

The impact of the reduction of consumption subsidies on the industrial chain of new energy vehicles

-- Based on the perspective of profitability and r&d ability

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Abstract. In recent years, in order to promote the independent development of the new energy vehicle industry, Chinese government has decided to reduce the consumption subsidies for new energy vehicles until the subsidies are completely withdrawn. The reduction of consumption subsidy has a great impact on the production and sales of new energy vehicles in the whole vehicle market. However, does the reduction of this subsidy also have an impact on other enterprises in the new energy vehicles industry chain? This paper tests this problem using data from 2016 to 2018, and finds, through empirical analysis, that during the period of subsidy decline, the profitability of component enterprises is significantly positively correlated with this subsidies, while the r&d investment of enterprises is significantly negatively correlated with this subsidies. The results show that in terms of profitability, the reduction of consumer subsidies not only has an impact on the whole vehicle industry of new energy vehicles, but also has an adverse impact on the core component companies in the industrial chain. However, in terms of r&d, the reduction of subsidies has more negatively strengthened the input and attention of R&D in component companies.

1 Introduction

In the face of global warming and energy crisis, the cultivation and development of new energy industry has become an indispensable focus for every country. In order to alleviate the pressure of energy, some countries have made many measures to promote the development of new energy industry.

At present, Chinese consumers lack sufficient understanding of new energy vehicles, and their awareness of low-carbon and sustainable development is also weak. And they tend to prefer fuel vehicles when they buy cars. Therefore, the Chinese government decided to subsidize the consumption of new energy vehicles in order to enhance consumers' purchase of new energy vehicles.

In January 2009, the project of "1000 Energy-saving and new energy Vehicles Demonstration promotion and Application Project in Ten Cities" targeting at new energy vehicles was officially launched under the auspices of the Chinese government. In February of the same year, the government introduced subsidies for new energy vehicles. Since 2013, China has entered a new phase of implementation and application of new energy vehicles, because the government has introduced a series of policies to support procurement subsidies, research and development, production, technological innovation, punishment mechanisms, regulatory management and other aspects.

It is because of a series of government incentives that new energy vehicles have developed rapidly. At the same

time, it also brings a good development opportunity for the whole industry chain of new energy vehicles. The upstream enterprises of new energy vehicles, such as batteries, motors and electronic controls, have a strong development momentum in the stage of promotion and application of consumption subsidies. The power battery industry shipped only 0.4GWh in 2011, while the industry shipped 28GWh in 2016, with an annual compound growth rate of 134%. Meanwhile, the market size of new energy vehicle motor also grew rapidly during this period, with a year-on-year growth of 325.00% and 152.27% in 2014 and 2015. At the same time, many domestic brands, such as Ningde Times and BYD, became world leaders during this period.

However, it must be admitted that the rapid development of China's new energy vehicles in the past few years is largely dependent on the support of the government subsidies. And the government's original intention is to help the new-energy automobile industry to develop the initial market. In the short term, consumption subsidies do help new energy vehicles to open the market, but in the long term, some disadvantages of consumer subsidies are also gradually emerging, such as the influx of a large number of new manufacturers, increasing cheating behavior. Therefore, the development of new energy vehicles must break away from the "shelter" given by subsidies and must rely on their own value and the coordination of a good production chain system.

In 2015, the ministry issued "about 2016-2020 new energy vehicles to promote fiscal support policy notice"

that further clear the target and standards of this consumer subsidies. At the same time, the government gave products and enterprises consumption subsidies more precise requirements, the implementation of liquidation, increased supervision and verification. In addition, the government also clearly indicated the trend of government subsidies in the future: subsidies for the promotion and application of new energy vehicles will gradually decline until they are completely withdrawn after 2020.

Judging from the production and sales of new energy vehicles in 2019, the new energy vehicle industry has reacted sharply to the sharp decline of subsidies in 2019. China's new-energy vehicle sales have declined for five consecutive months since July, as subsidies for new energy vehicles declined by more than 50 percent in 2019. In November, the production and sales of new energy vehicles reached 110,000 and 95,000, respectively, down 36.9 percent and 43.7 percent year-on-year. And in the situation of domestic new energy vehicles decline, China has lifted the restrictions on foreign enterprises. Therefore, the domestic new energy automobile industry will face a deep reshuffle, some enterprises without competitive ability will be eliminated by the market.

From the surface, the significant reduction of consumption subsidies has dealt a serious blow to the new energy automobile industry. The whole new energy automobile industry seems to be entering "a cold winter", but it is not objective and accurate to judge the future development of the whole industry by the short-term impact of consumption subsidies. The long-term development of new energy vehicles depends on the coordination and cooperation of the whole industrial chain. As long as the development momentum of other enterprises in the industrial chain is still strong, the whole vehicle industry of new energy vehicles will still have the strength to achieve long-term development. Therefore, in the context of reduced consumption subsidies, it becomes a matter of concern whether other enterprises in the industry chain of new energy vehicles, especially the three core components enterprises of new energy vehicles -- electric motors, electronic controls and lithium batteries, have suffered the same negative impact during the downturn.

Therefore, this paper, selecting the data of component enterprises and government consumption subsidies from 2016 to 2018, studies whether the profitability and R&D ability of core component enterprises will be significantly affected by the reduction of subsidies during the decline of consumption subsidy policies. The remainder of this paper is organized as follows. In the "Literature review" section, we understand the current academic research on the impact of subsidy policies on the industrial chain. In "Hypotheses" section, we develop our hypotheses linking the profitability and R&D ability of core component enterprises and consumption subsidies. In "Study design" section, we describe our data and measures, and our empirical analysis. In "Results and Discussion" section, we present and discuss the empirical results. In "Conclusion" section, we offer conclusions.

2 The Literature Review

2.1 The impact of subsidy policy on enterprises in the industrial chain

Guo, Liu found that government support played a positive role in the profitability of new energy vehicles, but in terms of r&d investment, government support did not have a positive effect on the r&d ability of new energy vehicles enterprises [1]. But Shao and Sun's finding, by using the sample data of 83 new energy vehicles listed companies from 2009 to 2016, provides evidence of the impact of the government's R&D subsidies on innovation ability of new energy vehicles industry [2].

In fact, there are not many studies about the impact of government subsidies on other enterprises in the industry chain of new energy vehicles. Luo studied the supply chain of electric vehicles by adopting the method of government subsidies and cooperative game and he concluded that although the direct subsidy target of the government is consumers, manufacturers and retailers in the supply chain will also share the "welfare cake" of the government by raising prices [3].

Although there are few studies on the impact of subsidy policies on industrial chain enterprises in the new energy automobile industry, in other industries, most scholars find that government subsidies will play an indirect role on other enterprises in the industrial chain. Yang and Fu found, in their study that based on two-level supply chain of low-carbon products, that although the government implements consumer subsidy policy, supply chain enterprises will also indirectly benefit from this subsidy policy, which indirectly realizes the purpose of subsidizing supply chain enterprises [4]. Zhang and Meng found, through mathematical analysis, that the government can enhance the enterprise innovation intensity and supply chain value through subsidies [5]. In other words, with the increase of subsidies, the value of supply chain, the value of enterprises within the chain and the value of consumers will also increase, especially in the process of supporting innovative enterprises and industries. Therefore, it can be known that the government's subsidy policy will not only affect its direct subsidy target, but also affect the supply chain enterprises of the subsidy target.

2.2 The influence of policy subsidy declining

Guo and Li found that the government's optimal strategy is not to provide subsidies under the condition of balanced cooperation between vehicle enterprises and their parts enterprises [6]. Therefore, it is possible to completely withdraw the government subsidy if the vehicle and parts enterprises realize the full innovation cooperation. Ma and Zhong concluded that it is imperative to reverse the new energy vehicle subsidy policy and the complete withdrawal of subsidy policy will not affect the development of new energy vehicles as long as the government takes advantage of restrictive policies and reasonable regression ratio [7].

In general, there are few literature studying the impact

of consumption subsidy policies on industrial chain enterprises in the new energy automobile industry. Meanwhile, there are also few relevant studies based on the background of this subsidy declining. Therefore, this paper, based on the background of subsidy policy decline, will take an empirical method to study whether the consumption subsidy policy decline of new energy vehicles will have a negative impact on industrial chain enterprises. This research will make up the gap of the current research about the impact of the declining subsidy policy on the industrial chain enterprises.

3 Research Hypothesis

3.1 Government consumption subsidies and the profitability of component companies

According to the demand theorem of economics, The market demand for a commodity is inversely related to its price when other conditions remain unchanged. Therefore, when the consumption subsidy provided by the government reduces the sales price of new energy vehicles in the market, the sales volume of new energy vehicles in the market will increase.

The consumption subsidy increases consumers' purchase of new energy vehicles, which plays a driving role in the demand for new energy vehicles. And the increasing demand for new energy vehicles in the market end stimulates the production capacity of upstream enterprises, which benefits enterprises in the production chain. Therefore, the implementation of consumer subsidies by the government is equivalent to an indirect subsidy to parts and components enterprises. Zhang and Meng found that with the increase of subsidies, the value of supply chain will also increase, especially in the process of supporting innovative enterprises and industries [5]. And Luo concluded that although the direct subsidy target of the government is consumers, manufacturers and retailers in the supply chain will share the "welfare cake" of the government [3]. Therefore, considering the close cooperative relationship between the new energy automobile industry and its upstream component enterprises, it can be speculated that the consumption subsidy policy adopted by the Chinese government actually not only has a direct subsidy effect on the whole vehicle market of new energy automobiles, but also indirectly plays a subsidy effect on the upstream supply chain enterprises.

So in general, it is speculated that, under the current situation of the production and sales of the new energy automobile industry severely impacted because of subsidy policy declining, enterprises that supply core components of new energy automobiles will also be negatively affected. We present hypotheses 1:

Hypothesis 1: The decline of consumption subsidy has a significant negative impact on the profitability of new energy vehicles' supply chain enterprises.

3.2 Government consumption subsidies and R&D investment of parts and components enterprises

Jacob proposed the demand-driven theory of technological innovation [8]. He believed that technological innovation activities, like other economic activities of enterprises, are guided by market demand and take profit realization as the basic goal. That is to say, the growth of market demand can improve the technological innovation level of enterprises. Wang theoretically analyzed the leading role of consumer demand on technological innovation and pointed out that consumer demand is the source power of technological innovation of enterprises [9]. Su and Nie conducted an empirical test using data from 31 provinces and cities, whose results proved that market demand was the driving force of technological innovation of Chinese enterprises [10]. Zou took Listed Chinese traditional medicine companies from 2007 to 2012 as the research object, and the research's results showed that market demand could significantly promote enterprises to increase investment in technological innovation and improve technological innovation output [11].

That is to say, while stimulating market demand, consumption subsidy will directly or indirectly promote r&d innovation investment of manufacturers, which forming a virtuous circle of investment in creation. Therefore, it can be speculated that during the decline of consumption subsidy policy, the market demand for new energy vehicles will decrease, and then the production and sales of core components of new energy vehicles will be affected. As a result, enterprises will lose innovation power and reduce r&d investment. We present hypotheses 2:

Hypothesis 2: The decline of consumption subsidy has a significant negative impact on the R&D investment of new energy vehicles' supply chain enterprises.

4 Research Design

4.1 Source and collection of sample data

To test these hypotheses, this paper considers the sample of the core components enterprises of new energy vehicles from 2016 to 2018, including lithium battery, motor and electronic control enterprises. Meanwhile, these samples were processed as follows: (1) samples of ST category were eliminated, because the data of such samples fluctuated greatly; (2) In order to ensure that the selected samples belong to the upstream enterprises of new energy vehicles, we excluded companies where the production and sales of electric motors, electronic controls and lithium batteries are not the main businesses; (3) In order to avoid the influence of outliers, extreme values other than 1% and 99% of the points for each variable were reduced. Finally, this paper selected 95 sample companies. And the enterprise data and government consumption subsidy data used in this paper are from the Flush Database and the calculation amount of new energy vehicle application promotion subsidy published by the

Ministry of Industry and Information Technology.

4.2 Model design

To test these hypotheses, this paper sets up a linear model as follows:

$$ROA = \beta_1 \lnsub + \beta_2 \lnsize + \beta_3 TOTA + \beta_4 Lev + \beta_5 Grow + \varepsilon \quad (1)$$

$$\lnRD = \gamma_1 \lnsub + \gamma_2 \lnsize + \gamma_3 roa + \gamma_4 lev + \varepsilon \quad (2)$$

Model (1) considers the impact of consumption subsidies on the profitability of component companies. In the model (1), the dependent variable (ROA) refers to the return on total assets. The independent variable (Lnsub) is the logarithm of government consumption subsidy. Selected control variables are respectively the enterprise scale (Lnsize), capital structure (Lev), the enterprise operation ability (TOTAL) and enterprise's growth opportunities (Grow).

Model (2) considers the impact of consumption subsidies on R&D investment of component enterprises. The dependent variable (LnRD) in the model (2) is the logarithm of R&D expenditure in these enterprises. The independent variable (Lnsub) is the logarithm of consumption subsidy in the new energy automobile industry. The control variables are the logarithm of total assets (Lnsize) to reflect the size of the enterprise, the return on assets (ROA) to reflect the enterprise's profitability, and the asset-liability ratio (Lev) to reflect the enterprise's asset structure.

5 Results and Discussion

5.1 Descriptive statistics

Table1. Descriptive statistics of variables

variable	mean	Std.	minimum	maximum
Lnsize	3.616522	1.231	1.068153	7.573382
lnRD	-0.2388157	1.335626	-9.965363	4.446866
grow	32.19382	48.98391	-58.62	557.03
roa	8.101614	9.460506	-50.96	47.05
tota	0.6930175	0.3837968	0.17	3.31
lev	42.68747	17.3846	4.7	98.86
lnsub	5.87865	0.6830125	4.925658	6.482262

As can be seen from Fig. 1, the maximum value of the log of R&D (LnRD) expenditure is 4.446866, the minimum value is -9.965363, and the standard deviation is 1.335626, which indicate that there is an obvious gap in r&d investment among parts and components enterprises. The maximum value of return on total Assets (ROA) is 47.05, the minimum value is -50.96, and the standard deviation is 9.460506, which indicate that there is also a gap in profitability among the parts enterprises of new energy vehicles. And the average growth rate of operating income is 32.19382, which shows that the average level of growth ability of core parts enterprises is relatively high.

5.2 Correlation analysis among variables

Table2. Tables of the Correlation Coefficient

	lnsub	lnsize	grow	roa	tota	lev	lnrd
lnsub	1.000						
lnsize	-	1.000					
grow	0.1352	0.1957	0.0909	1.000			
roa	0.2108	0.2092	-	0.2427	1.000		
tota	0.0814	0.0980	0.0447	0.3512	1.000		
lev	-	0.0967	0.5491	0.0887	-	0.1174	1.000
lnrd	-	0.1928	0.6859	0.1166	-	0.0551	0.4330
				-	0.1312		1.000

The correlation test in Fig. 2 shows that the government's consumption subsidy for new energy vehicles (Lnsub) is significantly correlated with the profitability (ROA) and R&D investment (LnRD) of core parts enterprises, preliminarily indicating that the consumption subsidy for the whole vehicle industry of new energy vehicles will have an impact on the parts enterprises.

5.3 Regression analysis

5.3.1 Government consumption subsidies and the profitability of component companies

Table3. The test results of hypothesis 1

roa	Coef.	Std. Err	t	P> t
lnsub	1.12763	0.650766	1.73	0.084*
lnsize	-0.3281171	0.4320723	-0.76	0.448
tota	8.683153	1.231157	7.05	0.000***
lev	-0.1248067	0.0304235	-4.10	0.000***
grow	0.0657664	0.011526	5.71	0.000***
-cons	0.0764091	4.259378	0.02	0.986

***, **, * are statistically significant at the 1, 5, and 10 % levels, respectively

It can be seen from Fig. 3 that the consumption subsidy of new energy vehicles (Lnsub) have a significant positive impact on the profitability of component enterprises (ROA), which verifies hypothesis 1. This shows that although the consumption subsidy of new energy vehicles has a direct effect on the sales of the whole vehicle, it can also indirectly have a significant impact on the parts enterprises. The results also indicate that the profitability of component companies will be significantly reduced with the reduction of government consumption subsidies during 2016-2018. Because every node in the production chain of new energy vehicles is closely related, the production and sales of new energy vehicles determine the demand for parts provided by suppliers. Therefore, when the production and sales of new energy vehicles decrease significantly, the production and sales of parts will inevitably decrease, and the profitability of parts enterprises will suffer adverse effects. Because of this transmission effect, in the period of vigorous promotion of consumption subsidies, parts and components enterprises will gain indirect benefits, while in a period of declining consumer subsidies, core parts and components enterprises of new energy vehicles will also suffer adverse

effects.

5.3.2 Government consumption subsidies and R&D input of parts and components enterprises

Table4. The test results of hypothesis 2

lnrd	Coef.	Std. Err	t	P> t
lnsub	-0.1719011	0.0711621	-2.42	0.016***
lsize	0.6979861	0.0466151	14.97	0.000***
roa	0.0032922	0.00577	0.57	0.569
lev	0.0035559	0.0033398	1.06	0.288
-cons	-1.915368	0.4598621	-4.17	0.000***

***, **, * are statistically significant at the 1, 5, and 10 % levels, respectively

It can be seen from Fig. 4 that consumer government subsidies for new energy vehicles (Lnsub) have a significant negative impact on R&D investment of parts enterprises (LnRD), which shows that during the decline of government consumption subsidies, with the gradual reduction of consumer subsidies, the R&D investment of core components of new energy vehicles gradually increased. The explanation for this result is as follows: During the decline of government consumption subsidies, the reason for the significant increase of enterprises' R&D investment is that the decline of government consumption subsidies serves as an information warning to the R&D investment of component enterprises. Although the reduction of market demand will have a certain impact on enterprises' R&D investment, enterprises are more aware that the most important way to maintain their long-term development is to strengthen their innovation ability.

6 Conclusion

This paper investigates the link between government consumption subsidies and the profitability and R&D investment of core component enterprises. And this paper finds that with the gradual reduction of consumer subsidies in the vehicle market, the profitability of core parts enterprises is significantly reduced, which shows that the production and sales of the whole vehicle market did bring a negative impact on the parts companies. However, the R&D investment of parts and components enterprises in the industrial chain has increased gradually with the reduction of consumption subsidies, which showing an unexpected momentum.

The result of this paper leads us to think about the new energy vehicle consumption subsidy policy. The consumption subsidy, mainly through the change of production and sales volume, has an indirect effect on the component enterprises. Therefore, during the decline of consumer subsidies, the profitability of enterprises whose main business is to sell core component will suffer a significant loss. However, in terms of research and development, the reduction of consumption subsidy is more of a signal function: only by strengthening the innovation ability of enterprises can core components enterprises make up for the loss caused by the decrease of production and sales, so as to they maintain the power of

long-term development. Therefore, during the period of gradual withdrawal of subsidy policies, core components enterprises of new energy vehicles significantly increased r&d investment.

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