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Influence of Government Subsidies for Green Technology Development on the Performance of Chinese New-Energy Automobile Enterprises

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ABSTRACT

Recently, facing situations of insufficient energy and harsh environmental conditions, new-energy vehicles begin to enter people's lives. But considering many factors such as price and market acceptance development of new-energy automobile market must not lack government incentives. In recent two years, the government's subsidy for green technology development to new-energy automobile enterprises has entered the post-subsidy era. To explore the sustainable development of new-energy automobile enterprises, Foton automobile was selected as the research object and the scale of government subsidy for green technology development to Foton automobile was clearly defined, the performance was analyzed by using multiple regression method. Results show that government subsidy and tax return for green technology development have a positive effect on Foton automobile's performance, environmental regulation stringency has a significant positive moderating effect. Referring to the conclusions, some suggestions were put forward for Foton automobile's future development and the development of new-energy automobile industry.

INTRODUCTION

As the international environment continues to change and various advanced technologies continue to change, environmental and energy issues are becoming more and more prominent and countries are attaching more and more importance to environmental protection. Traditional cars need to consume a large amount of oil and emit carbon monoxide, carbon dioxide, hydrocarbon chemicals and other waste gas, polluting the air environment. In such an environment, new-energy vehicles emerge as the times require (Chu et al. 2018). However, as new-energy vehicles need the support of high-end technologies, there is no advantage in price, and the market acceptance of new-energy vehicles is not high compared with traditional cars at present. Therefore, the development of new-energy vehicles enterprises and industries requires a series of subsidies and policy support for green technology development from the government.

In 2010, China's government issued a new-energy subsidy policy to support green technology development. In recent years, with the change of market conditions, the government subsidy policy for green technology development has been changing constantly in the continuous process. In 2016, the Ministry of Finance exposed the "subsidy fraud" of some auto companies. Starting from 2018, relevant government departments' support measures for relevant enterprises are significantly lower than before, which can be described as entering the "post-subsidy era".

As early as 2011, the production and sales volume of new-energy vehicles in China was very low, which was only 820,000 units. According to the overall automobile production in 2011, the proportion of new-energy vehicles was less than 1‰. By 2018, however, tremendous changes had taken place. The annual sales volume reached 1.27 million, accounting for 4.5% of the total automobile production and sales volume, and the production and sales volume increased by more than 150 times. From 2011 to 2018, both the production and sales volume, as well as the proportion of total automobile production and sales volume in China, showed an amazing development speed.

The ministry of industry and information technology has released the audit report on the promotion and application of new-energy vehicles for the first time since May 2017. According to the latest report, the number of new-energy vehicles receiving government subsidies for green technology development totaled 615,100, and the number of subsidies to be liquidated reached 62.4 billion RMB. The specific situation is shown in Table 1.

Table 1: New-energy vehicles to promote the application of clearing table.

Year of the vehicle	Enterprise declaration and promotion (unit)	Liquidation fund (ten thousand RMB)	Number of promotions approved by the expert group (unit)	Subsidy funds to be liquidated (ten thousand RMB)	Time of public notice	Batch
2016	94,072	641,482	85,094	585,936	2017.05.17	First
2016	71,446	320,804	71,199	314,263	2017.09.07	Second
2016	57,816	1,684,109	57,494	1,676,431	2017.11.28	Third
2016	51,016	1,246,311	50,208	1,233,058	2018.05.25	Fourth
2017	230,616	960,115	161,667	664,099	2018.05.25	Fourth
2016	10,952	266,020	10,876	264,500	2018.09.25	Fifth
2017	85,717	274,872	78,011	244,319	2018.09.25	Fifth
2015	30,936	330,055	29,034	300,088	2019.03.19	Sixth
2016	72,614	968,440	71,546	957,937	2019.03.19	Sixth
Total	705,185	6,692,208	615,129	6,240,631		

The cumulative sales volume of new-energy vehicles in China increased continuously from the first quarter of 2016 to the third quarter of 2019. The quarterly sales volume of new-energy vehicles fluctuated and increased from the first quarter of 2016 to the fourth quarter of 2018, and showed the characteristic of quarterly change from 2017 to 2018, which meant that the sales volume kept rising from the first quarter to the fourth quarter. In addition, it could be found that the sales volume in the second and third quarters of 2019 was lower than that in the same period of 2018, which was most likely due to the serious decline of government subsidies for new-energy vehicles during this period. It could be seen that government subsidies for green technology development had played a positive role in promoting the overall performance of the industry.

Had new-energy automobile enterprises used government subsidies to enhance their strength? Did government subsidies and policy support for green technology development promote the pace of development of each enterprise and the whole industry? What would companies need to do to cope with future subsidy declines? Therefore, it is of great significance for both the government and enterprises to study the influence of government subsidies for green technology development on the performance of new-energy automobile enterprises.

PAST STUDIES

Government subsidies mainly referred to the free monetary and non-monetary economic subsidies provided by the government to enterprises. The purpose was to promote the upgrading and development of enterprises and industries, to optimize the allocation of social resources, and to promote the balance of social supply and demand. Government subsidies were generally free and conditional. Therefore, government subsidies did not affect the ownership of enterprises, and enterprises in turn had no obligation to repay the assets to relevant departments in the future. But enterprises would be limited in their use of government subsidies. At present, subsidies for green technology development of the Chinese government to the new-energy automobile enterprises were mainly in the form of direct subsidies and tax incentives. In 2012, the government just issued a new energy vehicle subsidy policy, vigorously advocating the purchase of new energy vehicles, and adopting different subsidy rules according to different models. In 2013, the subsidy rate was reduced by 5%, and in 2014, the subsidy rate was reduced by 10%. In 2017, the subsidy policy was substantially adjusted to further improve the subsidy rules from requirements of energy consumption, mileage and power battery standards. The requirements of electric passenger cars were strictly stipulated to avoid cheating and compensation. In addition to large subsidies to businesses, consumers could enjoy exemption from vehicle purchase tax when they buy a car. In addition, electric vehicles in new energy vehicles could also enjoy an additional exemption from consumption tax. At the same time, new-energy automobile manufacturers, if they met the requirements for the recognition of high-tech enterprises, might pay enterprise income tax at a tax rate of 15%, and allow additional deductions based on research and development expenses (Han 2019).

It was found that government subsidy would slow down the growth of enterprises in terms of performance and scale, which would have a negative influence on the performance of enterprises (Fredrik 2000). Okamuro & Nishimura (2015) pointed out that government subsidy could improve innovation performance. Research showed that non-tax subsidies had a greater influence on the cost of debt and social performance than tax subsidies. Government subsidies to university-industry research collaborations through financial subsidies could improve innovation performance, and financial subsidy from the government would slow down the growth of enterprises in terms of performance and scale, which would have a negative influence on the performance of

enterprises (Beason 2015). In addition, supporting measures of relevant departments could also promote development pace of some small and medium-sized enterprises that attached importance to advanced technology (Du & Huang 2020). Although direct replenishment funds of relevant subsidy policies were relatively limited, the atmosphere in the industry tended to be optimistic due to the encouragement of government departments, which indirectly introduced capital from outside the industry into the industry. Relevant subsidy measures further encouraged the enthusiasm of technological innovation of relevant enterprises and guide their development direction (Xu et al. 2016, Kolkis 2019). Support policies of relevant departments could positively affect the financial performance of enterprises with little force (Roper & Hewitt-Dundas 2015, Votinov et al. 2020).

Government subsidies would cause enterprises to become dependent on subsidy funds and even lead to non-productive investment behaviours, which would reduce the financial performance of enterprises and hinder the improvement of the innovation ability of enterprises (Syed & Kamel 2018, Miguel et al. 2020). Due to the information asymmetry between government and enterprises, and the motivation of enterprises to maximize profits, enterprises could apply for subsidies without conducting research and development, namely, showing the problem of enterprises cheating for subsidies.

MATERIALS AND METHODS

In the study, 79 enterprises' data on two core explanatory variables of government subsidy (*Gov*) and tax return (*Tax*) in 2018, the moderating variable of environmental regulation stringency (*ERS*), and the control variables of total asset size (*Size*), listed age (*Age*), and revenue growth rate (*Rgr*) were selected. The explained variable was analyzed by a cross-sectional regression method. The regression analysis of the performance (*Perf*) was carried out. Because of the cross-sectional data, data of different enterprises were independent of each other. Therefore, before regression, stability test can be avoided, and only some data need to be logarithmically processed. The processed variables can be shown as government subsidies (*Gov*), tax returns (*Tax*), and total asset size (*Size*). The selection and definition of specific indicators are shown in Table 2.

RESULTS ANALYSIS

Scale of government subsidy for green technology development granted to Foton automobile: According to the data of the enterprise's annual report and quarterly report, the number of government subsidies for green technology development Foton automobile received from 2012-2019 is shown in Table 3.

The number of government subsidies that Foton received from 2012 to 2015 was increasing. In 2012, it received a total of 33.90 million RMB of government subsidies, and in 2015, it reached 90.23 million RMB, achieving an increase of 166.29%. Since 2016, the number of government subsidies received by Foton automobile had been declining. The subsidy in 2018 was only 22.35% of that in 2015. In 2019, the number of government subsidies for green technology development received was close to that in 2018.

According to the annual report of Foton automobile, the ways included financial allocation and tax refund. In terms of financial allocation, the subsidies received by Foton automobile in 2012-2015 mainly included automobile

Table 2: Definition of variables.

Variable	Variable name	Variable symbol	Variable explain
Dependent variable	Performance	Perf	Market value/total assets
Independent variable	Government subsidies	Gov	Log(government subsidies)
	Tax refund	Tax	Log(tax refund)
Moderating variable	Environmental Regulation Stringency	ERS	Strict degree of regional environmental regulation
Control variable	Total asset size	Size	Log(total assets)
	Listed age	Age	Observed year and established year impairment
	Revenue growth rate	Rgr	Main revenue of the current period-main revenue of the previous period)/main business income of the previous period

Table 3: Amount of Government subsidy for green technology government of Foton automobile from 2012 to 2019.

Year	Amount (ten thousand RMB)	Year	Amount (ten thousand RMB)
2012	33895.24	2016	85719.75
2013	46777.66	2017	37443.37
2014	72737.32	2018	20169.14
2015	90230.06	2019	19805.21

R&D subsidies, automobile basic research fund subsidies, energy-saving automobile subsidies for green technology development, etc. After 2016, the government subsidies for green technology development received by Foton automobile mainly focused on automobile R&D, production and sales.

Regression result: The correlation between independent variables and dependent variables is given in Table 4. Government subsidy (*Gov*), tax return (*Tax*), and total asset size (*Size*) have a significant positive relation with revenue growth rate (*Rgr*). In addition, total asset size (*Size*) has a significant positive relation with listed age (*Age*).

According to index and relative data, the regression result is given in Table 5. It shows that the influence of government subsidies (*Gov*) on performance (*Perf*) is significantly positive at 5% level, and the coefficient is 0.07, which can be shown in equation (1).

$$Perf = 0.89 + 0.07Gov + 0.57Size - 0.11Age + 1.22Rgr \quad (1)$$

The influence of tax return (*Tax*) on performance (*Perf*) is significantly positive at 5% level, and the coefficient is 0.06, which can be shown in equation (2)

$$Perf = 0.31 + 0.06Tax + 1.45Size + 0.15Age + 0.58Rgr \quad (2)$$

When the moderating variable of environmental regulation stringency (*ERS*) is introduced, the influence of government subsidies (*Gov*) on performance (*Perf*) is significantly positive at 1% level, and the coefficient is 0.23, which can be shown in equation (3). It means that under the situation of environmental regulation, new-energy automobile enterprises tend to get better performance by using government subsidies, which shows lager coefficient and higher significance level.

$$Perf = 1.32 + 0.23Gov + 1.11ERS \times Gov + 0.89Size - 1.24Age + 0.98Rgr \quad (3)$$

The influence of tax return (*Tax*) on performance (*Perf*) is significantly positive at 1% level under environmental regulation, and the coefficient is 0.14, which can be shown in equation (4). It means that under the situation of environmental regulation, the coefficient is larger and the significant level is improved. Due to tax return, new-energy automobile enterprises get more capital in green technology development. Strict regulation may constrain enterprise behaviour.

$$Perf = 0.67 + 0.14Tax + 0.53ERS \times Tax + 0.66Size + 0.35Age + 1.21Rgr \quad (4)$$

Under environmental regulation, the influence of government subsidies (*Gov*) on performance (*Perf*) is significantly positive at 5% level, and the coefficient is 0.35. The influence of tax return (*Tax*) on performance (*Perf*) is significantly positive at 5% level, and the coefficient is 0.10, which can be shown in equation (5).

$$Perf = 0.78 + 0.35Gov + 1.10Tax + 0.89ERS \times Gov + 0.25ERS \times Size - 0.12Age + 0.84Rgr \quad (5)$$

Through the analysis, the following results are drawn. Firstly, the government subsidies for green technology development of China's new-energy automobile industry are characterized by large overall subsidies and large differences in the number of government subsidies received by different enterprises. And relevant documents show that the government subsidies to new-energy automobile enterprises will be withdrawn shortly. At present, China had issued several policies to encourage new-energy automobile enterprises to strengthen technological transformation and upgrading and increased support and government subsidies. However, from the actual effect, it was not ideal. It was mainly reflected in the fact that the core technology of new-energy enterprises had not made great progress, and the problems such as the endurance and security of new-energy technology have not been completely solved (Samanta et al. 2019). At the same time, after obtaining government subsidies, some enterprises did not fully invest in green technology research and development, but invested their funds in real estate, stock market, etc., resulting in a large amount of capital waste, which was not conducive to the whole industry

Secondly, after a specific empirical analysis, it is found that government subsidies for green technology development have a significant positive influence on the performance of relevant enterprises. At the significance level of 5%, the

Table 4: Correlation between independent variables and dependent variables of the samples.

	Gov	Tax	ERS	Size	Age	Rgr
Gov	1	-0.07	0.16	0.01	-0.09	0.24**
Tax	-0.07	1	0.08	-0.04	0.02	0.12*
ERS	0.16	0.08	1	0.13	0.05	0.21*
Size	0.01	-0.04	0.13	1	0.17*	0.32**
Age	-0.09	0.02	0.05	0.17*	1	0.05
Rgr	0.24**	0.12*	0.21*	0.32**	0.05	1

Note: *, ** and *** indicate that the parameter estimates are significant at the level of 1%, 5%, and 10%, respectively.

Table 5: Regression results.

Independent variable	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
	Coefficient (t)				
c	0.89***	0.31**	1.32	0.67**	0.78*
	(5.68)	(2.47)	(0.56)	(2.12)	(1.69)
Gov	0.07**		0.23***		0.35**
	(2.44)		(4.67)		(2.29)
Tax		0.06*		0.14***	0.10**
		(1.88)		(6.43)	(2.44)
ERS*Gov			1.11**		0.89*
			(2.40)		(1.74)
ERS*Tax				0.53*	0.25*
				(1.73)	(1.87)
Size	0.57***	1.45**	0.89**	0.66***	0.53***
	(3.78)	(2.14)	(2.39)	(5.12)	(7.32)
Age	-0.11*	0.15**	-1.24*	0.35**	0.12*
	(-1.77)	(1.99)	(-1.85)	(2.15)	(1.72)
Rgr	1.22**	0.58**	0.98*	1.21	0.84**
	(2.01)	(2.25)	(1.91)	(1.26)	(2.47)

Note: *, ** and *** indicate that the parameter estimates are significant at the level of 1%, 5%, and 10%, respectively.

coefficients of government subsidies and tax refunds are 0.06 and 0.02, respectively. This means that government subsidies for green technology development can promote new-energy automobile enterprises to continue to carry out technology research and development, to improve their technological level and enhance their competitive strength. Finally, sustainable development ability may be gained (Dou et al. 2019, Elston 2019).

Thirdly, through a case study of Foton automobile, it is found that the government subsidies for green technology development have a significant positive effect on the profitability, operation ability and growth ability, but it has no obvious effect on the debt-paying ability. In general, government subsidies for green technology government have a significant positive influence on the performance, and to some extent, government subsidies have improved the performance of Foton automobile. From the performance point of view, profit and growth can reflect the sustainable competitive advantage of new-energy automobile enterprises. Foton automobile can continue to invest in R&D, continuously launch green products and innovate and upgrade green technology by obtaining government subsidies for green technology development, to not only make continuous profits but also to promote its rapid growth. At the same time, it can also drive the whole new-energy automobile industry to transform into green technology and green energy.

Fourthly, after introducing the moderating variable of environmental regulation stringency, the influence of both government subsidies and tax return on performance is enhanced, which may explain that environmental regulation may have a strict requirement of using the subsidies. New-energy automobile enterprises should use these subsidies in green technology development, to improve the core competitiveness and sustainable development capacity. With relative regulations, most enterprises may have capital embezzlement, which may lead to a vicious cycle.

CONCLUSION

It can be concluded that government subsidies for green technology development have a significant positive effect on the performance of new-energy automobile enterprises. To sum up, government subsidies for green technology development have a significant positive influence on Foton automobile's performance, which to some extent improves its' performance.

Through the analysis of this study, it can be found that development position shown and disclosed by some companies is not true. Therefore, enterprises should be aware of this situation. While receiving and applying government subsidies for green technology development, attention should be paid to research, development and innovation. A series of measures should be adopted to improve operating conditions and strength, to achieve independent and sustainable development.

Due to the emergence of many failure cases, China's subsidies to new-energy automobile enterprises are becoming less and less. Enterprises should be able to make good use of subsidies to promote their development, rather than relying on government subsidies for green technology

development. It can be found that government subsidies for green technology development can play a positive role in promoting the performance of enterprises. It also takes into account the decline and withdrawal of government subsidies. What's more, the government should introduce relevant environmental regulations in succession, because requirements of these regulations may supervise enterprises to increase green technology development input, and standardize the use of government subsidies. In addition, what enterprises need to do is increasing R&D input, to get sustainable development ability. Therefore, investors in the market should conduct in-depth research and analysis on the performance of the intended investment enterprises, and consider the factor of government subsidies, so as to reduce investment risks to some extent.

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