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Research on Financing Risk, Government Subsidy and Innovation Ability of New Energy Enterprises

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Abstract: New energy enterprises face high financing risks due to their long investment return period, large capital demand and high research and development risks, making it difficult to obtain funds for innovative activities. New energy enterprises, as the target of our country's key support, can alleviate the financing pressure through various policies subsidized by the government. Based on this, this paper takes the panel data of 126 new energy listed enterprises in China from 2009 to 2018 as samples, uses the time-fixed effect model to conduct regression analysis, and studies the relationship between financing risks, government subsidies and enterprise innovation capability of new energy enterprises. The study found that: financing risk has a significant negative impact on the innovation ability of enterprises; Government subsidies have a significant positive impact on the innovation ability of enterprises.

Keywords: New Energy Sources; Financing Risks; Government Subsidies; Innovation Ability.

1. Introduction

1.1. Research Background and Significance

According to a joint prediction by the US Energy Foundation and the National Development and Reform Commission, China will require energy investment of 18 trillion yuan between 2005 and 2020, of which about 7 trillion yuan is needed for new energy, energy conservation, and environmental protection. Single new energy project investment often requires billions or even billions of yuan. Xie Zhenhua, former deputy director of the National Development and Reform Commission, proposed that to achieve the goal of national independent contribution by 2030, China's new energy investment should reach 41 trillion yuan. As an important part of measuring the level of high-tech development in a country, the new energy industry's investment behavior such as fixed assets investment and R&D investment plays a key role in the long-term development of new energy enterprises. At present, the government's subsidy methods for new energy enterprises mainly include financial subsidies, On the one hand, government subsidies can send a positive signal to the market through signal transmission effects, reducing the financing risk of enterprises. On the other hand, enterprises can use government investment and subsidies to solve the problem of R&D funding shortage in the development process of enterprises, thereby improving their innovation capabilities. So, can government subsidies have a positive impact on the innovation activities of new energy enterprises after being invested? Can new energy enterprises use government subsidies to reduce their financing risks and improve their innovation capabilities?

2. Theoretical Analysis and Research Assumptions

2.1. Financing Risks and Innovation Capabilities of New Energy Enterprises

The innovation of new energy enterprises not only requires a certain level of technology, but also requires a large amount of capital investment. Internal financing has always been an important channel for corporate financing.

2.2. Government Subsidies and Innovation Capabilities of New Energy Enterprises

During the process of innovation activities, enterprises inevitably experience knowledge spillovers, especially in some basic research fields. Innovation achievements may easily be utilized by other economic entities in the market, resulting in individual costs of innovation activities far exceeding social costs, thereby reducing the motivation and enthusiasm of enterprise innovation.

2.3. Financing Risks, Government Subsidies, and Innovation Capabilities of New Energy Enterprises

The innovation activities of new energy enterprises have high investment amounts, high risks, and long investment return cycles, making them a very complex activity. This activity is a process of converting intangible assets through research, experimentation, and trial production guided by a new idea.

3. Variable Selection and Model Design

3.1. Variable Selection

3.1.1. Explanatory Variable

The explanatory variables of this article are financing risk and government subsidies. There are many measurement indicators for financing risk used in current literature, such as asset liability ratio, interest cover ratio, operating leverage coefficient, financial leverage coefficient, total leverage coefficient, etc.

3.1.2. Explained Variable

This article takes the intensity of technological innovation investment as the dependent variable. At present, two indicators, namely the intensity of technological innovation investment and the output of technological innovation, are generally used in literature to measure the innovation capability of enterprises. The intensity of technological innovation investment is generally measured by the natural logarithm of a company's R&D expenditure or the ratio of the total R&D expenditure to the company's total assets at the end of the year; The output of technological innovation is generally measured by the number of patents applied by enterprises, the proportion of innovative product sales revenue, and other numerical values. Due to the different benefits that each product can provide, and the current technological level in China, enterprises lack the ability to transform patents into productivity. Therefore, it is inappropriate to use technological innovation output results as a measure of enterprise innovation ability, which lacks comparability. Therefore, this article uses the intensity of technological innovation investment to measure the innovation capability of enterprises. The greater the intensity of technological innovation investment, the higher the innovation capability of enterprises.

3.1.3. Control Variable

In summary, the variable design of this article is shown in Table 1.

Table 1. The variable design of this article

Variable category	Variable	Variable Symbol	Calculation method
The dependent variable	Take 1 for state-owned enterprises, otherwise take 0	RD	Technological innovation investment intensity
Explained Variable	Technological innovation investment intensity	DAR	R&D expenses/total assets at the end of the year
	Financing risk	GS	Total liabilities at the end of the year/total assets at the end of the year
control variable	Government subsidies	SIZE	Total government subsidies
	Enterprise size	ROE	Natural logarithm of total assets at the end of the period
	Roe	AGE	Net profit margin/total assets
	enterprise age	ICR	The natural logarithm of the number of years a company has been established
	Corporate solvency	GOV	Profit before interest and tax/financial expenses

3.2. Modeling

This article reviews and draws on relevant literature to construct financing risk models, government subsidy models, and government subsidy effect models.

1) Financing risk model in this model, the investment intensity of technological innovation is taken as the explanatory variable, the financing risk is taken as the explanatory variable, and five variables including enterprise size, return on net assets, enterprise age, enterprise solvency and property right nature are added as control variables. The model is shown in model 1:

$$RD=\alpha0+\beta1DER+\beta2SIZE+\beta3ROE+\beta4AGE+\beta5ICR+\beta6GOV+\varepsilon \quad (1)$$

2) Government subsidy model in this model, government subsidies are taken as explanatory variables, and five control variables consistent with the model are added. The model is shown in model 2:

$$RD=\alpha_0+\beta_1GS+\ +\beta_2SIZE+\beta_3ROE+\beta_4AGE+\beta_5ICR+\beta_6GOV+\varepsilon \quad (2)$$

3) Government subsidy effect model in this model, financing risk is taken as the explanatory variable, and six other control variables such as government subsidies are added to test the negative impact of government subsidies on enterprise innovation activities. The model is shown in 3:

$$RD=\alpha0\ +\beta1DER+\beta2GS+\beta3SIZE+\beta4ROE+\beta5AGE+\beta6ICR+\beta7GOV+\varepsilon \quad (3)$$

4. Empirical Results and Analysis

4.1. Sample Selection and Data Sources

The data used in this article comes from the Oriental Wealth Database and the Guotai An CSMAR database. Firstly, new energy companies listed on the A-share market of the Shanghai and Shenzhen Stock Exchanges were selected to obtain relevant data from 2009 to 2018. Companies with severe data deficiencies were excluded and a 1% tail reduction was applied. Finally, data from 126 new energy enterprises were selected as samples.

4.2. Descriptives

Table 2. The descriptive statistical results of the main variables in this article

variable	number	mean value	standard deviation	minimum value	Maximum value
ICR	925	851.4	25,207	-2,428	766,573
GS	1,153	8.080e+07	2.518e+08	7,930	2.873e+09
ROE	1,179	0.0269	0.0913	-1.121	1.119
DAR	1,179	0.399	0.218	0.000631	1.794
GOV	1,189	0.388	0.487	0	1
AGE	1,189	2.821	0.346	0.693	3.611
RD	1,189	0.00374	0.0200	0	0.268
SIZE	1,179	22.20	1.304	18.46	25.95

Firstly, the intensity of government subsidies, financing risks, and technological innovation investment intensity of new energy enterprises were tested. Descriptive statistical analysis was conducted on the main variables of 126 new energy listed enterprises. Table 2 shows the descriptive statistical results of the main variables in this article.

Table 3. The correlation analysis results of the main variables in this article

	Non-state-owned enterprise					State-owned enterprise				
variable	number	mean value	standard deviation	minimum value	Maximum value	number	mean value	standard deviation	minimum value	Maximum value
ICR	538	27.98	461.5	-2,428	10,348	387	1,996	38,966	-30.09	766,573
GS	710	3.881e+07	1.239e+08	7,930	2.339e+09	443	1.481e+08	3.651e+08	21,000	2.873e+09
ROE	721	0.0268	0.0967	-1.121	1.119	458	0.0271	0.0823	-1.121	0.511
DAR	721	0.357	0.190	0.000879	1.137	458	0.466	0.241	0.000631	1.794
AGE	728	2.791	0.356	1.609	3.611	461	2.868	0.326	0.693	3.497
RD	728	0.00277	0.0158	0	0.268	461	0.00527	0.0252	0	0.267
SIZE	721	21.81	0.982	18.95	24.84	458	22.81	1.502	18.46	25.95

4.3. Correlation Analysis

Table 3 shows the correlation analysis results of the main variables in this article.

4.4. Multiple Regression Empirical Testing

4.4.1. Analysis of Multiple Regression Results

Table 4. The regression results of Model 1

	(1)	(2)	(3)
	RD	RD	RD
DAR	-0.010***		-0.010***
	(-2.68)		(-2.60)
ICR	-0.000	-0.000	-0.000
	(-0.41)	(-0.31)	(-0.40)
ROE	-0.012	-0.006	-0.012
	(-1.45)	(-0.78)	(-1.40)
GOV	0.005***	0.004**	0.005***
	(1)	(2)	(3)
	RD	RD	RD
	(-1.20)	(-0.96)	(-1.00)
SIZE	-0.001	-0.002***	-0.002***
	(-1.27)	(-3.29)	(-2.96)
GS		0.000***	0.000***
		(3.68)	(3.62)
Constant	0.033**	0.064***	0.063***
	(2.15)	(3.61)	(3.57)
Observations	925	894	894
R-squared	0.017	0.025	0.032
Number of Y	10	10	10
F test	0.0162	0.00111	0.000147
r2_a	0.000733	0.00826	0.0147
F	2.613	3.740	4.194

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4 (1) shows the regression results of Model 1.

4.4.2. Endogeneity Testing

This article conducts endogeneity testing by re regressing the first-order lagged variables of government subsidies and financing risks as the dependent variables. Tables 5 show the results of endogeneity tests for the three models.

4.5. Robust Test

In order to ensure the robustness of the three models proposed in the article, this article uses the ratio of government subsidies to total assets at the end of the period to re measure the government subsidy variable, uses the return on equity to re measure the financing risk of the enterprise, and re conducts regression analysis. The regression results are shown in Tables 4-7. From the regression results, there was no significant change in the relationship between the explanatory variable and the dependent variable. That is to say, the empirical research results of this article are reliable and robust.

5. Research Conclusion and Policy Suggestions

5.1. Research Conclusion

Technological innovation is particularly important for new energy enterprises. Enterprises need to continuously enhance the intensity of technological innovation investment to support innovation activities.

Table 5. The results of endogeneity tests for the three models

	(1)	(2)	(3)
	RD	RD	RD
LDAR	-0.008**		-0.008**
	(-2.11)		(-2.04)
ICR	-0.000	-0.000	-0.000
	(-0.44)	(-0.32)	(-0.43)
ROE	-0.007	-0.007	-0.007
	(-0.82)	(-0.76)	(-0.83)
GOV	0.005***	0.005**	0.005***
	(2.88)	(2.50)	(2.85)
AGE	-0.004	-0.004	-0.004
	(-1.35)	(-1.19)	(-1.20)
SIZE	-0.001	-0.002***	-0.002***
	(-1.61)	(-2.91)	(-2.77)
LGS		0.000***	0.000***
		(2.83)	(2.79)
Constant	0.043**	0.066***	0.067***
	(2.42)	(3.33)	(3.38)
Observations	825	795	795
R-squared	0.017	0.022	0.028
Number of Y	9	9	9
F test	0.0320	0.00710	0.00273
r2_a	-0.000150	0.00480	0.00880

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

However, due to the high risks, high costs, and long investment return period of innovation activities, it is necessary for the government to incentivize enterprises' innovation activity, compensate for research and development costs, and diversify research and development risks through policy subsidies. In addition to government subsidies, external financing is also an important channel for enterprises to conduct innovative financing. However, due to information asymmetry in the market and the development situation of enterprises themselves, enterprise financing often faces significant financing risks. The limitations of government subsidies and the constraints of corporate financing risks will have an impact on the intensity of technological innovation investment by enterprises, ultimately affecting their innovation capabilities. This article analyzes the data of 126 eligible new energy listed companies from 2009 to 2018 and studies the relationship between financing risk, government subsidies, and innovation ability of new energy enterprises.

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