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Analysis of the Threshold Effect of Renewable Energy Industry Subsidies Based on the Perspective of Industry Life Cycle

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Abstract: Based on the industry life cycle theory, this study investigates the influence mechanism of renewable energy industry subsidies on industry development. Using data from 78 public Chinese electric power enterprises in the A-share market from 2011 through 2020, the threshold effect of government subsidies on the development of the renewable energy industry is empirically tested, and the heterogeneity of subsidy efficiency in the renewable energy industry is explored. The results reveal an inverted U-shaped nonlinear relationship between government subsidies and the enterprise output of the sample electric power enterprises. In addition, market investment has a positive and limited effect on enterprise output, and there is heterogeneity in subsidy efficiency and the signalling effect of subsidies on investment in the wind and photovoltaic power industries. Accordingly, we recommend that government departments use rational and flexible subsidy policy tools according to different industries, set reasonable subsidy ranges, and proactively design top-level policies that will actively broaden the application of renewable energy consumption to help industry development. By examining the overall threshold effect of electric power enterprises, this study fills a gap in the literature, as there has been scant research on the specific relationship between renewable energy industry subsidies and industry development.

Keywords: renewable energy; industry subsidies; industry life cycle; market investment; threshold effect

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1. Introduction

The effectiveness of industry subsidies not only attracts the attention of industry practitioners and policy makers but is also a matter of debate in the academic community, primarily due to the differences in the focus of each study and the different samples selected for analysis. Under the global trend of energy transition, promoting the renewable energy industry is inevitable. Renewable energy subsidies are common policies countries adopt to promote the growth and development of the renewable energy industry. However, industry subsidies are not the only effective means to promote renewable energy production and consumption, and excessive renewable energy subsidies can have economic costs [1].

The high dependence on subsidies is an important issue globally. In 2008, the EU Summit issued the "Renewable Energy Directive", with member states providing subsidies for specific areas such as hydropower, wind power, solar power, and biomass in their national action plans. China's renewable energy subsidy gap exceeded 100 billion yuan ($15 billion) in 2020, and the bill passed by the US Senate in 2022 totalling $430 billion explicitly provides long-term tax credits for wind and solar energy projects and additionally

increases tax credits for energy storage, biogas, and hydrogen. Globally, renewable energy businesses have been built on the backs of government subsidies. Excessive subsidies not only create financial constraints but also make renewable energy companies too dependent on the subsidies, which is not conducive to the healthy and sustainable development of the industry.

Renewable energy is recognised as a key to reducing global warming and carbon dioxide emissions. To achieve the global goal of "reducing carbon dioxide emissions, thereby mitigating the greenhouse effect and controlling the rise in global temperatures", many governments have formulated policies. For example, the Biden administration in the United States has set the goal of developing a carbon-neutral power sector by 2035 and a net-zero-emission economy no later than 2050. As green and clean energy, the ecological value brought by renewable energy input has positive externalities, and industry subsidies are a common means to solve these. In addition, the renewable energy industry is a new strategic industry, and industry subsidies are correlated with industry output. Along with the reform of renewable energy subsidies, the following questions need to be answered: what is the relationship between subsidies and industry development, and is there heterogeneity in the effect of subsidies in different renewable energy industries?

One of the bottlenecks of renewable energy development is the financial constraint of enterprises [2]; therefore, another pertinent question is: what is the relationship between market investment and government subsidies as different sources of funding for industry development, and do government subsidies have a crowding-out effect on market investment?

While there is no consistent conclusion on the policy effects of industry subsidies, there is a nonlinear relationship between industry subsidies and economic development. Additionally, a nonlinear relationship exists between industry subsidies and industry structure transformation and upgrading [3]. Specifically, there are few studies on the relationship between renewable energy industry subsidies and industry development, and they primarily focus on the macroeconomic impact of energy subsidies. Both have shown that subsidy policies can have negative impacts. In the short term, government intervention subsidies will reduce the peak production capacity provided by private sources, while in the long run, they will bring costs to suppliers in the form of regulation, and further subsidies will also create a vicious cycle [3–7]. The main theoretical analysis framework is to apply game theory to the whole industry scope, while the micro-level of the industry is less discussed. Therefore, to explore the most effective way of driving the healthy and sustainable development of the renewable energy industry, this study analyses the threshold effect of industry subsidies based on the mechanisms of subsidies that affect industry development from an industry life cycle theory perspective. Using the data of public upstream electric power enterprises in the renewable energy industry as the research object to illustrate whether renewable energy subsidies can promote industry development, we examine whether there is a crowding-out effect between subsidies and market investment and whether there is a threshold effect on output in different renewable energy generation industries.

This paper proceeds as follows: Literature review is in Section 2, followed by theoretical analysis and hypotheses development in Section 3. Section 4 describes the data and methods, and Section 5 presents the results, analysis, and discussion. The paper concludes with Section 6.

2. Literature Review

Industry subsidies are an essential element of industry policy, and the research on this topic has evolved from 'whether to implement' to 'how to implement'. In 2012, Philippe Aghion and others pointed out that the focus of industry policy should be on how to design and manage it to promote economic growth and social welfare [8]. Industry subsidies, a common government policy to promote industry development, have been a popular topic in the academic field. The literature on industry subsidies in recent years primarily focuses

on the effectiveness of industry subsidy policies using theoretical and empirical approaches, whether industry subsidy policies can properly promote industrial development, and ways to design a more effective and efficient industrial policy. Ref. [9] indicates that the grid electricity price policy can promote the increase of installed capacity [9]. However, Lin and Wesseh Ref. [10] reached different conclusions. Based on the real options model, it verifies that the current level of feed-in electricity prices is not optimal, and feed-in electricity policies cannot maximize incentives for investors with minimal government expenditure. On the whole, the content of the research is in line with the concerns of economic and social development.

The influence of subsidies on industrial development has two sides, which have not only a promoting effect but also an inhibiting effect on industrial development through the crowding-out effect and adverse selection. The effect of subsidies is a process of dynamic adjustment, and the effect of industrial subsidies has heterogeneity. For example, the impact of subsidy policy on different industries is heterogeneous. Wang et al. argued that production subsidies will promote strategic emerging industries and impact traditional industries in the short term. In addition, they will inhibit technological progress in the long term, with the effect of research and development (R&D) subsidies depending on the size of knowledge spillover effects among industries [11]. Within the same industry, the introduction of industrial subsidies with different contents will also have diverse effects. For example, Ref. [12] explores the wind energy industry and, based on a budget balance perspective, uses a two-stage dynamic optimization model to find that capital subsidies will be more effective than electricity price subsidies. It concludes that capital subsidies should be reduced to achieve an effective increase in the generation rate.

Taxes and subsidies, which are frequently used by the government to address externalities, have varied effects on the same industry. Zhang et al. analyse the promotion effects of the two policies, government subsidies and tax incentives, on high-tech industries and conclude that financial subsidies are more effective than tax incentives in terms of output growth, while tax incentives are more effective in promoting the optimization and upgrading of the overall industrial structure [13]. Liu et al. analyse micro-enterprise data and found that for the new energy industry, the effect of tax incentives on total revenue and net profit was also greater than that of financial subsidies [14]. Based on institutional economics, Zhou et al. argue that subsidies cause an increase in transaction costs compared to preferential taxes and that the policy for the new energy vehicle industry should shift from fiscal subsidies to preferential taxes [15]. Marino et al. show that tax incentives and subsidy policies can have a crowding-out effect on enterprise R&D investment, and the crowding-out effect of medium-level subsidies is more pronounced [16]. Gorg and Strob show that with an increase in subsidy intensity, the crowding-out effect of government R&D subsidies on local enterprises' R&D investment becomes apparent [17].

Innovation is essential for sustainable economic development, as it makes a central contribution to the economic development that has become widely agreed upon by economists [18,19]. R&D subsidies are an important part of government subsidies and the most direct and effective policy instrument to promote innovation and development. The role of R&D subsidies in promoting industrial development has both direct and indirect aspects. The direct promotion effect in R&D subsidies is reflected in the increase of enterprises' R&D investment after the inflow of funds; however, the degree of improvement is limited. Wu et al. find that as the intensity of government funding increases, the coefficient of enterprise R&D investment intensity changes from positive to negative, with an inverted 'U' shape relationship between the two [20].

The indirect effect of R&D subsidies is reflected in the improvement of enterprises' R&D innovation capacity and, thus, their innovation performance or technological innovation efficiency. Li et al. find that government subsidies have a positive effect on the innovation performance of listed enterprises in the electronic information industry based on the data of the public companies in Shanghai and Shenzhen, and that there is a threshold effect between the intensity of subsidies and the nature of enterprises [21]. Using a sample

of Beijing districts and counties, Fang et al. demonstrate a threshold effect of subsidies on technological innovation efficiency and a spatial spillover effect [22]. Yuan et al. ascertain the impact of government R&D subsidies on industrial structure transformation and upgrading using inter-provincial panel data from 2005 through 2015 [23]. They find a significant promotion effect of government R&D subsidies on the advancement and rationalization of industrial structure and the heterogeneity of region, enterprise size, and enterprise nature. Palage et al. set the FIT policy as a dummy variable and find that FIT has a significant positive impact on photovoltaic patent activities [24]. Breitschopf uses the policy text method to quantify Germany's photovoltaic power generation policy, and the research results show that demand-driven policies have an incentive effect on photovoltaic technology innovation [25]. Ravseli and Aristovnik find that both government subsidies and tax incentives can motivate companies to innovate [26]. Engel et al. demonstrate that Germany's repeated R&D subsidy projects can more promote the growth of private R&D investment than one-time subsidies [27].

Due to the output effect of subsidies, promoting subsidy policies will affect output and promote industrial development by changing factor prices. However, unreasonable subsidy policies will disrupt the market and make the relevant enterprises overly dependent on government subsidies. With insufficient independent development capacity, it is easy to make enterprises reverse selection, as blind production leads to overcapacity [28]. In 2012, China's photovoltaic overcapacity contradictions erupted and resulted in overcapacity due to the lack of technological innovation capability and the untimely adjustment of the industrial subsidy policy. To maximise social welfare and economic benefits, the government should adjust the target of subsidies to alleviate the problem of energy overcapacity. Huiming et al. state that there is a nonlinear relationship between government subsidies and capacity utilization and that various energy sectors have different subsidy thresholds [29].

As excessive subsidies can cause a waste of resources and a loss of efficiency, the results of removing subsidies will have certain impacts on macroeconomics, industry output, and residents' welfare in many aspects; the degree of the impacts depends on multiple factors, such as the industry and the target of the elimination of subsidies. From an industry perspective, the impact of subsidy removal is twofold: directly, it will affect output through the size of different factor elasticizes, while indirectly, it will effectively improve factor efficiency and promote structural optimization. Yao et al. analysed the possible impact of energy subsidy reform based on the computable general equilibrium (CGE) model and found that the elimination of fossil subsidies would have a positive impact on the macroeconomy from the perspective of subsidy redistribution by using the eliminated fossil subsidies for clean energy, thus resulting in a positive impact on the macroeconomy [30]. Based on a three-sector dynamic stochastic general equilibrium model analysis, Liu argues that too rapid a 'departure' of subsidies would be fatal to industry development, especially for emerging industries [31]. Harberger uses the 2×2 model to consider the impact of corporate income tax by employing the CGE model to analyse tax effects [32]. The two primary factors of production in Harberger's model are capital and labour. His research found that the elasticity of demand substitution by consumers, the elasticity of factor substitution of various products and the capital-intensive degree of products affect the distribution of the tax burden. Subsequently, Thomas extends the model from 2×2 to 2×3 to include resource inputs as factors of production and analyses the response of wages and resource rents (relative to the price of capital) when subsidies are applied to resource inputs in a single sector [33]. The impact of subsidies on resource inputs is determined by the choice of production function.

3. Theoretical Analysis and Hypotheses

3.1. Theoretical Analysis of the Impact of Industry Subsidies

In the 21st century, grid reliability in the face of increasingly frequent severe weather is critical to enhancing national economic competitiveness. Groups such as ACORE, the American Council on Renewable Energy, consider the renewable energy industry to be

an important member of the strategic emerging industries, such as the new energy industry, the energy conservation and environmental protection industry, the new generation information technology industry, the biological industry, and the new energy automobile industry. Developing renewable energy can effectively replace fossil fuels and gradually achieve energy self-sufficiency. It is also an important way to cultivate strategic emerging industries and accelerate technological progress, which is of great significance for adjusting industrial structure, promoting transformation, and upgrading, driving effective investment, stabilizing economic growth, and expanding employment. Based on the perspective of the industry life cycle, strategic emerging industries have strong innovation, positive externality, and uncertainty as compared with traditional industries. However, the lifecycle of strategic emerging industries is also divided into formation, growth, maturity, and decline phases, as in traditional industries.

As a strategic new industry, renewable energy requires large amounts of capital to develop markets and purchase related equipment during the initial period of its industry development. The renewable energy industry in its initial stage represents the direction of economic development, but there are strong uncertainties in various aspects such as technological innovation and product development. Simultaneously, the market for the renewable energy industry in the formative stage is also uncertain, with the acceptance of products and returns on the investment cycle of production. Forced by this stronger uncertainty, the emerging industry faces higher development risk. Therefore, in this early stage, the renewable energy industry is urgently in need of financial support to alleviate the financial pressure.

The growth period is a key stage of the industry and the sustainable development of the renewable energy industry. In this phase, the industry's development potential is weakened when compared to the formative stage; however, the industry's development enters an explosive state, and the market orientation and market value gradually become clearer. The renewable energy industry in this period still remains in need of financial support to drive innovation by enhancing R&D or to increase production capacity to expand market scale quickly. The entry of government subsidies has already created a certain diversion effect, and enterprises can obtain financial support through bank credit or market venture capital. As a strategic emerging industry, the renewable energy industry's technology support brings a level of uncertainty and risk gets lower. The role of financial subsidies at this stage should not simply compensate for the costs of enterprises, but more importantly, the government should consider how to use fiscal policy to motivate enterprises to maintain their leading edge and promote effective market demand.

The mature renewable energy industry is a pillar industry that plays a supporting role in the national economy; simultaneously, it has a strong driving effect on other industries. Due to the scale effect of enterprise production, the market has the highest demand for production products, and the technology is more mature, resulting in the highest product profits during this period. In the maturity period, enterprises need to further capture market share, continue to invest, consolidate initial products, and develop new products to explore new markets in the hopes of forming new economic growth points for the industry. In this period, it is important for enterprises to explore mergers and acquisitions, and the entry of financial subsidies helps the development of industry integration by reducing transaction costs and improving production efficiency. At the external level, the maturity of the industry can continue to develop on its own. Still, for the development of the market for mature enterprises, gradual expansion in the scale of R&D is inevitable, thus forming a barrier to entry for others. In this case, the direction of financial subsidies should be selected by setting market standards and other ways to maintain market competition.

When industry profits continue to decline and market size shrinks, the industry will be replaced by a new industry and enter the final stage of the industry cycle—the recessionary period. When entering this period, the competitiveness of industry products gradually declines, often relying on the original product as it is challenging to obtain new growth points. Along with the maturation of new industries, the self-development capacity of

enterprises gradually takes shape, and the direct investment of financial resources may cause a crowding-out effect on private investment. At this stage, to maintain sustainable development, enterprises must create new technologies and continually transform and upgrade traditional products or models. These two aspects, whether the enterprise's self-intervention or cooperation with other enterprises, require the investment of market funds, and the financial advantages of subsidies are no longer evident. Then, financial subsidy tools should be based on the actual situation and promote enterprises so that new industries are launched, thus optimising the enterprise structure. Some enterprises that still have development potential to adjust may be stimulated to demonstrate certain characteristics of the growth or maturity period.

Financial subsidies and market investments are factors in enterprise capital production. Based on the industry life cycle theory, subsidies, as an important fiscal policy tool, play an essential role in the industry development process. Subsidies have a strong protective effect on growing industries and replace market capital in the initial stages of industry development to compensate for the cost expenditure in the early stages of industry development. They also reflect a certain guaranteed role for enterprises' R&D and innovation. In the growth and maturity of the industry, the role of government subsidies will gradually diminish as the degree of industry development deepens or when the role of subsidies in promoting industry development is no longer purely financial support but more of a directional diversion with various perspectives. Market investment exists throughout the entire industry development cycle and focuses on the growth and maturity of the industry; financial subsidies become complementary to the development of enterprise needs.

3.2. Analysis of the Mechanism of Renewable Energy Subsidies on Industry Development

On the one hand, the government provides subsidies to renewable energy enterprises to enhance the willingness of power generation enterprises to use renewable energy production. In turn, it further motivates and promotes enterprises to strengthen their renewable energy-related production activities and to maximise the positive externalities of renewable energy to achieve social welfare (i.e., the resource effect of subsidies). On the other hand, industry subsidies send signals to social investors, thus producing an investment orientation. In this process, many investors in the market regard government subsidies as a form of information guidance. It is a change in the future development direction of the industry and policy guidance, which may impact the investment and operation behaviour of enterprises inside and outside (i.e., the signal effect of subsidies [34,35]).

Renewable energy power generation is primarily divided into hydropower, wind power, PV power, and nuclear power. Multifarious types of renewable energy power output have certain differences regarding resource endowments, production input factors, and corporate governance. Government subsidies' policy effect in alleviating enterprises' financial difficulties will also create prominently heterogeneous industry characteristics.

3.2.1. Changes in Intra-Firm Production Activities under Subsidies

Government subsidies have incentive effects and crowding-out effects. From the resource allocation perspective, they increase the resources available to enterprises, which, in turn, have different degrees of impact on the enterprise factor inputs, production capacity, and end consumption. Government subsidies can also help enterprises reduce any potential uncertainty brought by production. Renewable energy enterprises seek profit maximization, and renewable energy subsidies can effectively assist in adjusting their production factor inputs by increasing R&D funds to stimulate their innovation activities. They can also optimize the power supplies structure to increase the proportion of renewable energy power supply and provide equipment to expand production.

The effectiveness of subsidies depends on the subsidy elasticity of diverse input factors. However, excessive subsidies can also produce a crowding-out effect on enterprise production, thereby leading to undue reliance on the government. It encourages enterprises to engage in low-cost, low-risk, and ineffective production with higher transaction costs that create excessive pressure on the government's financial subsidy gap. The crowding-out effect arises from information asymmetry, as the government cannot make a true and accurate judgment of the enterprises' actual subsidy use, profitability, and development status. Enterprises seek government subsidies for various purposes, and under government subsidies for industry development, it is rational for them to enter the renewable energy industry. Subsequently, the enterprises may use the subsidies for economic activities for other purposes instead of expanding production thus resulting in adverse selection.

Different renewable energy enterprises have diversified structures of specific input factors; for example, nuclear power generation requires a considerably high technology level, while wind power generation and PV power generation are primarily equipment inputs and human capital inputs for operation. Therefore, after obtaining subsidies, enterprises will increase or compensate for the various factors of production to expand production, thus leading to inter-industry divergences concerning the resource allocation effect of subsidies.

3.2.2. Changes in Firms' External Investment Activities under Subsidies

Government subsidies can transmit incentive or disincentive effects to market investors. In addition to government subsidies' impact on enterprises' internal production, they also produce an additional investment guidance effect. On the one hand, market investors will take the subsidies as a sort of government recognition of the industry's development support, indicating that such enterprises have long-term development potential. This situation effectively reduces market investors' concerns about market uncertainty and leads them to their acceptance of subsidised enterprises, enhances the enterprises' financing ability, increases debt servicing ability, and promotes market vitality. However, the development of China's renewable energy industry is characterised by long investment cycles, low returns, and high initial investment amounts, and the complete elimination of subsidies may lead to capital outflows and a decline in market transactions. This condition may ultimately affect industry output and enterprise development.

When further considering the heterogeneity of subsidy effects in divergent renewable energy industries, the investment signal effect of subsidies will also be heterogeneous. Under the premise of rational assumption, market investments are profit-seeking and pursue the maximization of payoff within an investment period. Government investments prefer to achieve the win-win situation of project profit and social welfare. Therefore, when investing in a project, the investment body will consider the input-output structure of the industry as much as possible and then decide in line with the goal of maximizing benefits. Diverse renewable energy resources have varying factor concentration characteristics, so the market investment flow also differs according to the diversity in the input-output structure. That is, the investment signal effect of subsidies has industry heterogeneity.

The impact of government subsidies on developing the renewable energy industry under energy transition is shown in Figure 1.

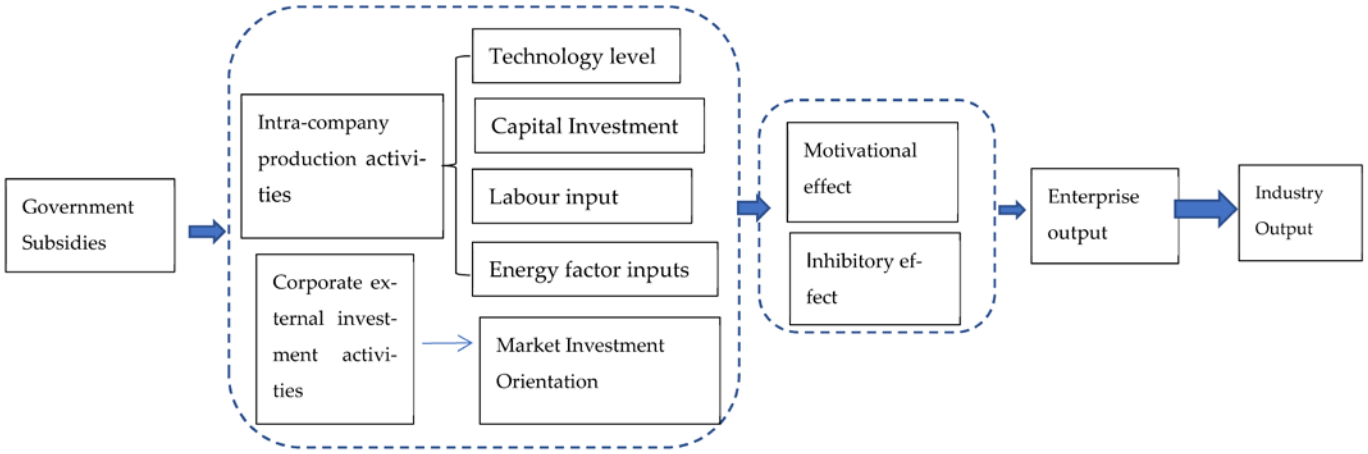


Figure 1. The impact path of government subsidies on the development of the renewable energy industry under energy transition.

3.3. Hypotheses

From the perspective of the industry life cycle, as a member of strategic emerging industries, the life cycle of the renewable energy industry is also divided into the formation period, growth period, maturity period, and decline period, just like the traditional industry. Subsidies play different roles in the formation period, growth period, maturity period, and decline period. Based on this, Hypothesis 1 is proposed.

Hypothesis 1. *There is a nonlinear relationship between subsidies and industry output, and there exists a reasonable interval that maximises output.*

According to the analysis of the changes in enterprises' internal production activities under subsidies and enterprises' external investment activities under subsidies, it is found that the proportion of enterprise input factors is different in different industries. Subsidies will adjust the proportion of factor input to adjust the business direction of enterprises, affect the business decisions of enterprises, and then affect industry development. When the government carries out industry subsidies to different industries, it will pass an incentive effect or inhibition effect to market investors. Based on this, Hypothesis 2, Hypothesis 3, and Hypothesis 4 are proposed.

Hypothesis 2. *Subsidies and market investment act together on industry development, and the effect is a nonlinear relationship.*

Hypothesis 3. *The subsidy effect varies across industries.*

Hypothesis 4. *The market investment effect varies across industries.*

4. Data Description and Model Selection

4.1. Model Construction

The threshold effect refers to the structural mutation caused by one economic parameter when it reaches a certain value and causes another economic parameter to occur, and the specific value that causes the mutation is called the threshold value. The essential idea is to divide the sample data into different sample intervals with threshold values to construct segmentation functions and find the correlation between the explanatory and explained variables [36]. While there may not be a generalized linear relationship between the effect of subsidies on renewable energy output, there is a linear relationship across all stages of the industry cycle. This study uses the panel threshold regression model proposed by

Hansen and introduces subsidy intensity as a threshold variable to examine the relationship between subsidies and output [37]. Accordingly, the following panel threshold model is constructed:

$$Y_{it} = \beta_0 R_{it} I(q_{it} \leq \gamma) + \beta_1 R_{it} I(q_{it} > \gamma) + \beta_2 z_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

In Equation (1), i denotes different firms, t denotes time, Y_{it} denotes the actual output of firm i in period t, q_{it} is the threshold variable, R_{it} is the core explanatory variable affected by the threshold variable, γ is the threshold value, z_{it} is the other control variables affecting the firm's output, μ_i is the individual fixed effect of the firm, and ε_{it} is the residual term. I(-) is the indicator function whose value depends on the threshold variable q_{it} and the threshold value γ, when the bracketed condition holds, I(-) is 1, and I(-) is 0 when it does not hold.

4.2. Sample and Indicator Selection

4.2.1. Sample Selection

This study uses publicly disclosed data in the financial statements of the public electric power companies in the A-share market from 2011 through 2020 for the threshold effect analysis of industry subsidies. The data are obtained from the China Statistical Yearbook, the China Stock Market & Accounting Research Database, and the Wind database. According to the Shenwan industry classification, there are 96 public electric power enterprises. When we exclude missing data, extreme values, and other factors, 78 public electric power industry enterprises are selected for the analysis. The total sample size is 858, where individual missing data are approximated by the mean value method for substitution or extrapolated according to the average growth rate of existing data.

4.2.2. Indicator Selection

The explained variable is firm output (Y), which is expressed using the net profit (*Tobin*) of each listed firm, which is the remaining part of the total profit after deducting taxes. It serves as a financial indicator, reflecting the enterprise's ability to continue business.

The core explanatory variables are the government subsidies (*Sub*) and market investment *(I)* received by the enterprises. The government subsidies are expressed by the government subsidies (*Sub*) indicator disclosed in the financial statements of each listed company. The market investment is expressed by the number of shares held by institutional investors in listed companies (*Share*). Institutional investors have more industry investment information and professional investment skills than ordinary investors, so the number of shares held by institutional investors is used to represent a market investment.

The threshold variable is enterprises' subsidy intensity (RD), which is expressed by the ratio of subsidy amount to primary business revenue. Subsidy intensity is a relative indicator that can more accurately reflect the dependence of enterprises on subsidies.

The control variables are *various production factor inputs, capital structure,* and the *macroeconomic and industry development environment* in which the enterprises run operations and production. The specific indicators are as follows: Enterprise technology level (A) is expressed by enterprise R&D expenditure (*Tech*), capital (K) is expressed by enterprise total assets, labour input (L) is expressed by enterprise number of employees, energy factor input (E) is expressed by enterprise disclosed inventory details indicator, and capital structure is expressed by enterprise debt ratio (*Beta*). The macroeconomic situation is expressed by gross domestic product per capita, and the industry development environment is expressed by energy consumption intensity (*Top1*). To reduce the possible heteroskedasticity in the data and examine the elasticity of the variables, we use the log value of the explained and explanatory variables in this study.

5. Empirical Results, Analysis, and Discussion

5.1. Analysis of the Overall Threshold Effect of Electric Power Enterprises

Based on the continuous optimization and adjustment of power structures, power enterprises continuously increase the proportion of renewable energy power generation. Therefore, the study first analyses the threshold effect of industry subsidies for the overall power enterprises and then subdivides the sample enterprises into industries according to the main business content of the listed enterprises. As China has superior resource endowment conditions in wind power and PV power and the development of renewable energy in China in recent years has been dominated by wind power and PV power, the threshold effect of subsidies for the wind power and PV power industries will be analysed.

Prior to analysing the threshold effect of subsidies, the panel model was estimated on the sample data first. Hausman tests that the *p*-value is 0, rejects the original hypothesis, and chooses the fixed effects model. Subsequently, the threshold effect is tested with government subsidy intensity as the threshold variable, and the results of the F-value and *p*-value by Bootstrap 500 times repeated sampling are shown in Table 1. The results indicate that the threshold variable, government subsidy intensity, is significant at the 5% level of the double threshold model. Therefore, the analysis will be based on the double threshold model, with the results shown in Table 2. The threshold value γ_1 at the 95% confidence interval is 9.8551, and γ_2 is 25.6036. From the results of the double threshold model in Table 3, the sample enterprises can be divided into three groups with government subsidy intensity as the threshold variable, which are low subsidy intensity ($RD \leq 9.8551$), medium subsidy intensity ($9.8551 < RD \leq 25.6036$), and high subsidy intensity ($RD > 25.6036$), which are analysed as follows.

Table 1. Results of the threshold effect test.

Bootstrap = 500 Level = 95			**Threshold Value**		
	F-Value	***p*-Value**	**10%**	**5%**	**1%**
Single Threshold	79.90	0.01	36.2660	47.3081	59.9218
Double Threshold	37.90	0.02	21.1011	28.8583	39.1808

Table 2. Results of double threshold measurement.

Threshold Estimator (Level = 95):			
	Threshold	**Lower**	**Upper**
Th-1	9.8551	9.0842	10.3489
Th-2	25.6036	24.7114	26.8646

The analysis of the threshold effect of government subsidies shows that government subsidies have different effects on corporate profits at different stages. When *RD* is below the threshold value of 9.8551, the amount of government subsidies is positively related to corporate profits, and for every 1% increase in subsidy intensity, corporate profits increase by 5.449%, which is significant at the 10% level. According to the industry cycle theory, at this time, the enterprise is in the early stages of development. The subsidy effect is critical, has a certain protection effect on the emerging industry, and replaces the market capital to make up the cost expenditure to a certain extent. When *RD* is in the (9.8551, 25.6036) threshold interval, the amount of government subsidies is negatively related to corporate profits, with corporate profits decreasing by 12.182% for every 1% increase in subsidy intensity and significant at the 1% level. At this time, the development of enterprises has been in the growth or maturity stage, and the role of government subsidies decreases with the increase in profits. A possible reason is that an increase in government subsidies can cause enterprises to become overly dependent, and they blindly invest in implementing projects with higher production. This move results in higher subsidy amounts; however, it

can eventually lead to lower subsidy amounts, limited operational capacity, and financing constraints, all culminating in poor profitability in the long term. When *RD* is higher than the threshold value of 25.6036, government subsidies positively correlate with corporate profits, but not significantly. This result indicated that the impact of continuously increasing the intensity of subsidies on corporate profits has been minimal. In terms of the magnitude of the coefficient, the degree of impact of government subsidies on corporate profits shows an inverted U-shape of increasing and then decreasing. This finding supports Hypothesis 1, where there is a nonlinear relationship between government subsidies and corporate performance, and the effect of government subsidies is greatest when the intensity of government subsidies is below 9.855.

Table 3. Regression results of the two-threshold model.

	(1) **Tobin**	**(2)** **Tobin**	**(3)** **Tobin**
0._cat#c. Sub	−0.080	4.449 *	5.449 *
	(−0.026)	(1.679)	(1.679)
1._cat#c. Sub	−12.742 ***	−14.183 ***	−12.182 ***
	(−4.825)	(−6.420)	(−6.420)
2._cat#c. Sub	−1.373	2.121	1.021
	(−0.688)	(1.060)	(1.060)
0._cat#c.Share		0.0382 ***	0.0315 ***
		(4.462)	(3.119)
1._cat#c.Share		0.0109 ***	0.0157 **
		(14.325)	(2.037)
2._cat#c.Share		0.0671 ***	0.0428 ***
		(7.509)	(5.736)
Tech			6.292 ***
			(2.751)
Labour			−0.002 ***
			(−5.019)
Asset			0.049 ***
			(12.777)
Stock			−3.595 ***
			(−12.771)
Beta			−0.125 ***
			(−5.224)
Grow			17.778
			(0.704)
Top1			−93.608
			(−1.572)
_cons	15.367 ***	7.408 ***	35.738 ***
	(13.219)	(6.226)	(11.358)
N	858	858	858
R2	0.087	0.316	0.590
adj. R2	−0.018	0.233	0.535
F	17.683	42.452	60.414
p	0.000	0.000	0.000

Note: *t* statistics in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The relationship between market investment and corporate profits is positive, but the subsidy exerts a stage-like utility. When *RD* is below the threshold value of 9.8551, an increase of 1 unit of market investment can contribute to a 0.0315% increase in corporate profits, which is significant at the 1% level. When *RD* is in the threshold interval of (9.8551, 25.6036), an increase of 1 unit of market investment can contribute to a 0.0157% increase in enterprise profit, which is significant at the 5% level. When *RD* is above the threshold value of 25.6036, an increase of 1 unit of profit from market investing can contribute to a 0.0428% increase in enterprises, which is significant at the 1% level.

The results of the data analysis indicate that the pulling effect of subsidies on the market investment of sample enterprises creates a U-shaped trend, and the investment efficiency tends to increase with the initial stage of subsidies, indicating a strong signalling effect of subsidies. When the subsidy intensity continues to increase, the investment efficiency manifests a decreasing trend, thus indicating that the signalling role played by subsidies is limited. Although continuing to increase subsidies will produce a strong investment signalling effect, subsidies that are too high will not only increase the national financial burden but also increase the proportion of subsidies in earnings, thereby leading to enterprises focusing on short-term profits. They will rely on government subsidies or market attraction, which ultimately is not beneficial to the long-term development of enterprises. This situation supports Hypothesis 2, which states that subsidies and market investment jointly act on industry development, and there is a nonlinear relationship.

From the relationship between other control variables and corporate profits, technology level, total corporate assets and corporate profits are positively correlated and significant at the 1% level. The degree of impact of the technology level improvement on corporate profits is significantly better than increasing the amount of corporate assets, while increasing labour input will weaken corporate profits.

In summary, when the subsidy intensity is lower than the threshold value of 9.8551, it can not only guide the market investment direction, increase enterprise financing channels, and reduce enterprise financing constraints, but also lower enterprise costs and diversify risks to enhance enterprise output. When the subsidy intensity is higher than the threshold value, the subsidy will have a crowding-out effect on enterprise profits, thus resulting in the loss of investment and the decline of enterprise output.

5.2. Sub-Industry Subsidy Threshold Effect Analysis

To further analyse the impact of renewable energy subsidies on the development of the renewable energy industry, this study subdivides the sample electric power enterprises into two categories to analyse the threshold effect of sub-industries. As stated in Section 5.1, we focus on the wind power and PV industries as the sample power enterprises; there are 24 wind power sample enterprises and 43 PV sample enterprises.

From the results of the subsidy threshold effect measurement in Tables 4 and 5, the PV industry subsidy has a single threshold effect with a threshold value of 0.038. When *RD* is lower than the threshold value, the subsidy amount is positively correlated with enterprise profit: for every increase of 1 unit of subsidy intensity, enterprise profit is raised by 2.613%. When *RD* is higher than the threshold, increasing corporate subsidies will have a negative impact on corporate profits, with corporate profits decreasing by 19.404% for every 1 unit increase in subsidy amount. This decrease far exceeds the increase in profits brought about by subsidies within a reasonable range. There should be a scientific scope for subsidies in the PV electricity industry, and there is an inverted U-shaped nonlinear relationship between subsidies and corporate output.

Table 4. Photovoltaic industry, wind power industry threshold effect test, and threshold value measurement.

Bootstrap = 500, Level = 95					**Threshold**		
		Threshold Value	**F-Value**	***p*-Value**	**10%**	**5%**	**1%**
Photovoltaic power industry	Single Threshold	0.038	34.43	0.08	28.9247	50.7832	68.4419
Wind power industry	Single Threshold	0.0004	21.3	0.01	13.686	14.8308	20.3005
	Double Threshold	0.0009	17.23	0.07	15.0748	18.3214	22.135

Table 5. Regression results of the subsidy single threshold model for the photovoltaic power industry.

	Tobin	**t**	***p* > t**	**[95% Conf. Interval].**
Sub ($\gamma \leq 0.0038$)	2.613099	0.56	0.057	(−6.686525 11.91272)
Sub(γ >0.0038)	−19.40488	−2.63	0.011	(−34.1299 −4.679859)
share ($\gamma \leq 0.0038$)	−0.027	−1.91	0.061	(−0.0553 0.0125)
share (γ > 0.0038)	−0.141	−2.88	0.005	(−0.0433 −0.0239)
Tech	−4.9256	−2.26	0.027	(−9.272802 −0.5783977)
Labor	0.0012219	2.17	0.034	(0.0000964 0.0023474)
Asset	0.0420236	4.87	0.000	(0.0247843 0.0592629)
Beta	−0.0636922	−2.8	0.007	(−0.1092133 −0.0181712)
Grow	−1.037735	−0.07	0.947	(−32.23965 30.16418)
Top1	−7.099355	−0.19	0.848	(−80.85208 66.65337)
_cons	3.241112	1.75	0.085	(−0.4542709 6.936494)
R-sq: within = 0.6063				Prob > F = 0.0000

Market investment and enterprise profits are inversely related, meaning that when the intensity of subsidies is below the threshold, the increase of 1 unit of market investment enterprise profits decreases by 0.027%. When the intensity of subsidies rises above the threshold, the increase of 1 unit of market investment leads to enterprise profits decreasing by 0.141%. These results also suggest that an increase in government subsidies will cause a crowding-out effect of market investment on enterprise output, probably because the government's financial subsidies to enterprises will produce too much of investment guidance. It could have a 'negative effect' on enterprise production and financial market investment. For PV, both subsidies and investment are (not) significant when RD is greater (lower) than the threshold value.

From the measured results of the subsidy threshold effect in the wind power industry in Tables 4 and 6, there is a double threshold effect in the subsidies, with threshold values of 0.0004 and 0.0009, respectively; the threshold interval value is low. When *RD* is below the threshold value, the subsidy amount positively correlates with corporate profits. For every 1 unit increase in the subsidy amount, corporate profits will increase by a notable 61.6617%. While *RD* is between 0.0004 and 0.0009, there is a negative correlation between government subsidies and corporate profits; increasing the number of subsidies will create a crowding-out effect and reduce corporate profits. When *RD* is above the threshold, increasing corporate subsidies positively impacts corporate profits. When increasing the subsidy intensity by one unit, corporate profits will correspondingly increase by 0.2695%; however, the test result is not significant, which means that the impact of subsidies on corporate profits is minimal after exceeding the threshold. There is an inverted U-shaped nonlinear relationship between subsidies and firm output in the wind power industry, and the subsidy effect is more potent in this industry than in the PV power industry when the subsidy intensity is below the threshold.

In terms of market investment, overall market investment is positively related to corporate profits in the wind power industry, and government subsidies open more financing channels for enterprises, which is beneficial to corporate profits. When *RD* is below 0.0004, the number of subsidies is positively related to corporate profits. For every 1 unit increase in subsidy intensity, corporate profits will increase by 0.0000395%; however, the measured results are insignificant. While *RD* is between 0.0004 and 0.0009, every 1 unit increase in subsidy intensity will raise corporate profits by 0.0005%, which is significant at the 1% level. When *RD* is above 0.0009, increasing corporate subsidy intensity continues to positively impact corporate profits, with profits improving by 0.000278% for every 1 unit increase in subsidy intensity; however, the magnitude of the impact decreases. The smaller threshold and coefficient values for subsidies in the wind power industry indicate, to some extent, that the investment signal from subsidies is weaker. Conversely, the market investment coefficient of the wind power industry is smaller than that of the PV industry, indicating that the investment signal of subsidies in the wind power industry is weaker than that of the

PV industry. This analysis supports Hypothesis 3 and Hypothesis 4. Regarding the wind power industry, the subsidy effect is only significant at a low threshold level. In contrast, the investment effect is only significant at the medium and high threshold levels, which reflects the different roles of subsidies in different stages of industrial development. In the early stages of the development of the wind power industry, a lower level of subsidies can stimulate corporate profits, but when the wind power industry develops to a certain extent, more subsidies play a signal role in investment. At a higher level of subsidy intensity, investment in corporate profits becomes a more obvious stimulus.

Table 6. Wind power industry subsidy single threshold model regression results.

	Tobin	**t**	***p* > t**	**[95% Conf. Interval].**
Sub ($\gamma < 0.0004$)	61.66174	3.02	0.003	(21.20597 102.1175)
Sub ($0.0004 \leq \gamma < 0.0009$)	−5.456899	−1.08	0.283	(−15.47152 4.557717)
Sub ($\gamma > 0.0009$)	0.2695726	0.51	0.608	(−0.767039 1.306184)
share ($\gamma < 0.0004$)	0.0000395	0.35	0.728	(−0.000185 0.000264)
share ($0.0004 \leq \gamma < 0.0009$)	0.0005	9.17	0.000	(0.000392 0.000608)
share ($\gamma > 0.0009$)	0.000278	6.38	0.000	(0.000192 0.000365)
Tech	−3.314346	−6.97	0.000	(−4.256103 −2.37259)
Labor	0.0007143	2.02	0.045	(0.0000151 0.0014135)
Asset	0.0258824	6.9	0.000	(0.018453 0.0333118)
Beta	−0.0251031	−3.88	0.000	(−0.0379222 −0.012284)
Grow	−10.6474	−1.22	0.227	(−27.98692 6.692119)
Top1	4.913666	0.24	0.807	(−34.86066 44.68799)
_cons	2.290405	2.66	0.009	(0.5844037 3.996407)
R-sq: within = 0.7997				Prob > F = 0.0000

Although the PV power and wind power industries both belong to the same clean energy types of industries, the government's national strategic direction may strongly support the development of these green industries due to the subsidy effect with regard to industry heterogeneity; however, the investment value of the two has certain differences. From a business production perspective, the government is more inclined to provide a larger investment value in the industry than it would with power generation, as the installed capacity of PV electricity is likely to grow faster than wind power. The economic cost of wind power projects derives from wind turbines, which account for 60% of the total cost. The primary cost of PV power projects is the module and its installation, accounting for 40% of the total cost. When comparing the two industries, the fixed cost of PV power projects is lower. Currently, the kilowatt-hour cost of PV power generation is between 0.2 and 0.41 yuan per kilowatt-hour, which is also lower than that of wind power generation. Accordingly, PV power projects are relatively more economical, as wind power generation is only favoured when subsidies are available. Thus, wind power has a higher subsidy sensitivity than the PV power industry.

From the measured results of the control variables in Tables 5 and 6, both industries reveal a positive correlation between labour, total enterprise assets, and enterprise output. The output efficiency of increasing one unit of asset input is better than the input-output rate of the labour factor. Contrarily, improving the technology level is negatively correlated with enterprise output, probably because the wind power and PV point industry are more capital-intensive than technology intensive. Enterprises use equipment as the focus of input, and the overall level of technology in the industry is more mature, but update speed is weak. Although the technical level is not the decisive factor affecting the output of enterprises, from the perspective of the power generation principle of wind power, wind power is the use of wind to drive the fan blade rotation. When the wind blows to the blade to drive the wind wheel rotation, wind energy is converted into kinetic energy, and then to promote the generator power generation, the power generation is mainly affected by the blade size and motor power. In the future, the use of wind power in low wind volume

areas, the trend of single generators with high power and large blades is apparent, and technology will become the main driving force to promote the progress and development of wind power. In addition, promoting the large-scale development and application of distributed PV electricity, PV key technology breakthroughs, and process improvements will significantly increase PV production capacity and result in lower product prices.

6. Robustness Test

According to the actual research problems, we conducted a robustness test to validate our findings further. For that purpose, we replaced the core independent variable and the threshold variable with the subsidy intensity and amount, respectively, to test the subsidy effect. The calculated thresholds are shown in Table 7. Table 8 displays the model's expected outcomes, indicating a threshold effect between subsidy intensity and output, and the relationship between the respective variables and the dependent variables is consistent with the previous analysis results. It can be seen that both the number of subsidies and the intensity of subsidies have a significant threshold effect on output. The results are consistent with Table 3. The model's *p*-value is 0.000, which is statistically significant.

Table 7. Threshold effect test and threshold value measurement.

Bootstrap = 500 Level = 95				**Threshold**		
	Threshold Value	**F-Value**	***p*-Value**	**10%**	**5%**	**1%**
Single Threshold	0.0639	34.43	0.06	20.0692	27.7681	59.9846

Table 8. The robustness test results.

	Tobin	**t**	***p* > t**	**[95% Conf. Interval].**
Strength ($\gamma \leq 0.0639$)	−0.0785927	−1.66	0.098	(−0.1716299 0.0144445)
Strength ($\gamma > 0.0639$)	0.0104199	1.08	0.281	(−0.0085468 0.0293686)
share ($\gamma \leq 0.0639$)	5.21×10^{-9}	6.02	0.000	(3.51×10^{-9} 6.91×10^{-9})
share ($\gamma > 0.0639$)	1.96×10^{-9}	3.47	0.001	(8.50×10^{-10} 3.08×10^{-9})
Tech	2.009221	1.83	0.068	(−0.1455007 4163943)
Labor	0.0329444	9.37	0.000	(0.0260381 0.0398506)
Asset	−0.0025044	−6.4	0.000	(−0.032733 −0.0017354)
Beta	−0.1093763	−4.75	0.000	(−0.1546321 −0.0641206)
Grow	19.64964	0.82	0.415	(−27.66475 66.96403)
Top1	−96.86305	−1.71	0.087	(−207.9092 14.18314)
_cons	22.37714	8.71	0.000	(17.32826 27.42602)
R-sq: within = 0.4664				Prob > F = 0.0000

7. Discussion and Conclusions

7.1. Discussion

This article discusses the relationship between subsidies, market investment, and enterprise output in the renewable energy industry. Using the industry lifecycle as the theoretical mechanism, we clarify the impact mechanism of renewable energy subsidies on industrial development from two aspects: the resource allocation effect of subsidies and the signal effect of investment. Based on the relevant data of listed companies from 2011 to 2020 as the analysis sample, the threshold effect of subsidies was analysed, and the main conclusions drawn from the analysis are as follows:

From the perspective of upstream renewable energy power enterprises, there is an inverted U-shaped nonlinear relationship between renewable energy subsidies and enterprise output, and there is a dual threshold effect of subsidies, with threshold values of 9.8551 and 25.6036, respectively. This conclusion is basically consistent with the inverted "U" relationship discovered by [20]. When the subsidy intensity is lower than 9.8551, the subsidy has a significant pulling effect on enterprise output. When the subsidy intensity is within the range of (9.8551–25.6036), it will generate a crowding-out effect on enterprise

output, leading to a decrease in enterprise output. There is a dual threshold effect between market investment and enterprise output influenced by subsidies, and the signal effect of subsidies on market investment shows a band-like upward effect that rises first and then decreases. When the subsidy intensity is below 9.8551, the signal effect of subsidies on market investment is more substantial.

Like other scholars' research findings, the effects of subsidies are a dynamic adjustment process with heterogeneity. The threshold effect of subsidies for the renewable energy industry is industry heterogeneity. The subsidy for the photovoltaic industry is a single threshold effect with a threshold value of 0.038. In contrast, the subsidy for the wind power industry has a double threshold effect with a threshold value of 0.0004 and 0.0009, respectively, with lower threshold values. The subsidy efficiency of the renewable energy industry has industry heterogeneity. The relationship between subsidies in the photovoltaic and wind power industries and enterprise output shows an inverted U-shaped nonlinear relationship. From the parameter values, the incentive effect of subsidies on the wind power industry is better than that of the photovoltaic industry. The signalling effect of subsidies for the renewable energy industry on investment also has industry heterogeneity. With the increase in subsidies, market investment in the photovoltaic industry will have a crowding-out effect on enterprise output. The increase in subsidies will have a guiding effect on market investment in the wind power industry, leading to a phased increase in enterprise output. From the parameter values, the investment signal effect of subsidies in the wind power industry is weaker than that in the photovoltaic industry.

7.2. Policy Insights

Through the analysis of renewable energy industry subsidies, combined with the current development status of renewable energy, the results have certain policy implications that can promote the development of the renewable energy industry, vigorously enhance the renewable energy structure, accelerate the enhancement of new power system construction, and achieve the most return from the subsidies.

First of all, the rational use of subsidy policy tools to maximize the role of subsidies in resource allocation. There is an inverted U-shaped nonlinear relationship between renewable energy subsidies and enterprise output, and there is a double threshold effect of subsidies. When designing subsidy policies, it is necessary to fully consider the stage of industry development, design subsidy policies in line with the development direction according to different stages and improve the pertinency of policy auxiliary objects. In the early stages of industrial development, direct subsidies can be used to promote the research and development of advanced technologies and the establishment of demonstration projects. When the industry reaches a certain stage of development, direct financial subsidies to producers can be terminated on time, and indirect subsidies such as taxes can be used to promote the consumption of renewable energy products, achieving the driving effect of consumption on production.

Secondly, subsidy efficiency has apparent industry heterogeneity, and it is necessary to flexibly use subsidy policy tools according to different industries. By setting a reasonable subsidy interval, selecting a subsidy interval suitable for the current development stage of enterprises, maximizing the promotion effect of subsidies on enterprise output, promoting the flow of production factors to key production sectors, optimizing resource allocation, and promoting structural adjustment and upgrading. Therefore, the government should formulate differentiated policy support and adopt different prices, policies, or preferential measures between different regions, markets, and customers to make enterprise production more efficient and improve renewable energy enterprises' market competitiveness and efficiency.

Third, investment and subsidies jointly affect corporate profits and promote industry development. We should make good top-level policy design, consider the relationship between subsidies and market investment, and fully play the linkage role of the two. Focus on giving play to the investment signal effect of subsidies, take this opportunity

to focus on optimizing the investment environment of the project, improve the financing ability of enterprises and market competitiveness, and gradually reduce the restrictions on subsidies to release greater market space. Although functional subsidies are beneficial to production, excessive scale subsidies can lead to excessive investment and overcapacity. Therefore, current functional subsidy methods cannot be blindly promoted. It is necessary to implement functional subsidy policies more scientifically and reasonably and make them the dominant mode of subsidy systems. Functional industrial policies need to be fully utilized, and governance models need to be improved.

With the global energy transition, China's 'energy revolution' continues to be promoted, with environmental governance, energy saving, and emission reduction gaining more attention. The green and clean attributes of renewable energy make this industry key within the energy industry, and the direction is supported by national policies. As a common government policy tool to solve external issues, subsidies play an important role in the early growth of the renewable energy industry. The gradual withdrawal of subsidies indicates a belief that the current renewable energy industry has certain self-growth abilities. This study and analysis of the subsidy threshold effect demonstrate that the continued use of subsidies will not only help with the benign development of the industry but also illustrate the inevitability and necessity of a subsidy retreat policy.

7.3. Study Limitations and Suggestions for Future Research

The issue discussed in this paper is the impact of government subsidies on industry development, which is a classical issue in economics research. It also explores subsidies for the renewable energy industry, an emerging industry for the country's socio-economic development. Although the findings provide implications for the policy making, there are still topics for future research.

7.3.1. Change the Perspective of Empirical Analysis and Further Optimize Data Analysis

Firstly, in the theoretical framework and empirical analysis of this paper, most of the analysis is carried out at the micro level, i.e., the operational development of enterprises. In future research, we can analyse the impact mechanism of renewable energy subsidies from a macro perspective based on the industry cycle theory. Regarding research methodology, the CGE or DCGE model can be further improved for theoretical and empirical research.

Secondly, the relationship between renewable energy subsidies and industry development has been analysed and illustrated based on the principle of data availability. However, the industry subsidies only account for a portion of the enterprises' revenues or operating expenses and do not fully reflect the direct or transmitted effect of state industry subsidies on the enterprises' revenues, enterprise development, and even industry development. Therefore, in the next step of the study, further attempts can be made to analyse the threshold effect using macro data from the central financial subsidies.

7.3.2. Further Optimization of the Adoption of Analytical Indicators

In the theoretical analysis, this paper analyses the mechanism of industry subsidies in different stages of industry development based on the industry cycle theory, clarifies the important role and status of financial subsidies and market investment in industry development, and analyses the influence path between government subsidies and industry development. In the subsequent empirical tests, institutional investors' shareholding was adopted as the variable for market investment based on the availability of data. In contrast, the relationship between market investment and enterprise investment needs to be further clarified. Therefore, the choice of indicators can be further examined.

7.3.3. Further Expand the Research Scope and Diversify the Research Results

In future research, we will continue to expand the research scope and diversify the research results. This expansion can enhance the generality of the findings by broadening the scope of the study to include more diverse companies and regions. Moreover, in

addition to analysing the role of subsidies on output, other factors affecting the renewable energy industry, such as technological innovation and regulatory policies, should be further explored. First-hand data are obtained through field investigation and visits, and the research samples are further expanded through experimental economics and other research methods. Based on the renewable energy resource endowment conditions, the geographical heterogeneity affecting the development of the renewable energy industry is analysed, and private enterprises and companies are also included in the study sample.

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