics, has been formally included in the national strategic emerging industries since 2010 and has become an important part of national development and scientific and technological progress. In 2023, China's annual production and sales of new energy vehicles are expected to reach 9.587 million and 9.495 million units, respectively, maintaining the country's global lead for nine consecutive years. The rapid expansion of new energy vehicle production enterprises has propelled this sector to become a key driver of economic transformation and leapfrog development in China.

The booming development of new energy vehicle production enterprises cannot be separated from national financial subsidies to support the development of new energy vehicles. These subsidies provide incentives for enterprises to invest in research and development (R&D) and promote the advancement and innovation of new energy vehicle technology, reducing the cost of purchasing new energy vehicles for consumers, making new energy vehicles more attractive to consumers, and increasing market demand. Nevertheless, as the industry has rapidly developed, a series of issues has emerged in new energy automobile enterprises. These include the lack of significant advances in high-end products and core technologies. Enterprises have become dependent on government support and lack the ability to develop themselves and adapt to market changes. This leads to unfair competition between different enterprises, especially for small or emerging enterprises that do not receive subsidies, and even to phenomena such as enterprises cheating on financial subsidies.

This paper finds that financial subsidies have a threshold effect on the development of new energy vehicles. If the government implements the financial subsidy policy, it can promote the technological innovation and product upgrading of new energy vehicle enterprises. Nevertheless, as the level of subsidy increases, its effect may turn negative, resulting in a disruption of business development. The purpose of this paper is to reveal the complex influence mechanism of financial subsidies for the development of new energy vehicle enterprises through the perspective of

*Corresponding author: Zhou Songlan, Guangzhou College of Applied Science and Technology, China. Email: sesslzhou@gzhu.edu.cn

threshold effect and to test the theoretical derivation through relevant data.

The rationale for undertaking this study at this particular juncture is that since the new energy vehicle industry has been designated as a national strategic emerging industry, it has been the recipient of a range of financial subsidy policies at the central and local levels. Rapid growth in production and sales of new energy vehicles driven by the benefits of support policies. Despite an increase in production, the use of new energy vehicles in competition with traditional fuel vehicles is not advantageous due to technical limitations and high costs. The question of how to play the role of financial subsidies in order to achieve the quality and efficiency of the new energy vehicle industry is a pressing concern for both academics and the public alike. Furthermore, the country's subsidized car production does not align with the actual utilization of the allocated 'fraudulent subsidies', and other unfavorable occurrences are also frequently brought to light. This leads to the question of whether the financial subsidies are excessive. On 23 April 2020, the Ministry of Finance, the Ministry of Industry and Information Technology, the Ministry of Science and Technology, and the Development and Reform Commission jointly issued the Circular on Improving the Financial Subsidy Policy for the Popularization and Application of New Energy Vehicles. This extends the implementation period of the financial subsidy policy for the popularization and application of new energy vehicles to the end of 2022 and provides for a gradual reduction in the level of subsidy, as well as a corresponding adjustment in the pace of this reduction. From 2020 to 2022, the subsidy standards were, respectively, 10 percent, 20 percent, and 30 percent regressive when considered in relation to the previous year. On 23 June, the State Council executive meeting to study policy measures to promote the high-quality development of the new energy automobile industry highlighted that it had been decided to continue and optimize the policy of reducing and exempting the vehicle purchase tax for new energy vehicles. The policy has been extended from its original termination date of 31 December 2023 to 31 December 2027. During this period, a vehicle purchase tax exemption will be in effect from 1 January 2024 to 31 December 2025. Additionally, a 50% reduction in vehicle purchase tax will be implemented from 1 January 2026 to 31 December 2027. The country's financial subsidy policy for the new energy vehicle industry has undergone a gradual decline from a previously highly favorable position to its current level of support. In light of the aforementioned context, this paper seeks to address the following questions: This paper seeks to elucidate the internal mechanism of the fiscal subsidy policy designed to promote the development of the new energy vehicle industry. What is the extent of financial subsidy maximization in promoting the development of the new energy vehicle industry? The question thus arises as to whether the new round of regression policy is the optimal choice. The question thus arises as to whether this course of action will succeed in realizing the government's policy intention.

Based on this, the impact of financial subsidies on the high-quality development of new energy automobiles and the internal mechanisms is explored. This study uses data on China's new energy vehicle listed enterprises from 2017 to 2022 and first applies the entropy value method to measure the comprehensive indicators of the high-quality development of new energy vehicle enterprises, explores the relationship between the measurement of financial subsidies and the development of enterprises from a linear and non-linear perspective, and adopts the threshold effect regression model to find the threshold value of financial subsidies to promote the high-quality development of new energy vehicle enterprises to the greatest extent. Then, a mechanism effect test is conducted to determine the mediating effect of R&D investment on financial subsidies and high-quality development. Finally, the relationship between R&D investment and high-quality development is examined for state-owned and non-state-owned enterprises (SOEs) and for newly listed and mature enterprises.

2. Literature Review

In the academic world, the following three main views exist in existing research on the impact of financial subsidies on enterprise development.

2.1. The positive effects of financial subsidies on enterprise development

Some scholars have asserted that financial subsidies significantly positively affect enterprise development [2]. From the perspective of firms' innovative capacity, fiscal subsidies can have an impact on firm innovation by influencing firms' R&D investment [3, 4]. Incentives' effectiveness varies between industries and firms with different property rights. Financial subsidies are more effective in promoting innovation in private firms [5] and in tax-sensitive industries [6]. From an industry perspective, financial subsidies can help industries, manufacturing, and emerging firms overcome financial constraints and exert significant influence on the R&D output of emerging firms, enhancing the probability of success [7–9]. Studies show that manufacturing enterprises receiving financial subsidies outperform others in innovation performance [10, 11]. With the new energy automobile industry's development, scholars have begun studying the impact of financial subsidies on this industry. Government R&D subsidies can significantly stimulate technological innovation of new energy vehicle manufacturers, promoting the industry's overall development [12–14]. These studies examine the influence of financial subsidies on enterprise innovation and growth from various perspectives, including resource access, signaling, and inter-firm collaboration. Focusing on manufacturing, emerging industries, and the new energy automobile industry, these studies emphasize the positive role of government R&D subsidies in promoting technological innovation and industry development. They provide a basis for policy formulation. However, it may be argued that they have overemphasized the positive impacts of financial subsidies without fully considering the negative effects, such as resource mismatch and increased dependence.

2.2. The negative effects of financial subsidies on enterprise development

As research has progressively deepened, some scholars have proposed that financial subsidies do not improve business performance [15]. Financial subsidies can distort competition [16] and lead to overcapacity [17], which is detrimental to the long-term development of enterprises' core competitiveness. For instance, enterprises in developing countries are susceptible to investment "surge phenomena" during economic cycles, resulting in overcapacity [18]. Furthermore, financial subsidies have demonstrated a significant crowding-out effect of financial subsidies on enterprise R&D, and the impact of this effect was moderated by changes in enterprise ownership attributes [19, 20]. Fiscal subsidies may prompt firms to pursue a 'quantity over quality' innovation strategy, which could have a detrimental impact on their innovation inputs and outputs. This is due to the

fact that such subsidies may lead to distortionary effects, whereby firms are inclined to accept less optimal innovations and engage in rent-seeking activities [21, 22]. Industry-specific research has been conducted in sectors such as manufacturing [23, 24], emerging industries [25, 26], and automobiles [27, 28]. The investigation revealed that fiscal subsidies in these industries do not exert a considerable positive influence on the development capacity of enterprises. The provision of fiscal subsidies may give rise to a number of issues, including an expansion in enterprise output and a distortion in the allocation of factors of production [29]. This study highlights the potential risks associated with overcapacity and distortion of market competition that may arise from fiscal subsidies. It offers a comprehensive examination of fiscal subsidy policies and assists policymakers in balancing the overall assessment of subsidy effects.

2.3. The non-linear relationship between fiscal subsidies and enterprise development

In recent years, a number of studies have highlighted the complex relationship between financial subsidies and business development. However, once subsidies surpass a critical threshold, beneficial effects may diminish and impede growth [30–32]. Subsidies may have varying effects at different firm life cycle stages and lose effectiveness in long term. This indicates no straightforward linear correlation between financial subsidies and enterprise technological innovation. Some scholars posit a U-shaped or inverted U-shaped relationship [33–35]. Researchers found a threshold effect between financial subsidies and enterprise development [36]. In the optimal interval, subsidies can facilitate development; conversely, they can impede it. This phenomenon is prevalent in manufacturing [37] and the new energy vehicle industry [38, 39].

Compared to the existing literature, the marginal contribution of this paper in three ways. First, while previous studies focused on macroeconomic impacts, this paper analyzes the meso-level of new energy vehicle enterprises, aligning with state objectives to foster their growth. It highlights the role of financial subsidies in advancing these enterprises and addresses gaps in existing literature. Second, it constructs a measurement system for high-quality development of new energy automobile enterprises, providing a quantitative evaluation tool for assessing development quality and benefits, promoting industry growth. Third, this paper adopts a quantitative study to comprehensively consider the impact of financial subsidies on the high-quality development of the new energy industry from both positive and negative perspectives, and empirical analyses to further determine the threshold at which their effect is maximized.

3. Methodology Theoretical Analysis and Research Hypotheses

3.1. Non-linear relationship of financial subsidies on the high-quality development of new energy vehicle enterprises

Financial subsidies exert a substantial positive influence on the R&D efforts of new energy vehicle enterprises. These subsidies can reduce the costs associated with R&D and increase investment in this domain, thereby fostering technological innovation and product upgrades. Moreover, financial subsidies can bolster the financing capabilities of enterprises in the capital market via a signaling effect, which in turn attracts a greater influx of social capital to invest in new energy vehicle manufacturers. However, excessive financial subsidies may lead to distortions in market competition and overcapacity, potentially having a detrimental impact on the long-term enhancement of core competitiveness. In recent years, scholars have initiated investigations into the non-linear relationship between fiscal subsidies and the development of new energy vehicles. Several studies have suggested an inverted U-shaped relationship between fiscal subsidies and firms' innovation performance. Specifically, fiscal subsidies can act as a catalyst for firms' innovation within a certain threshold. Nevertheless, when subsidies exceed this threshold, their efficacy may become negative thereby, hindering the development of firms.

Based on the aforementioned theories, the following hypothesis is proposed for consideration:

H1: There is a threshold effect between financial subsidies and the high-quality development of new energy automobile enterprises: when the financial subsidies are below the threshold, the financial subsidies can promote the high-quality development of enterprises, and when they are above the threshold, they will have an inhibitory effect.

3.2. Indirect transmission path of financial subsidies on the high-quality development of new energy vehicle enterprises

The primary objective of financial support is to bolster enterprises' independent innovation capacity and to facilitate increased innovative output. Shi [40] used digital green business model innovation as a mediating variable to explain the relationship between strategic positioning and innovation performance. In the new energy vehicle industry, financial subsidies may play a role by influencing the business model innovation of companies, thereby affecting innovation performance. For new energy automotive enterprises, projects backed by financial subsidies are typically deemed high-quality ventures, thereby enhancing the likelihood of securing bank loans and social capital support. As financial subsidy funds are infused into the enterprise, they are predominantly allocated toward enhancing R&D-related inputs. When R&D investments yield patent results that align with market demand, the enterprise achieves substantial profit returns, which, in turn, prompts the enterprise to further increase R&D expenditure. This cycle of continuous R&D activities generates more innovative outcomes, ensuring a consistent revenue stream for the enterprise and positively affecting its quality development. However, excessive R&D subsidies can lead to issues such as an imbalance between inputs and outputs, disrupting the micro supply-demand equilibrium within enterprises, and potentially affecting the competitive dynamics of the entire new energy vehicle industry. In light of the aforementioned analysis of the impact mechanism, the second hypothesis of this paper is proposed

H2: Financial subsidies indirectly affect the high-quality development of enterprises by promoting their innovation input.

3.3. Heterogeneity in the role of financial subsidies in the development of new energy vehicle enterprises

Private enterprises, in comparison to state-owned counterparts, have insufficient funds to maintain operations and scale up. Consequently, it is difficult for them to have surplus funds to engage in innovative investment activities that have external effects. Hence, private enterprises exhibit higher sensitivity to

financial subsidies, which can substantially boost their R&D investment and spur innovative endeavors. Moreover, for recently listed new energy automotive enterprises the pursuit of high-quality development necessitates more forward-looking strategic planning, the accumulation and distillation of management experience, and the enhancement of personnel capabilities to improve the effective allocation of resources. However, government support in the form of direct subsidies can lead to short-term access to funds rapidly allocated to R&D investments. In the long term, such subsidies may disrupt the external competitive equilibrium and hinder market efficiency. Internally, they may reduce incentives for scientific and technological innovation because of the lack of stringent internal and external regulatory mechanisms, which can foster management inefficiencies and ineffective investments. Therefore, from a holistic perspective of high-quality enterprise development, there may be an imbalance between financial subsidies and the high-quality development of private enterprises or newly listed new energy automotive enterprises. Based on the aforementioned analysis of the impact mechanism, this study posits hypothesis 3 and hypothesis 4.

H3: Financial subsidies promote the high-quality development of state-owned new energy vehicle enterprises more than non-SOEs.

H4: Financial subsidies have contributed more to the high-quality development of mature new energy vehicles than newly listed companies.

4. Research and Data Methodology

4.1. Research methodology

This study, the entropy value method, was first used to measure the comprehensive indicators of high-quality development of new energy automotive enterprises. The entropy value method employs the overall impact of changes in each indicator as the primary basis for weighting, thereby eliminating the potential for weighting bias that may arise from subjectivity. Concurrently, greater emphasis is placed on stability indicators and on those that provide more detailed information. These are aligned with the evaluation criteria for the comprehensive indicators of high-quality economic development. Consequently, they are incorporated into the calculation of the development indicators Li [40], Xin [41], Yang [42].

Subsequently, the non-linear relationship between fiscal subsidies and enterprise development is quantified. In this study, a threshold effect regression model was employed, with fiscal subsidies and R&D share designated as the introductory variables, the level of high-quality development of firms as the explanatory variables, and the introduction of control variables. Threshold effect regression is a more effective approach for validating the non-linear relationships at this juncture. This was accomplished by identifying the threshold values of the key variables and conducting significance tests, thereby establishing the presence of a threshold effect and determining the optimal range to maximize the benefits associated with the two variables. In their respective studies, Sun [43] and Dai [44] investigated the influence of R&D investment on organizational performance, employing the threshold effect as a theoretical lens. Subsequently, a mechanism effect test is conducted to ascertain the mediating effect of R&D investment on financial subsidies and high-quality development. Finally, the relationship between R&D investment and high-quality development was tested for state-owned and non-SOEs, newly listed enterprises, and mature enterprises.

4.1.1. Entropy method

The entropy method is employed to calculate the composite indicator, where the year span is designated as d, the number of firms in the sample is represented by n, and number of indicators is indicated by m. Subsequently, $X_{\theta ij}$ signifies the jth indicator for province i in year θ.

① The standardization of indicators

$$X_{\theta ij}^{'} = \begin{cases} \frac{X_{\theta ij}}{X_{\theta j\ max}}, & The\ value\ of\ indicator\ j\ is\ positive \\ \frac{X_{\theta j\ min}}{X_{\theta ij}}, & The\ value\ of\ indicator\ j\ is\ negative \end{cases} \tag{1}$$

② Calculation of the entropy value of the indicator

$$\begin{gathered} H_j = -k\sum_{\theta=1}^{d}\sum_{i=1}^{n}\left[Y_{\theta ij} ln Y_{\theta ij}\right] \\ \left(k = \frac{1}{\ln(dn)}, Y_{\theta ij} = \frac{X_{\theta ij}^{'}}{\sum_{\theta=1}^{d}\sum_{i=1}^{n} X_{\theta ij}^{'}}\right) \end{gathered} \tag{2}$$

③ Calculation of the effect values of indicator information

$$G_j = 1 - H_j \tag{3}$$

④ Calculation of indicator weights

$$W_j = \frac{G_j}{\sum_{j=1}^{m} G_j} \tag{4}$$

⑤ Calculation of composite score

$$Z_{\theta j} = \sum\nolimits_{j=1}^{m}\left(W_j X_{\theta ij}^{'}\right) \tag{5}$$

4.1.2. Panel threshold regression

This section builds on the theoretical analysis of the literature reviewed above to elaborate on the model that corresponds to the non-linear relationship between financial subsidies and the high-quality development of new energy vehicles. The objective is to identify the optimal interval for the relationship between financial subsidies and the high-quality development of new energy vehicles. Threshold regression analysis was utilized to investigate the non-linear relationship among the variables, drawing extensively on the comprehensive theoretical framework developed by Hansen (1999). The threshold regression model for panel data is as follows:

$$Y_{it} = \begin{cases} \mu_i + X_{it}\beta_1^{'} + \varepsilon_{it}, q_{it} \le \gamma \\ \mu_i + X_{it}\beta_2^{'} + \varepsilon_{it}, q_{it} > \gamma \end{cases} \tag{6}$$

In this context, q_{it} represents the threshold variable, γ denotes the threshold value of the surrogate estimate, and the perturbation term ε_{it} is assumed to be independently and identically distributed.

$$LR = \frac{SSR^{*} - SSR(\hat{\gamma})}{\hat{\sigma}^2} \tag{7}$$

where $\hat{\sigma}^2 = \frac{SSR(\hat{\gamma})}{n(T-1)}$ denotes a consistent estimator of the variance of the disturbance term, SSR^{*} represents the sum of squared residuals in the absence of a threshold variable. If the null hypothesis $H_0 : \beta_1 = \beta_2$ holds, there is no threshold effect. If the null hypothesis is rejected, it is inferred that a threshold effect exists, and further tests can be conducted to examine the confidence intervals for the estimated threshold values.

$$LR(\gamma) = \frac{SSR(\gamma) - SSR(\hat{\gamma})}{\hat{\sigma}^2} \tag{8}$$

To test the null hypothesis $H_0 : \gamma_1 = \gamma_2$ at a significance level α, if the likelihood ratio $LR(\gamma)$ is sufficiently large, the null hypothesis can be rejected; when $LR(\gamma) \leq -2\ln\left(1 - \sqrt{1-\alpha}\right)$, the null hypothesis is accepted. Consequently, the confidence interval for γ can be calculated using $LR(\gamma)$.

4.2. Description of the study sample and indicators

4.2.1. Sample description

The concept of "high-quality" development was first introduced by the state in 2017. Consequently, this study empirically investigates the period from 2017 to 2022, focusing on listed new energy automobile companies. All sample data were sourced from the wind database. The following cleaning procedures were implemented to ensure the currency:

"ST" and "*ST" companies were excluded from the sample during the research interval, as these designations indicate financial distress. (2) Outliers were removed from the dataset, as they contained unrealistic, extremely large, or abnormally small values for financial indicators such as operating income. (3) Samples with missing indicator data were eliminated, as incomplete data preclude accurate regression parameter estimation.

4.2.2. Definition of variable

1) **Explained variable: High-quality development.** The development of high-quality enterprises is measured across three dimensions: financial performance, development capability, and sustainability Liu [45]. Financial performance indicators represent the profitability of the business and serve as the foundation for assessing high-quality enterprise development. The return on net assets is the ratio of net profit to average shareholder equity, indicating the efficiency with which a company utilizes the capital invested by its shareholders. The return on total assets is the ratio of net profit to total assets, reflecting the efficiency with which an enterprise utilizes all its assets. Finally, total asset turnover is the ratio of an enterprise's operating income to its total assets, reflecting its ability to use its assets to generate sales revenue. The combination of these three indicators constitutes a multidimensional framework for assessing an enterprise's financial performance. In addition to reflecting the profitability of the enterprise, this framework reveals the efficiency of the enterprise's asset management and the rationality of its capital structure. Development capability is crucial for enterprises to maintain their core competitive advantage and the size of the core competitiveness of enterprises is measured based on the quality and quantity of intangible assets Tang Xiangxi [46]. This study measures a firm's ability to grow using the growth rate of intangible assets. Sustainability, particularly in the context of the current economic landscape where production, supply, and sales value chains are unstable, is vital for ensuring an enterprise's resilience to risk. Thus, the sustainability of an enterprise is a critical factor, providing a robust guarantee of its continuity, and is measured by the cash flow ratio. The cash flow ratio can reflect the solvency of the company and show whether the cash flow generated by the company's operating activities is sufficient to repay short-term debt, which is a direct reflection of the company's short-term solvency and can reveal the quality of earnings; long-term growth of the business requires continued reinvestment, including capital expenditure and working capital investment. Cash flow ratios can assess a company's ability to reinvest and manage risks. Therefore, business resilience will go a long way to ensure the sustainability of a business, as measured by the cash flow ratio.

The selected metrics are shown in Table 1 below:

2) **Explanatory variables: Financial subsidies and R&D investment.** Financial subsidy is the amount of government subsidy to enterprises in the current year. In recent years, in order to accelerate the rapid development of new energy enterprises, especially energy automobile enterprises, and to achieve lane-changing overtaking, the state has continuously

Table 1
High-quality development measurement system

Level 1 indicators	Level 2 indicators	Meaning of the indicator	Formula
Financial performance	Return on net assets	The level of profitability of the company's own assets, with a higher indicator indicating a higher return on investment.	Net profit/equity
	Return on total assets	The level of profitability of the firm's total assets, with higher levels indicating better overall input-output performance	Net profit/total assets
	Total asset turnover	The level of operation of the enterprise's total assets, with higher indicators indicating higher management efficiency and quality of operations	Operating income/total assets
Development capacity	Growth rate of intangible assets	Level of accumulating core resources, with a higher indicator indicating a greater capacity to sustain innovative development.	Increase in current value of intangible assets/ end of previous period
Sustainability of development	Cash flow ratio	Net cash solvency from operations, where a higher indicator indicates a better ability to control operational risk.	Net cash flow/current liabilities

increased the number of subsidies for new energy enterprises. The study uses, the financial subsidies as an explanatory variable, to prevent the regression of heteroskedasticity, the number of financial subsidies to use natural logarithm processing.

R&D investment (RD) as a proportion of R&D personnel serves as an indicator of the level of investment in human capital for R&D within an enterprise. A higher proportion of R&D investment typically corresponds to greater investment in R&D human capital, which in turn is associated with a higher level of innovation development within the enterprise.

3) **Control variables.** To conduct a more comprehensive analysis of the impact of financial subsidies on the quality development of enterprises, it is essential to consider disparities in growth potential, operational capacity, financial leverage, and equity structure among enterprises, as these factors also influence enterprise development. Firstly, the proportion of shares held by the largest shareholder reflects the equity structure of the enterprise. This is not only a pivotal indicator of the governance structure but also has a direct impact on the enterprise's operational performance and future development. Secondly, the size of assets corresponds to the material base and resource allocation capacity of enterprises, which can effectively control for variations in enterprise scale. The growth rate of the operating income serves as a predictive indicator of an enterprise's development potential and market prospects, indicating both its development ability and market share. Furthermore, the number of years an enterprise has been in the market significantly affects its growth trajectory, industry trends, and the market environment. Simultaneously, the length of the market presence can be used to gauge responses to changes in the external market environment. Finally, leverage, defined as the ratio of total liabilities to total assets, is a critical financial metric. On one hand, financing through debt often carries a higher cost of capital, necessitating investment in production and operating activities with short payback periods and immediate returns. On the other hand, excessive leverage prompts companies to be vigilant about their operational risk; thus, variation in a company's gearing ratio can influence its strategic decision-making. Ultimately, based on the foregoing analyses, the following control variables are incorporated: the proportion of shares held by the largest shareholder (Z), asset size (Size), the growth rate of operating income (Growth), company's age (Age), and the leverage ratio (LEV).

The final variable definitions are listed in Table 2.

Following the selection of indicators for data determination, 99% Winsor was applied to the data to mitigate the potential impact of outliers on the results. The descriptive statistics for the final set of indicators are provided in Table 3.

4.3. Modeling and results

4.3.1. Modeling

This study investigates the threshold effect of financial subsidies on the high-quality development of listed new energy automotive enterprises. The objective is to determine the optimal interval for financial subsidy levels through model design. The findings suggest that as the level of financial subsidies increases, so does the level of high-quality development within these enterprises.

Initially, this study examines the threshold effect of financial subsidies on the high-quality development of new energy vehicles. Subsequently, the following model is proposed:

Table 2
Variable definition

Variable type	Variable name	Variable symbol	Variable definition
Explained variable	High-quality development	HQD	Entropy Method Composite Indicator
Explanatory variable	Financial subsidies	SUB	Natural logarithm of subsidies
	R&D investment	RD	R&D investment/revenue
	Shareholder	Z	Shareholding ratio of the largest shareholder
	Asset size	Size	Natural logarithm of total assets
Control variable	Growth rate of operating income	Growth	The growth rate of operating income
	Company's age	Age	Age of listing
	Leverage ratio	LEV	Total liabilities/total assets

Table 3
Data descriptive statistics

Variables	Indicator symbols	Sample size	Mean	Std.Dev	Min	Max
High-quality development	HQD	552	38.262	10.292	16.309	67.483
Financial subsidies	SUB	552	17.654	1.538	13.668	21.260
R&D investment (%)	RD	552	14.894	7.101	0.810	34.850
Shareholder (%)	Z	552	55.333	42.170	3.449	167.108
Asset size	Size	552	23.151	1.220	20.372	26.477
Growth rate of operating income (%)	Growth	552	21.240	34.105	−48.959	164.339
Company's age	Age	552	13.299	7.512	1.000	29.000
Leverage ratio (%)	LEV	552	51.517	16.436	10.883	83.867

$$HQD_{it} = \mu_i + \beta_1' SUB_{it} \cdot I(SUB_{it} \le \gamma_1) + \beta_2' SUB_{it} \cdot I(SUB_{it} > \gamma_1) + \alpha_1 Z_{it} + \alpha_2 Size_{it} + \alpha_3 Growth_{it} + \alpha_4 Age_{it} + \alpha_5 LEV_{it} + \varepsilon_{it} \quad (9)$$

The significance of γ_1 and γ_2 in the schematic function of the equation suggests the presence of a threshold effect in the relationship between financial subsidies and the high-quality development of new energy automotive enterprises. Specifically, γ_1 and γ_2 represent cut-off points. When financial subsidies exceed or fall below these values, the impact of subsidies on the high-quality development of new energy vehicles undergoes a significant change.

Furthermore, recognizing that fiscal subsidies can effectively incentivize enterprises to enhance their R&D investment and that such subsidies can facilitate enterprise scientific and technological innovation through various mechanisms, including financial support and tax incentives, ultimately enhancing the level of high-quality development of enterprises. Consequently, in examining the threshold effect of fiscal subsidies on the high-quality development of new energy automotive enterprises, this study introduces R&D investment as a mediating variable to assess its role in the relationship between fiscal subsidies and enterprise development quality. The proposed model is as follows:

$$RD_{it} = \mu_i + \beta_{21} SUB_{it} + \alpha_{21} Z_{it} + \alpha_{22} Size_{it} + \alpha_{23} Growth_{it} + \alpha_{24} Age_{it} + \alpha_{25} LEV_{it} + \varepsilon_{it} \quad (10)$$

$$HQD_{it} = \mu_i + \beta_{21}' RD_{it} \cdot I(SUB_{it} \le \gamma_2) + \beta_{22}' RD_{it} \cdot I(SUB_{it} > \gamma_2) + \alpha_{21} Z_{it} + \alpha_{22} Size_{it} + \alpha_{23} Growth_{it} + \alpha_{24} Age_{it} + \alpha_{25} LEV_{it} + \varepsilon_{it} \quad (11)$$

First, this study tests the effect of financial subsidies on R&D investment. A significantly positive coefficient for β_{21}' would indicate that financial subsidies have a direct and significant positive impact on R&D investment. Subsequently, on the premise of this finding, the study proceeds to examine the influence of R&D investment on the high-quality development of the enterprise within the interval where the threshold effect of financial subsidies is observed.

4.3.2. Empirical findings

This section employs stepwise testing for empirical analysis. To capture the non-linear relationship between financial subsidies and the threshold effect in new energy automotive enterprises, separate tests are conducted on samples within the same group to contrast linear relationships. Subsequently, a mechanism effect test is performed to ascertain the mediating role of R&D investment between financial subsidies and high-quality development. Finally, the study examines the relationship between R&D investment and high-quality development for state-owned versus non-SOEs, as well as for newly listed versus mature enterprises.

1) **Regression model test.** For the panel data regression analysis, the model effect is determined by F-test and Hausman test before modeling; after determining the optimal model effect of the panel data, the threshold effect is further examined to determine whether there is a threshold effect between financial subsidies and new energy automobile enterprises, as well as the existence of multiple threshold results. First, the regression test for the whole sample (model 1) is conducted; then, the heterogeneity test for SOEs (model 2) and non-SOEs (model 3) is conducted according to the grouping of the type of property rights; finally, according to the number of years of listing, those listed within three years are defined as newly listed enterprises and the rest are mature enterprises, and the difference in the impact of financial subsidies and high-quality development between mature enterprises (model 4) and newly listed enterprises (model 5) is compared.

The results of the tests for each model are shown in Tables 4 and 5:

As can be seen from Table 5, there is no threshold effect of financial subsidies on the high-quality development of non-state-owned and newly listed companies. For the full sample and mature firms, there is a single threshold effect of financial subsidies on their high-quality development. The thresholds are [19.308, 19.511] and [19.638, 19.750] at 95 percent confidence intervals; For SOEs, fiscal subsidies have a double threshold effect on their high-quality development, the thresholds are [19.619, 19.741] and [19.287, 20.278].

2) **Study of the relationship between financial subsidies and high-quality enterprise development.** Table 6 reveals that there is no straightforward linear correlation between financial subsidies and the high-quality development of new energy automobile enterprises. Specifically, an increase in government subsidies for these enterprises does not lead to a significant enhancement in their level of high-quality development. Furthermore, the threshold effect test indicates that the coefficient for a single threshold does not reach statistical significance. This suggests that, for the new energy industry as a whole, the relationship between financial subsidies and the high-quality development of enterprises is linear, with no evidence of a threshold effect. In addition to examining the impact of financial subsidies, the control variable operating income growth rate is significantly positive at the 1% significance level ($\beta = 0.059, p < 0.01$), the higher the growth rate of operating profit, the higher the corresponding level of quality development of the company. Gearing is significantly negative at the 1% significance level. ($\beta = -0.145, p < 0.01$), The higher the debt ratio, the lower the level of quality development of the company.

The results presented above indicate that there is no straightforward linear relationship between tax subsidies and the

Table 4
Panel data model effects test

	F-test		Hausman test		
Model	Coef.	P-value	Coef.	P-value	Test results
Full sample	21.88***	0.000	9.81	0.133	random effects
SOES	37.79***	0.000	4.60	0.596	random effects
NSOES	14.12***	0.000	8.50	0.204	random effects
MES	13.82***	0.000	43.96***	0.000	fixed effect
NLES	22.88***	0.000	4.96	0.549	random effects

Table 5
Threshold estimation result

NSO	Theorem	Theorem value	95% confidence intervals	F-value	P-value	Test results
Full sample	Theorem γ_1	19.462	[19.308, 19.511]	18.300	0.020	Single
	Theoremγ_2	16.295	[16.281, 16.307]	7.380	0.430	
SOES	Theoremγ_1	19.671	[19.619, 19.741]	29.830	0.000	Double
	Theoremγ_2	19.442	[19.287, 20.278]	24.060	0.000	
NSOE	Theoremγ_1	19.075	–	6.980	0.480	Non
	Theoremγ_2	16.414	[16.413, 16.448]	5.590	0.630	
MES	Theoremγ_1	19.741	[19.638, 19.750]	39.060	0.000	Single
	Theoremγ_2	16.254	[16.207, 16.267]	6.630	0.480	
NLES	Theoremγ_1	16.638	[16.302, 16.648]	6.950	0.330	Non
	Theoremγ_2	16.465	[16.460, 16.767]	6.440	0.430	

Table 6
Total regression results

	Linear relationship	Threshold effect	Intermediary effect	
	HQD	HQD	RD	HQD
SUB	0.008		0.829***	
	[0.02]		[3.51]	
SUB_0		0.421		
		[0.99]		
SUB_1		0.183		
		[0.44]		
RD_0				−0.121
				[−1.49]
RD_1				−0.446***
				[−4.06]
Z	−0.006	0.004	−0.003	0.008
	[−0.54]	[0.32]	[−0.42]	[0.69]
Size	0.28	−0.341	−1.669***	−0.097
	[0.39]	[−0.41]	[−3.5]	[−0.13]
Growth	0.059***	0.063***	0.001	0.061***
	[8.17]	[8.59]	[0.19]	[8.73]
Age	0.075	−0.006	0.398***	0.076
	[0.72]	[−0.04]	[4.83]	[0.52]
LEV	−0.145***	−0.14***	−0.018	−0.144***
	[−4.84]	[−4.28]	[−0.95]	[−4.44]
Cons_	37.172***	44.956***	34.668***	47.607***
	[2.95]	[2.9]	[3.91]	[3.08]
N	552	552	552	552
R2	0.159	0.184	0.079	0.197
F	91.14***	14.61***	6.50***	15.89***

high-quality development of enterprises, nor is there evidence of a threshold effect. This finding contradicts hypothesis 1. Consequently, in subsequent sections, the analysis will be stratified to investigate the potential threshold effects of tax subsidies on the high-quality development of enterprises within different categories.

3) **Financial subsidies, R&D investment, and high-quality development in new energy vehicle enterprises.** Fiscal subsidies exert a dual influence on the high-quality development of new energy automobile enterprises: they have a direct impact on the development level and can also be harnessed internally as productivity through corporate R&D investment, thereby catalyzing ongoing enhancement of enterprise development. Consequently, this section delves into the mediating role of R&D investment in the relationship between fiscal subsidies and high-quality enterprise development.

Referring to Table 6, which outlines the mediating effect of R&D investment and fiscal subsidies on high-quality development, we observe that Fiscal subsidies are positively correlated with firms' R&D investment at the 1%r cent significance level ($\beta = 0.829, p < 0.01$). This confirms the initial stage of the mediation mechanism's operation. Further examination, in the regression analysis of fiscal subsidies and R&D investment on high-quality development, reveals that once fiscal subsidies surpass a certain threshold, R&D investment exerts a significant negative impact on high-quality development ($\beta = -0.446, p < 0.01$). This suggests that R&D investment partially mediates the effect of fiscal subsidies on the high-quality development of new energy automobile enterprises, yet excessive fiscal subsidies may paradoxically hinder high-quality development.

The intermediary effect test underscores the pivotal role of financial subsidies in fostering R&D investment within new energy automobile enterprises. Originating as a function of enterprise production capabilities, these subsidies serve as a steady catalyst for companies striving to enhance their developmental quality. Indeed, the influence of financial subsidies on R&D investment in the new energy sector is substantial. Yet, a critical observation emerges when subsidies become excessive, they paradoxically hinder the enterprise's potential for high-quality development. Moreover, an abundance of financial support can precipitate managerial and operational challenges, impacting the enterprise's overall efficiency and effectiveness.

4) **Heterogeneity test.** In this section, we conduct a heterogeneity test based on property rights and enterprise maturity to examine the threshold effect of financial subsidies on high-quality development. The results, presented in Table 7, delineate SOES, NSOES, mature enterprises, and newly listed enterprises, revealing distinct patterns: For state-owned new energy automobile enterprises, our findings indicate a dual-threshold effect of financial subsidies on high-quality development. Specifically, subsidies within the range of 19.442 to 19.671, financial subsidies can significantly improve the quality development level of state-owned new energy vehicle enterprises at the 10% significance level ($\beta = 1.325$, $p < 0.1$); Conversely, subsidies outside this range fail to exert a substantial impact on the high-quality development of SOEs in the new energy sector. Regarding NSOEs in the same industry, the analysis reveals that financial subsidies do not significantly influence high-quality development, and no threshold effect

Table 7
Threshold regression analysis of fiscal subsidies and high-quality development

	SOEs	NSOEs	Mature enterprises	Newly listed enterprises
SUB_0	0.912	0.895	0.931**	−2.779***
	[1.34]	[1.45]	[2]	[−2.65]
SUB_1	1.325*			
	[1.98]			
SUB_2	0.464	0.642	0.424	−2.549**
	[0.71]	[1.14]	[0.94]	[−2.54]
Z	0.013	0.002	0.006	−0.005
	[0.74]	[0.15]	[0.43]	[−0.22]
Size	−0.366	−0.721	0.157	−0.103
	[−0.23]	[−0.72]	[0.16]	[−0.05]
Growth	0.076***	0.057***	0.067***	0.053***
	[5.23]	[6.87]	[7.94]	[3.75]
Age	−0.556**	0.126	0.11	−0.423
	[−2.14]	[0.73]	[0.75]	[−0.86]
LEV	−0.163**	−0.121***	−0.178***	−0.058
	[−2.62]	[−3.26]	[−4.49]	[−1.01]
Cons_	50.3	45.849**	25.454	87.386**
	[1.42]	[2.55]	[1.42]	[2.24]
N	156	396	432	120
R2	0.422	0.176	0.240	0.282
F	11.15***	9.85***	15.94	5.23

exists between the two variables. When stratifying by the duration since listing, for enterprises listed for over three years (categorized as mature), a single threshold effect of fiscal subsidies on high-quality development becomes evident, with a pivotal value of 19.741. Fiscal subsidies below 19.741 are associated with a notable positive impact on the high-quality development of mature new energy enterprises. However, subsidies exceeding 19.741 do not yield a significant positive effect on mature new energy enterprises. Contrastingly, for firms listed within the past three years (classified as newly listed), fiscal subsidies do not demonstrate a significant positive impact on high-quality development.

Table 8 encapsulates the outcomes of the mediation effect tests conducted for SOES, NSOES, and mature enterprises listed for at least three years. The investigation centered on the influence of financial subsidies and R&D investment on enterprise high-quality development.

A notable finding is the mediating role of R&D investment in the relationship between financial subsidies and high-quality development within SOES specializing in new energy automobiles. Specifically, when financial subsidy falls within the range of 19.442 to 19.671, R&D investment significantly amplifies the high-quality development of these SOES. This substantiates the proposition that moderate financial subsidies catalyze R&D investment, which in turn propels the high-quality development of SOES in the new energy vehicle sector. However, subsidies beyond 19.671 lead to a detrimental effect, where R&D investment impedes the high-quality development of SOES.

Conversely, the hypothesized mediating effect of R&D investment in the relationship between financial subsidies and high-quality development in NSOEs does not materialize. Our data reveal no significant mediation effect under these conditions.

For mature enterprises, the analysis fails to detect a mediating effect of R&D investment between financial subsidies and high-quality development. This implies that other factors might be

Table 8
Threshold effects of fiscal subsidies and R&D investment on high-quality development

	SOES		NSOES		MES		NLES	
variable	RD	HQD	RD	HQD	RD	HQD	RD	HQD
SUB	2.13***		0.787***		0.842***		0.858*	
	[3.76]		[2.67]		[3.15]		[1.89]	
RD_0		0.077		−0.124		−0.142		0.153
		[0.49]		[−1.28]		[−1.58]		[0.66]
RD_1		1.032***						
		[3.72]						
RD_2		−0.521**		−0.363***		−0.54***		−0.048
		[−2.61]		[−2.9]		[−4.58]		[−0.23]
Z	−0.013	0.015	−0.02**	0.005	−0.026***	0.006	0.037***	−0.01
	[−0.97]	[0.83]	[−2.37]	[0.32]	[−3.14]	[0.45]	[3.32]	[−0.4]
Size	−2.46***	−0.291	−1.132**	−0.318	−0.769	0.891	−5.178***	−1.408
	[−3.34]	[−0.19]	[−1.98]	[−0.38]	[−1.35]	[1.07]	[−5.22]	[−0.67]
Growth	0.033*	0.069***	−0.007	0.056***	−0.007	0.06***	0.013*	0.053***
	[1.84]	[4.68]	[−1.43]	[7.11]	[−1.44]	[7.26]	[1.87]	[3.67]
Age	−0.01	−0.444	0.176*	0.176	0.281***	0.143	1.262***	−0.29
	[−0.1]	[−1.58]	[1.78]	[1.03]	[3.26]	[0.96]	[5.08]	[−0.51]
LEV	−0.052	−0.153**	0.005	−0.134***	0	−0.17***	−0.026	−0.058
	[−1.45]	[−2.42]	[0.24]	[−3.64]	[0]	[−4.27]	[−0.9]	[−1.03]
Cons_	37.672***	61.35*	26.176**	50.304***	14.684	25.923	109.9***	72.2
	[3.58]	[1.78]	[2.61]	[2.9]	[1.38]	[1.45]	[5.65]	[1.58]
N	156	156	396	396	432	432	120	120
R2	0.143	0.431	0.068	0.185	0.101	0.225	0.324	0.244
F	4.13***	11.57***	3.94***	10.50***	6.61***	14.64***	7.51***	4.29***

Table 9
Robustness test results

	Threshold effect	Threshold effect	Threshold effect	Intermediary effect
Variable	Entirety	SOES	Mature enterprises	SOES
SUB_0	0.046	0.587***		
	[1.00]	[4.61]		
SUB_1		0.444***	0.271*	
		[4.09]	[1.85]	
SUB_2		0.371***	0.196	
		[3.55]	[1.47]	
RD_0				0.073***
				[3.29]
RD_1				0.139***
				[3.66]
RD_2				0.038
				[1.45]
Z	0.001	−0.006*	0.009***	6.48E-5
	[1.00]	[−1.76]	[2.99]	[0.03]
Size	0.309***	0.262	−0.476*	0.15
	[2.66]	[0.76]	[−1.68]	[0.58]
Growth	0.004***	0.004*	0.001	0.005**
	[5.25]	[1.91]	[0.72]	[2.35]
Age	−0.1***	−0.195***	0.19**	−0.112**
	[−4.06]	[−2.98]	[2.31]	[−2.3]
LEV	−0.013***	0.007	−0.015*	−0.016*
	[−3.59]	[0.65]	[−2.01]	[−1.8]
Cons_	−5.951**	−10.42	6.509	−1.476
	[−2.55]	[−1.38]	[1.14]	[−0.26]
N	368	104	80	104
R2	0.181	0.572	0.380	0.398
F	9.95***	7.36***	4.64***	5.79***

Note: Only significant results are shown in the table

more influential in shaping the high-quality development of mature enterprises.

In a stark contrast, for newly listed firms, R&D investment is found to notably suppress the level of high-quality development once financial subsidies surpass a certain threshold. This finding underscores the complex interplay between financial subsidies, R&D investment, and high-quality development in nascent enterprises.

The heterogeneity test outcomes elucidate that financial subsidies significantly impact the R&D investment of new energy enterprises. However, the question remains as to whether such investments effectively translate into enhanced production capabilities and, consequently, high-quality development. Notably, the transformation efficacy varies markedly across different enterprise types.

For SOES, financial subsidies within the range of 280 million to 350 million yuan positively stimulate R&D investment. Yet, subsidies below 280 million yuan fail to substantially influence the high-quality development of new energy vehicle enterprises. Paradoxically, excessively high subsidies can hinder high-quality development, potentially engendering management and operational complexities.

In contrast, for NSOES and newly listed enterprises, financial subsidies of up to 440 million yuan notably boost R&D investment levels. Nonetheless, this increase does not invariably correlate with a significant uplift in high-quality development. Instead, subsidies exceeding 440 million yuan tend to result in a reduction of R&D investment, thus impeding high-quality development. This scenario is particularly pertinent to NSOES and newly listed enterprises that often depend on governmental support.

Beyond fiscal aid, bolstering internal management and enhancing operational efficiency is crucial for achieving comprehensive high-quality development in enterprises. Such measures complement external financial incentives, ensuring that resources are optimally utilized toward sustainable growth.

5) **Robustness test.** This section reports the robustness checks conducted on the empirical findings. Robustness is assessed through recalculating the comprehensive indicators of high-quality development via factor analysis and adjusting the sample period to 2019–2022. Subsequently, the empirical model is re-estimated. The results of the robustness test are obtained as shown in Table 9.

Firstly, while the aggregate threshold effect test for the new energy automobile industry did not reveal a discernible impact of financial subsidies on high-quality development, further disaggregation by ownership type and enterprise maturity proved illuminative. Specifically, SOES and mature enterprises exhibited a threshold effect, indicating that financial subsidies within a moderate range significantly foster high-quality development. Conversely, subsidies outside this optimal range negatively affect high-quality development, potentially undermining enterprise growth.

Moreover, in the final mediation effect test for SOES, it was confirmed that financial subsidies within the aforementioned range facilitate high-quality development by stimulating R&D investment. This suggests a mediating role of R&D investment in the relationship between financial subsidies and high-quality development, particularly for SOES.

5. Conclusions and Recommendations

Compared to the existing literature, this paper analyzes the impact of financial subsidies on the quality development of enterprises from the micro level, which fills the lack of research in the field of new energy vehicle enterprises in the existing literature; A panel data threshold regression model was used, which was able to effectively identify the non-linear relationship between fiscal subsidies and quality development of enterprises, and determine the optimal interval of the level of fiscal subsidies. The article introduces R&D investment as a mediating variable and explores the indirect transmission path of financial subsidies on the quality development of firms, which enriches the study; The article distinguishes between state-owned and non-state-owned firms, and mature and newly listed firms, and analyzes the differences in the impact of tax subsidies on the quality development of different types of firms, which are more relevant. Of course, there are some shortcomings and improvements in this paper: The article selected three dimensions of financial performance, development capability, and development sustainability to measure the quality development of enterprises, and other factors that may affect the quality development of enterprises can be considered; The threshold effect test shows that there is no threshold effect of financial subsidies on the level of quality development of non-SOEs and newly listed enterprises, which can be further explored as an intrinsic reason.

This study employs a threshold regression model to explore the threshold effect between financial subsidies and the high-quality development of China's new energy automobile enterprises. The empirical findings reveal a pronounced threshold effect between

financial subsidies and the high-quality development of state-owned new energy automobile enterprises. Specifically, when financial subsidies range from 280 million yuan to 350 million yuan, an increase in subsidies significantly fosters high-quality development. Conversely, subsidies below 280 million yuan or above 350 million yuan do not optimize the impact of financial assistance, leading to diminished returns on subsidy investment.

Financial subsidies, however, do not exert a discernible influence on the high-quality development of non-state-owned new energy automobile enterprises. A similar threshold effect is observed in mature new energy automobile enterprises, where subsidies under 370 million yuan correlate with enhanced high-quality development. Yet, subsidies exceeding 370 million yuan fail to elicit a corresponding improvement in development quality. The mediating effect analysis, conducted for state-owned new energy automobile enterprises, indicates that financial subsidies bolster high-quality development by stimulating R&D inputs. Nevertheless, once subsidies surpass a critical threshold, R&D investment displays a marked inhibitory effect on high-quality development, suggesting that excessive policy subsidies can paradoxically stifle innovation and development. The evidence suggests that higher levels of R&D investment can have a detrimental impact on the quality of development in both non-state-owned new energy firms and those that have recently been listed on the stock exchange. This is particularly the case when financial subsidies are in excess of a certain level. This indicates that discrepancies in the characteristics of property rights and the duration of listing for the firms in question result in variations in the influence of financial subsidies on quality development.

Based on the results of the empirical analyses in this paper, the following recommendations are made at the governmental and societal levels Government administration: Firstly, in order to improve the efficacy of government subsidies, it is essential to enhance the guiding role of independent innovation for enterprises, introduce robust evaluation systems and standards, establish graded subsidy levels, and implement differentiated subsidy levels based on the evaluation results of enterprises. This approach will ensure the diversification of subsidy means, differentiation of subsidy amounts, and the optimal utilization of subsidies. Concurrently, a subsidy threshold is established, and when the subsidy exceeds this threshold, an early warning mechanism is put in place to guarantee the continued existence of market competition among enterprises, to reinforce their capacity for independent innovation, and to guarantee the sustainability of high-level enterprise development.

Secondly, financial subsidies should be based on the differences in management, operation, and development between state-owned and non-SOEs, with the establishment of differentiated subsidies. The current subsidy method is effective for the high-quality development of SOEs, but not for non-SOEs. Furthermore, even when market competition is broken, the method still has an inhibiting effect on the high-quality development of most enterprises. It is therefore recommended that the development characteristics of non-state-owned new energy enterprises be further combined through the introduction of technology, highly sophisticated talent, and the sharing of scientific research results. This will improve the high-quality development of new energy automobile enterprises, coupled with reasonable financial subsidies, which will in turn significantly improve the high-quality development of non-state-owned new energy automobiles, finally strengthening market regulation. By drawing on the experience of the United States, Germany, and other developed countries, it is possible to regulate the qualification evaluation mechanism of financial subsidies in order to guide enterprises toward improving their technological innovation ability through financial subsidies. This will also serve to reduce the rent-seeking behavior of enterprises not eligible for subsidies. Furthermore, the information disclosure system of enterprises can be improved and perfected in order to strengthen public supervision and reduce the waste of resources caused by asymmetric information. This will also serve to improve the efficiency of the use of financial subsidy funds. The result of this will be a more effective financial subsidy, which will promote the creation and innovation of the entire new energy automobile industry and drive the high-quality development of the industry.

Social significance: First, enterprises should deepen their understanding of the impact of fiscal subsidy policies on enterprise development, including both positive impacts and potential risks, in order to better exploit policy dividends and avoid policy risks. Second, enterprises should increase their R&D investment, enhance their innovation capability, optimize the allocation of resources, improve the efficiency of the use of funds, and allocate more of their financial subsidies to key areas such as R&D investment and talent training.

Acknowledgement

The authors are grateful to all the participants who generously contributed their time and data for this research. Furthermore, the authors would like to acknowledge the assistance provided by the staff at the [Wind data platform] in the collection and management of data.

Funding Support

This research was funded by the National Social Science Fund of China (NO:23&ZD127).

Ethical Statement

This study does not contain any studies with human or animal subjects performed by any of the authors.

Conflicts of Interest

The authors declare that they have no conflicts of interest to this work.

Data Availability Statement

The data that support the findings of this study are openly available in [Wind] at https://www.wind.com.cn/portal/zh/WFT/index.html

Author Contribution Statement

Leyan Zuo: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization, Project administration. **Mengxin Wang:** Conceptualization, Methodology, Software, Resources, Data curation, Writing – review & editing, Supervision, Project administration. **Siyu Zhang:** Methodology, Software, Validation. **Songlan Zhou:** Funding acquisition.

References

[1] Yin, S., Liu, L., & Mahmood, T. (2023). New trends in sustainable development for industry 5.0: Digital green innovation economy. *Green and Low-Carbon Economy*, *2*(4), 269–276. https://doi.org/10.47852/bonviewGLCE32021584

[2] Zheng, F., Shen, X., & Lu, R., (2021). Heterogeneous influence of government subsidies on enterprise performance: Based on the perspective of industry life cycle. *Economic Survey*, *38*(1), 96–104. http://doi.org/10.15931/j.cnki.1006-1096.2021.01.007

[3] Kang K.-N., & Park H. (2012). Influence of government R&D support and inter-firm collaborations on innovation in Korean biotechnology SMEs. *Technovation*, *32*(1), 68–78. https://doi.org/10.1016/j.technovation.2011.08.004

[4] Ma, Y., Yin, L., & Lv, L. (2022). Monetary policy, fiscal subsidy and corporate innovation. *Accounting Research*, (2), 56–69.

[5] Yang, Y., Wei, J., & Luo, L. (2015). Who innovate from the government subsidies? The joint moderate effects of the ownership and the factor market distortions. *Journal of Management World*, (1), 75–86. https://doi.org/10.19744/j.cnki.11-1235/f.2015.01.009

[6] Wang, Y. C., Li, L., & Wang, B. H. (2019). On the effects of tax incentives and subsidies on promotion of enterprise innovation. *Taxation Research*, (6), 92–98. https://doi.org/10.19376/j.cnki.cn11-1011/f.2019.06.017

[7] Bizan O. (2003). The determinants of success of R&D projects: Evidence from American–Israel research alliances. *Research Policy*, *32*(9), 1619–1640. https://doi.org/10.1016/S0048-7333(03)00044-1

[8] Wu, J., Tian, Z., & Long, X. (2018). The impact of government subsidies on corporate innovation in strategic emerging industries. *Studies in Science of Science*, *36*(1), 158–166. https://doi.org/10.16192/j.cnki.1003-2053.2018.01.018

[9] Yin, S., Yu, Y., & Zhang, N. (2024). The effect of digital green strategic orientation on digital green innovation performance: From the perspective of digital green business model innovation. *SAGE Open*, *14*(2), 21582440241261130. https://doi.org/10.1177/21582440241261130

[10] Guo, D., Guo, Y., & Jiang, K. (2016). Government-subsidized R&D and firm innovation: Evidence from China. *Research Policy*, *45*(6), 1129–1144. https://doi.org/10.1016/j.respol.2016.03.002

[11] Zeng, Z. (2021). *Research on the impact of government subsidies enterprise innovation quality: From the perspective of enterprise heterogeneity*. Master's Thesis, Sichuan University. http://doi.org/10.27342/d.cnki.gscdu.2021.000025

[12] Li, L. (2018). The research on the impacts of government R&D subsidies on the technological innovation output of new energy vehicle industry. *Science and Technology Management*, (17), 160–166. http://doi.org/10.3969/j.issn.1000-7695.2018.17.025

[13] Hu, S., & Liang, Z. (2021). On the evolution and enlightenment of the fiscal subsidies policy of new energy automobiles. *Journal of Shanxi Finance & Taxation College*, *23*(5), 3–9. http://doi.org/10.3969/j.issn.1008-9306.2021.05.002

[14] Guo, X., Pu, G., & Wang, F. (2023). New energy vehicles subsidy policy design, demand changes, and industrial technology upgrading. *China Soft Science*, (10), 109–118.

[15] Zhu, Z., & Liao, H. (2019). Do subsidies improve the financial performance of renewable energy companies? Evidence from China. *Nature Hazards*, *95*, 241–256. https://doi.org/10.1007/s11069-018-3423-8

[16] Chen, C. (2024). An optimization path for fair competition review of financial subsidies from the perspective of a unified national market. *Southeast Academic Research*, (4), 109–120. http://doi.org/10.13658/j.cnki.sar.2024.04.020

[17] Yu, S., Lu, T., Hu, X., Liu, L., & Wei, Y. (2021). Determinants of overcapacity in China's renewable energy industry: Evidence from wind, photovoltaic, and biomass energy enterprises, *Energy Economics*, *97*, 105056. https://doi.org/10.1016/j.eneco.2020.105056

[18] Lin, Y., Wu, H., & Xing, Y. (2010). Wave phenomena and formation of excess capacity. *Economic Research Journal*, (10), 4–19. CNKI:SUN:CHJJ.0.2010-00-023

[19] Yu, F., Guo, Y., Le-Nguyen, K., Barnes, S. J., & Zhang, W. (2016). The impact of government subsidies and enterprises' R&D investment: A panel data study from renewable energy in China. *Energy Policy*, *89*, 106–113. https://doi.org/10.1016/j.enpol.2015.11.009

[20] Li, M., Wang, H., & Yan, K. (2021). Economic growth targets and crowding-out effect of R&D: An empirical study based on multi-objective assessment theory. *Nankai Business Review*, *24*(1), 17–26.

[21] Ying, Q., & He, S. (2022). Corporate innovation strategies under the government's R&D subsidies: "Making up the number" or "strive for excellence"? *Nankai Business Review*, *25*(2), 57–69. http://doi.org/10.3969/j.issn.1008-3448.2022.02.007

[22] Yang, D., & Zhu, Y. (2019). Guiding for promotion or "icing on the cake": Reexamine causal relationship between China government's financial subsidy and enterprises' R&D input. *Management Review*, *31*(6), 77–90. http://doi.org/10.14120/j.cnki.cn11-5057/f.2019.06.003

[23] Czarnitzki, D., Hanel, P., & Rosa, J. M. (2011). Evaluating the impact of R&D tax credits on innovation: A microeconometric study on Canadian firms. *Research Policy*, *40*(2), 217–229. https://doi.org/10.1016/j.respol.2010.09.017

[24] Yan, Z., & Yu, J. (2017). Government subsidy and firms' total factor productivity: A comparative analysis of emerging industry and traditional manufacturing industry. *Industrial Economics Research*, *86*(1), 1–13. https://doi.org/10.13269/j.cnki.ier.2017.01.001

[25] Jiang, G. (2022). The equilibrium effects of Chinese industry policy—Based on perspective of government subsidy. *China Industrial Economics*, (6), 98–116. https://doi.org/10.19581/j.cnki.ciejournal.2022.06.019

[26] Duan, S., & Yang, B. (2020). Innovation incentive effect of fiscal subsidies and tax incentives – From the private scientific and technological enterprise's explanation. *Science & Technology Progress and Policy*, (16), 120–127. https://doi.org/10.6049/kjjbydc.Q201908279

[27] Ouyang, M., & Zhang, Y. (2018). Fiscal subsidies, distorting competition and overcapacity in the automobile industry. *Public Finance Research*, (12), 84–96. CNKI:SUN:CZYJ.0.2018-12-008

[28] Peng, P., & He, X. (2021). Government subsidies and development of new energy vehicle industry—Evolutionary game analysis based on system dynamics. *Operations Research and Management Science*, *30*(10), 31–38. https://doi.org/10.12005/orms.2021.0310

[29] Sun, C., & Zhan, Y. (2023). The impact of electricity price subsidy on technological innovation of new energy manufacturing enterprises: Evidence from the wind power and solar PV equipment manufacturing industry. *The Journal of Quantitative & Technical Economics*, (2), 158–180. https://link.cnki.net/doi/10.13653/j.cnki.jqte.2023.02.006

[30] Chen, Y., Chu, D., & Zhang, C. (2019). Study on the incentive effect of fiscal subsidies for strategic emerging industry in China. *Collected Essays on Finance and Economics*, (5), 33–41. https://doi.org/10.3969/j.issn.1004-4892.2019.05.004

[31] Liu, Z., Zhou, J., & Li, J. (2019). Not only additionality: The dual effects of subsidies on firm Innovation. *Science of Science and Management of S. & T.*, (1), 51–64. CNKI:SUN:KXXG.0.2019-01-004

[32] Yu, D., & Wang, J. (2022). Research on the impact of government subsidies on enterprise innovation in different life cycles. *Journal of Finance and Economics*, *48*(1), 19–33.

[33] Li, R., & Bai, J. (2013). The effect of government R&D subsidies on enterprise technology innovation: An empirical research based on threshold regression. *Economic Issues in China*, (3), 11–23. https://doi.org/10.19365/j.issn1000-4181.2013.03.002

[34] Haans, R. F., Pieters, C., & He, Z. L. (2016). Thinking about U: Theorizing and testing U-and inverted U-shaped relationships in strategy research. *Strategic Management Journal*, *37*(7), 1177–1195. https://doi.org/10.1002/smj.2399

[35] Wu, X., Chen, Y., &Yang, W. (2016). A research on the effect of government subsidies on R&D investment of strategic emerging industries. *Science Research Management*, (5), 19–23. CNKI:SUN:KYGL.0.2016-05-003

[36] Li, X., & Xu, Y. (2019). Research on the promoting effect and threshold effect of government subsidy on enterprise innovation performance—Based on data of listed companies of electronic and information industry in Shanghai and Shenzhen. *China Soft Science*, (5), 31–39. https://doi.org/10.3969/j.issn.1002-9753.2019.05.004

[37] Zhang, H., Liu, J., & He, Z. (2016). The impact of government subsidies on firms' R&D investment: A threshold analysis based on the database of Chinese industrial enterprises. *Economic Perspectives*, (12), 28–38. CNKI:SUN:JJXD.0.2016-12-004

[38] Liu, L., Zhang, M., & Huang, T. (2021). The impact of government subsidies and tax preferences on patent quality and its threshold effect—An empirical analysis based on the listed companies in the new energy automobile industry. *Science Research Management*, *42*(6), 9–16. https://doi.org/10.19571/j.cnki.1000-2995.2021.06.002

[39] Wu, J., Ren, Y., & Zhang, X. (2022). Research and development investment, government subsidies and enterprise value of enterprises in the new energy vehicle industry chain. *The Theory and Practice of Finance and Economics*, (6), 140–147. https://doi.org/10.16339/j.cnki.hdxbcjb.2022.06.019

[40] Yin, S., & Zhao, Y. (2024). An agent-based evolutionary system model of the transformation from building material industry (BMI) to green intelligent BMI under supply chain management. *Humanities and Social Sciences Communications*, *11*(1), 1–15. https://doi.org/10.1057/s41599-024-02988-5

[41] Li, X., Chen, J., & Fan, L. (2022). The coupling relationship between digital economy and high-quality development of economy. *On Economic Problems*, (9), 34–40.

[42] Xin, L., & An, X. (2019). Construction and empirical analysis of agricultural high-quality development evaluation system in China. *Economic Review Journal*, (5), 109–118. https://doi.org/10.16528/j.cnki.22-1054/f.201905109

[43] Yang, L., & Sun, Z. (2015). The development of western new-type urbanization level evaluation based on entropy method. *On Economic Problems*, (3), 115–119. https://doi.org/10.16011/j.cnki.jjwt.2015.03.023

[44] Sun, X., & Xin, M. (2013). Are the more R&D investments the better? The threshold regression analysis based on Chinese industrial department panel data. *Studies in Science of Science*, *31*(3), 377–385. https://doi.org/10.16192/j.cnki.1003-2053.2013.03.008

[45] Dai, Z., Gu, L., & Chu, Z. (2021). Research on the impact of R&D investment on firm performance: Based on threshold regression of firm financialization level. *Journal of Industrial Engineering and Engineering Management*, *35*(2), 36–43. https://doi.org/10.13587/j.cnki.jieem.2021.02.004

[46] Liu, D., Huang, J., & Zheng, Y. (2023). The influencing mechanism of technological innovation efficiency of listed logistics enterprises in China: Based on the threshold perspective of government subsidies and equity concentration. *Science and Technology Management Research*, *43*(24), 117–127. https://doi.org/10.3969/j.issn.1000-7695.2023.24.014

[47] Tang, X. (2004). How to operate intangible assets into core competence. *China Industrial Economics*, (1), 87–92. https://link.cnki.net/doi/10.19581/j.cnki.ciejournal.2004.01.012

How to Cite: Leyan, Z., Songlan, Z., Mengxin, W., & Siyu, Z. (2025). Research on the Impact of Fiscal Subsidies on High-Quality Development of New Energy Vehicle Companies Based on Threshold Effects. *Journal of Comprehensive Business Administration Research*. https://doi.org/10.47852/bonviewJCBAR52023926