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Study on Performance Evaluation and Influencing Factors of China's New Energy Vehicle Policy

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Abstract

New energy vehicles as a new industry has been promoted to the status of national strategic development, how to promote it healthy and rapid development has become an urgent problem need to be solved. Firstly, super-efficient SBM model was used to measure the performance level of existing policies in twenty-three cities promoting new energy vehicles. On this basis, complete factor decomposition is used to measure the external factors that affect the performance level. The results as follows: (1) the policy performance of the six cities with car purchase restriction is excellent over the years, and the seventeen cities without car purchase restriction have a larger room for improvement. (2) In cities with car purchase restrictions, the most important factor affecting residents' purchase decisions is the preferential license policy; in cities without car purchase restriction, all kinds of subsidies influence residents' purchase decisions in the early stage of promotion, but the influence of subsidies in the middle and later stage of promotion is limited, in that two stages, consumers pay more attention to NEV features such as endurance and safety of new energy vehicles. (3) The incremental sales volume of new energy vehicles in sample cities increases year by year. Complete factor decomposition shows that the contribution rates of government size, per capita GDP and financial support intensity are always positive.

Keywords

New energy vehicles; Policy performance; Super-efficiency SBM; Complete factor decomposition.

1. INTRODUCTION

With the increasing global energy shortage, the automobile industry, which is mainly powered by oil, is faced with the challenge of automobile energy transformation. The global automobile industry pattern is being reconstructed, and automobile products are in urgent need of transformation to energy conservation and environmental protection (Deng and Liu,2014). As a major energy consumer, China's vigorous development of new energy vehicles is a new way to solve energy problems and develop a low-carbon economy, as well as an important measure to cultivate the independent innovation ability of the automobile industry. In recent years, the central and local governments have made great efforts to support the development of the new-energy automobile industry and promote the structural change of the automobile industry. In 2009, the Ministry of Finance and the Ministry of Science and Technology jointly carried out demonstration and promotion trials of new energy vehicles, and the central government gave subsidies to consumers who purchased new energy vehicles. In 2013, new energy vehicles will be included in the advantageous conditions for innovation and the national major innovation base will be built on a pilot basis. Although the government gives great support to the new energy automobile industry, there is a big gap between the actual sales volume and the expected effect (Gao et al.,2014). For example, from 2015 to 2017, the sales

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volume of new energy vehicles were respectively 331,000 507,000 and 777,000. The sales volume of new energy vehicles accounted for about 2% of the total sales volume of the automobile market, which was far from the target of 25% in 2025 set in the Development Plan for Energy Conservation and New Energy Vehicles. The huge contrast between the large amount of policy input and the worrying sales of new energy vehicles may be attributed to two aspects: First, the policy support provided by the government is inefficient in the implementation process, leading to the failure of a large number of policy support to effectively promote the sales increase of new energy vehicles; Second, a number of external factors restrict the operation of the government itself, thus affecting the decision-making and formulation of policies. In view of the above problems, this paper attempts to measure the performance level of new energy vehicle policies over the years, and at the same time explore the external factors that affect the policy performance value, so as to find out the appropriate policy tools at the economic level.

As a new industry, the application and promotion of new energy vehicles have attracted wide attention, and a series of researches have been carried out in academic circles. Many literatures have qualitatively studied the subsidy policies to promote the development of the new energy automobile industry (Xiong and Li,2018) (Li and Zhan,2017), including purchase subsidy and tax exemption policies, supporting policies for the construction of charging facilities in public and private sectors, free parking, preferential charging policies and other policies to reduce consumer costs. Wang et al. conducted a questionnaire survey in 10 cities where new energy vehicles were first promoted and applied in China, and the results showed that unlimited purchase and unlimited purchase were the most important policies to enhance consumers' purchase intention. On this basis, some scholars also analyzed the relationship between subsidy policies and the development of new energy automobile industry. Cheng and Mu found that new energy automobile enterprises are highly dependent on government subsidies, and once the government subsidy intensity breaks through the reasonable range, the subsidy strategy will fail. Ma and Fan found that economic policies and administrative regulations were positively co-integrated with the sales share of new energy vehicles, at the same time, Ma et al. found that the government could promote the development of new energy vehicles industry by providing two kinds of subsidies to enterprises at the same time. As an emerging industry, new energy vehicles are dominated by the government. Therefore, the higher the proportion of government science and technology expenditure in general budget expenditure, the more conducive it is to the improvement of production efficiency of new energy vehicles (Tang and Zheng,2013). Xu et al. used vector autoregression model (VAR) to analyze the impact of government procurement on promoting the transformation of scientific and technological achievements, and the results showed that Beijing government procurement of new energy vehicles improved ford's independent innovation level.

In addition to the above analysis of relevant policies, there are also studies to measure the impact of existing policies on enterprises' production efficiency. In quantitative analysis, data envelopment analysis (DEA) is usually used to select a series of input-output indicators to measure the efficiency values of large, medium-sized and small enterprises (Min and Lu,2017). Zhang and Zeng found that the production efficiency of new energy automobile enterprises is relatively low, and various efficiency values of large-scale enterprises are significantly better than that of small and medium-sized enterprises. If the interference of exogenous environmental variables is not controlled, the production efficiency value of DEA measure is usually overestimated (Yu and Sun,2018). Zhang and Zhou established a subsidy policy quantitative system based on the policy Modeling Consistency Index (PMC) model, and the results showed that all government policies were within a good range. After a large number of literatures made relevant quantitative analysis, some scholars began to pay attention to the influence of external factors on policy performance value. Zhu and Wang found that the greater

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the scale of government expenditure, the lower the efficiency of resource allocation in the manufacturing industry. Chen and Li calculated the social expenditure efficiency of Local governments in China, and found that administrative corruption, income gap and other factors are variables to reduce the social expenditure efficiency, while education level, urbanization rate and other factors are variables to improve the social expenditure efficiency. After China's fiscal decentralization reform, most provincial governments' expenditure is not very efficient, and there is a big difference in the efficiency of government expenditure in eastern, central and western regions (Chen and Zhang,2008).

Existing literature to measure value and analysis of new energy vehicles policy performance has a certain reference value to the external influence factors, but there are still needs to improve the following questions: First, the existing literature is mostly adopts the traditional DEA model to measure policy performance, these models can't for decision-making unit sorting efficiency values are equal is the typical problems; Second, when exploring the external factors affecting the policy performance level, the existing literature usually has no quantitative measure of the relative contribution value, so it is difficult to find the key influencing factors. In order to make up for the deficiency of existing literature, this paper first used super-efficient SBM to measure and rank the policy performance levels of 23 cities (or city clusters). The super-efficient SBM model evaluates the DMU by referring to the composition frontier of other decision-making units (DMU), and can distinguish the DMU that has been judged to be effective, thus overcoming the deficiency of the traditional DEA (Bao and Wu,2018). Then, complete factor decomposition (Wang and He,2018) is used to decompose closely related external factors year by year. Complete factor decomposition is a common decomposition method, this model has the advantages of complete decomposition and no residual error, and can measure and rank the contribution degree and contribution rate of influencing factors, which fits the research needs of this paper very well.

2. RESEARCH METHODS AND DATA

2.1. Super-efficiency SBM Model

The measurement of performance or efficiency mainly includes stochastic frontier analysis method and DEA model. DEA is a systematic non-parametric method for evaluating relative performance, which is widely used in policy performance evaluation because it does not need to assume production function in advance and avoid errors caused by parameter estimation. However, the traditional DEA model cannot sort the decision units with equal efficiency values. In order to overcome the shortcomings of the traditional DEA model, the super-efficiency SBM model proposed by Tone is adopted in this paper. It is assumed that there are n DMU. For the k DMU, its efficiency value can be solved by the following programming model:

$$\rho=\min \frac{1+\frac{1}{n}\sum_{i=1}^{n}\frac{s_i^-}{x_{ik}}}{1-\frac{1}{q}\sum_{r=1}^{q}\frac{s_r^+}{y_{rk}}} \quad \text{s.t.} \begin{cases} \sum_{j=1,j\neq k}^{m} x_{ij}\lambda_j - s_i^- \leq x_{ik} \\ \sum_{j=1,j\neq k}^{m} y_{rj}\lambda_j - s_r^+ \leq y_{rk} \\ \lambda, s_i^-, s_r^+ \geq 0; \\ i = 1,2,\dots,n; \\ r = 1,2,\dots,q; \\ j = 1,2,\dots,m \\ (j \neq k) \end{cases} \tag{1}$$

Represents the efficiency value to be calculated, n and q represent the total number of input and output indicators, x_{ik} represents the i input of the k DMU, y_{rk} represents the r output of the k DMU, s_i^-, s_r^+ represent the relaxation variable of input and output respectively,

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202008_6(8).0019

represents the weight vector. The super efficiency SBM model has two orientation: input orientation is to keep output unchanged and select input to maximize performance value. The output orientation is to keep the input constant and determine the output to maximize the performance. The measure of NEV policy performance focuses on the maximum output that can be promoted by existing policy input, so output orientation is selected.

2.2. Complete Factor Decomposition

Based on the complete factor decomposition framework, combined with previous research results and the focus of this paper, the sales volume of new energy vehicles is taken as the proxy variable of policy performance value, and three indicators of government size, per capita GDP and local government financial support intensity are selected as external influencing factors. The decomposition process is as follows:

Per capita ownership of new energy vehicles

$$=\frac{Government\ expenditure}{Gross\ regional\ Product}\times\frac{Gross\ regional\ Product}{population}\times\frac{New\ energy\ vehicle\ sales}{Government\ expenditure}$$

Thus, Q=GS*GP*FI. Among them, GS represents government scale, GP represents per capita regional GDP, FI represents financial support intensity. Referring to the decomposition process of Wang and He (2018), in the case of three variables, the contribution of each variable to △Q can be expressed as:

$$GSeffect=GP0FI0\triangle GS+\frac{1}{2}\triangle GS(FI0\triangle GP+GP0\triangle FI)+\frac{1}{3}\triangle GS\times\triangle GP\times\triangle FI \quad (2)$$

$$GPeffect=GS0FI0\triangle GP+\frac{1}{2}\triangle GP(FI0\triangle GS+GS0\triangle FI)+\frac{1}{3}\triangle GS\times\triangle GP\times\triangle FI \quad (3)$$

$$FIeffect=GS0GP0\triangle FI+\frac{1}{2}\triangle FI(GP0\triangle GS+GS0\triangle GP)+\frac{1}{3}\triangle GS\times\triangle GP\times\triangle FI \quad (4)$$

Namely, △Q=GSeffect+GPeffect+FIeffect.

2.3. Research Objects and Data Sources

According to the research conclusion of Wang et al., convenience policies such as unlimited lines and unlimited purchase are the most important policies to enhance consumers' purchase intention. Therefore, the preferential license plate policy can best reflect the advantages of new-energy vehicles over traditional fuel-powered vehicles. Cities that introduce restrictions need to conduct auctions and lotteries to obtain license plates, both of which require consumers to bear certain costs, with the former paying auction fees and the latter time costs. To promote the application of new energy vehicles, Shanghai issued free special license plates for new energy vehicles purchased by private buyers in 2010. In 2013, there was no lottery for new energy vehicles in Guangzhou. In 2014, Beijing, Tianjin, Shenzhen and Hangzhou also lifted license plate restrictions. Based on this, data of 23 cities (or city clusters) from 2012 to 2017 are selected in this paper, in which the input index is set as X and output index as Y. Will be 23 cities (or city) is divided into a car purchase and no car purchase two kinds, including car purchase is 6 cities of Hangzhou, Shenzhen, Guangzhou, Beijing, Shanghai and Tianjin, no car purchase in 17 cities of Zhengzhou, Changsha-Zhuzhou-Xiangtan, Hefei, Suzhou, Wuhan, Shenyang, Dalian, Chengdu, Xiang-yang, Nanchang, Chongqing, Changchun, Xi 'an, Xiamen, Jinan, Kunming and Tangshan. Considering the quantifiable and economy of the indicators, the actual selected input-output indicators are shown in Table 1.

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202008_6(8).0019

Table 1. Input-output indicators of performance evaluation

	The variable name		unit	The data source
Input	Supply side	X1: Number of charging piles	bit	Statistical Yearbook of Energy Saving and New Energy Vehicles
		X2: Park construction subsidy	Ten thousand yuan	Statistical Yearbook of Energy Saving and New Energy Vehicles; Yearbook of Local Science and Technology
	Demand side	X3: Vehicle Purchase Subsidy	Ten thousand yuan	Statistical Yearbook of Energy Saving and New Energy Vehicles; Yearbook of Local Fiscal Expenditure
		X4: Electricity subsidies	Ten thousand yuan	Statistical Yearbook of Energy Saving and New Energy Vehicles; Yearbook of Local Fiscal Expenditure
		X5: License preferential	yuan	Reference to Hou et al. (2013)
Output	Y: New energy vehicle sales		bit	Statistical Yearbook of Energy Saving and New Energy Vehicles

In the analysis of external factors, the government size, per capita GDP and financial support intensity were selected. New energy vehicles as a new industry, the government will play a large role. The decomposition of the contribution rate of government scale to the sales of new energy vehicles can reflect the change of the government's influence on the industry, so as to see whether it is gradually market-oriented. For the private goods such as new energy vehicles, the per capita GDP reflects the change of income level, and the decomposition can reflect the influence of the change of income level on the purchase decision of new energy vehicles. The intensity of financial support measures the change of sales volume of new energy vehicles driven by financial support. If we break down the change, we can find the relationship between the level of local governments' actions and the sales volume of new energy vehicles. The data sources of the above three variables are: Statistical Yearbook of Chinese Cities, Statistical Yearbook of Energy-saving and New Energy Vehicles and Yearbook of Local Fiscal Expenditure.

3. THE EMPIRICAL ANALYSIS

3.1. Performance Level

3.1.1 The overall analysis

According to the selected input and output variables, the variable scale return model in super- efficient SBM is adopted to calculate the policy performance values of cities with and without auto purchase restriction, as shown in Table 2. The policy performance of the six cities with car purchase restriction was excellent, indicating that the financial expenditure and administrative support provided by these cities had achieved remarkable results in the promotion and sales of new energy vehicles. In the 17 cities without restriction on the purchase of automobiles, the average policy performance over the past years was greater than 0.5 in 14 cities, accounting for 82.4% of the total number of cities in this category, indicating that, on the whole, the implementation of policies in most cities has achieved certain effects. Among them, the policy performance values of Suzhou, Zhengzhou, Chengdu, Xiang-yang, Xiamen and

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202008_6(8).0019

Tangshan are around 0.5, which is on the edge of poor and good policy performance and deserves vigilance. The average policy performance of Jinan, Nanchang and Kunming over the years is less than 0.5, indicating that these cities still have great room for improvement in terms of policy input intensity or policy implementation efficiency. Of the 23 target cities, five are first-tier cities and 18 are second-tier and third-tier cities. In one line and two line city policy performance values were significantly higher than those three cities, suggests policy performance values related to urban economy development level, the more advanced the city's economic, the government financial subsidy funds can be put, the more the more residents have the ability to purchase new energy vehicles, under the function of double factors, the higher the policy performance value of the new energy vehicles.

Table 2. Policy performance values of 23 cities from 2012 to 2017

		City	2012	2013	2014	2015	2016	2017	Average
With-purchase limit cities	optimal (performance values >1)	Hangzhou	0.985	1.011	1.264*	1.392*	1.124*	1.187*	1.161
		Shanghai	0.976*	1.015*	1.020*	0.987*	1.137*	1.208*	1.057
		Shenzhen	0.934	0.948	0.964	1.128*	1.125*	1.175*	1.046
		Beijing	0.893	0.902	1.135*	1.122*	1.102*	1.109*	1.044
	medium (0.5< performance values <1)	Guangzhou	0.875	0.883*	1.107*	1.105*	0.973*	0.965*	0.985
		Tianjin	0.842	1.056	1.103*	0.965*	0.953*	0.948*	0.978
		Average	0.918	0.969	1.099	1.117	1.069	1.099	1.045
Without-purchase limit cities	optimal (performance values >1)	Hefei	0.965	1.101	0.982	0.987	1.112	1.101	1.041
		Chang-Zhu-Tan	0.978	0.985	0.919	0.921	1.119	1.116	1.006
	medium (0.5< performance values <1)	Wuhan	0.951	0.975	0.901	0.903	0.994	0.986	0.952
		Chongqing	0.891	0.942	0.855	0.864	1.002	0.903	0.910
		Changchun	0.709	0.845	0.633	0.669	1.068	0.987	0.819
		Shenyang	0.697	1.039	0.715	0.604	0.607	0.728	0.732
		Xi'an	0.861	0.787	0.616	0.507	0.651	0.796	0.703
		Dalian	0.675	0.897	0.669	0.552	0.599	0.796	0.698
		Suzhou	0.570	0.640	0.543	0.509	0.541	0.688	0.582
		Zhengzhou	0.507	0.517	0.555	0.533	0.614	0.662	0.565
		Chengdu	0.587	0.535	0.547	0.525	0.575	0.604	0.562
		Xiang-yang	0.659	0.511	0.585	0.493	0.542	0.560	0.558
		Xiamen	0.570	0.588	0.485	0.469	0.534	0.596	0.540
		Tangshan	0.597	0.588	0.511	0.412	0.421	0.644	0.529
	poor (performance values <0.5)	Jinan	0.449	0.562	0.436	0.429	0.555	0.556	0.498
		Nanchang	0.428	0.442	0.479	0.473	0.449	0.633	0.484
		Kunming	0.419	0.434	0.423	0.421	0.468	0.562	0.455
		Average	0.677	0.729	0.638	0.604	0.697	0.760	0.684

Note: In cities with limited purchase, * represents the year in which the new energy vehicle license plate is preferential.

3.1.2 Analysis of cities with purchase restriction

Furthermore, the reasons for the excellent policy performance of the six cities with car purchase restriction were analyzed. First, these six cities are economically developed, and they are all at the core of the local government and play a leading role. Therefore, the local government has sufficient financial resources and administrative power. In addition, these six cities are also the first to pilot new energy vehicles, which can accumulate more experience over time. Second, these six cities have a focus in policy making. On the supply side policy, the six cities in priority to satisfy production research and development base of local government land tax deduction, research and development funding and enterprise from three aspects, a lot of effort, give priority to meet the production research and development base of land protection enterprises can attract inflows, peace of mind, R&D funding to encourage new energy

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automobile enterprises to innovate, improve the core competitiveness, enterprises tax deduction that new energy automobile enterprises have more profit space. In terms of demand side policies, local governments in these six cities have given a lot of support in three aspects: purchase subsidy, car purchase loan and government purchase. More purchase subsidy and car purchase loan offered by local governments can make consumers more willing to buy new energy vehicles, thus increasing sales. Large quantities of government procurement can guarantee sufficient sales volume and profits for new energy automobile enterprises and play a role in promotion and publicity. To sum up, the combination of sound economic foundation, focused policy support by local governments and first-mover advantages of these six cities keeps the policy performance in the forefront. In addition, according to the empirical results, it can be found that in the first year and the second year of the new energy vehicle license plate preferential policy, the policy performance value of the six cities with purchase restriction has greatly improved compared with the previous years. It indicates that residents in first-tier cities have relatively high income and limited sensitivity to the price of new energy vehicles. Unlimited and unlimited purchase are the most important policies to enhance consumers' purchase intention, which is consistent with existing research conclusions.

3.1.3 Analysis of cities with unlimited purchase

In Hefei, Chang-Zhu-Tan and other 17 cities with unlimited purchase, the average policy over the years is 0.684, which is still far behind the first-tier cities of 1.045. Without restrictions in the city, Hefei and Chang-Zhu-Tan policy for optimal performance, similar in 17 cities economy development degree, policy performance values have significant differences, the reason for this may be as follows: the two cities (or city) in the process of new energy vehicles to give policy support, embodied in the supply side and demand side policy number, implement time earlier. From 2012 to 2017, the mean value of all policies in cities with a performance value greater than 1 was 26.5, which was about twice that of cities with a performance value between 0.5 and 1, and about three times that of cities with a performance value less than 1. Taking the supply-side and demand-side policies separately, the mean value of policies with a performance value greater than 1 city is much higher than those with a performance value between 0.5-1 and less than 1 city.

It is worth noting that in the cities with unlimited purchase, the policy performance value of most cities showed different degrees of decline in 2014 and 2015, which also led to a significant decline in the average policy performance of 17 cities in 2014 and 2015. Why this trend? Previous studies have suggested that it is mainly caused by the mismatch between the action time of supply-side and demand-side policies. In 2012 and 2013, the government led the demand side policy. The demand side policy was effective quickly, and the investment in that year produced great effects. 2014 and 2015, the government investment demand side policies as well as into the policy on the supply side, while the demand side policy but the duration of the short, quick results in the long term is no longer valid, so in 2014 and 2015 was supposed to supply side policy play a leading role, but the supply side policies often lag, so policy performance in 2014 and 2015 average six years minimum of two years. In 2016 and 2017, despite the weakness of the demand-side policy and even the phenomenon of subsidy regression, the supply-side policy began to show effects at that time. Therefore, the average performance of the policy in 2016 and 2017 rebounded, that is, the positive effect of the supply-side policy at this stage was greater than the negative effect of the demand-side policy regression.

3.2. Decomposition of External Influencing Factors

The effect of government size (GS), per capita gross regional product (GP) and financial support intensity (FI) on policy performance value was calculated by using complete factor decomposition. In order to avoid the "path dependence" problem due to the difference in the

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sequence of the decomposition of variables, the results of six different decomposition sequences of three variables were averaged, as shown in Table 3.

△Q value (change amount of new energy vehicle ownership per 10,000 people) of 23 target cities is always positive, and presents a trend of increasing year by year, which indicates that the sales volume of new energy vehicles in each city is accelerating year by year. Among them, there was a big leap in 2016, with the number of new energy vehicles per 10,000 people changing from single-digit to double-digit growth. The reasons for the substantial growth may be as follows: Made in China 2025 clearly points out that the manufacturing industry is the main body of the national economy, and the automobile industry involves many industries and has strong driving effect. It will be the main starting point for the transformation of the manufacturing industry, which greatly promotes the development of new energy vehicles. Meanwhile, in 2016, the supply-side policies began to show effects. According to the statistics of National Energy Administration, by the end of 2016, China had built 4,200 charging stations and 56,000 charging piles, which provided a great impetus to the sales of new energy vehicles. In addition, the comprehensive strength of BYD and Shanghai Vientiane automobile has been continuously enhanced, which has effectively improved the research and development of new energy vehicles and promoted the formation of their industrialization.

Table 3 Contribution and contribution rate of factors influencing sales of new energy vehicles

City category	Years	GSeffect		GPeffect		FIeffect		△Q
Purchase restriction	2012-2013	0.457	38.72%	0.433	36.70%	0.290	24.58%	1.180
	2013-2014	0.575	36.91%	0.469	30.10%	0.514	32.99%	1.558
	2014-2015	0.990	19.50%	1.577	31.06%	2.510	49.44%	5.077
	2015-2016	1.883	8.46%	5.692	25.58%	14.681	65.96%	22.256
	2016-2017	2.096	14.60%	4.338	30.22%	7.920	55.18%	14.354
Without restriction	2012-2013	0.071	10.57%	0.354	52.67%	0.247	36.76%	0.672
	2013-2014	0.128	9.78%	0.442	33.77%	0.739	56.45%	1.309
	2014-2015	0.227	7.69%	0.293	9.93%	2.432	82.38%	2.952
	2015-2016	0.791	6.05%	0.716	5.48%	11.567	88.47%	13.074
	2016-2017	0.599	7.10%	2.477	29.38%	5.355	63.52%	8.431
All cities	2012-2013	0.172	21.37%	0.375	46.58%	0.258	32.05%	0.805
	2013-2014	0.245	17.83%	0.449	32.68%	0.680	49.49%	1.374
	2014-2015	0.426	12.15%	0.628	17.91%	2.452	69.94%	3.506
	2015-2016	1.076	6.96%	2.014	13.02%	12.379	80.02%	15.469
	2016-2017	0.990	9.92%	2.962	29.69%	6.024	60.38%	9.976

The decomposition results of the 23 cities show that the contribution rate of government size (GS) is positive but decreases year by year. This conclusion is consistent with the views of Zhu et al. By examining the relationship between the scale of local government expenditure and the resource allocation efficiency of local manufacturing industry, Zhu found that the greater the scale of government expenditure, the lower the resource allocation efficiency. Specifically, in this paper, on the one hand, new energy vehicles are a policy-oriented industry. The larger the government scale, the larger the proportion of government expenditure in the local GDP, the more financial support can be given to enterprises and consumers, so as to promote the sales and promotion of new energy vehicles. On the other hand, as the scale of government procurement and incentive increases year by year, it will inevitably have a negative impact on the allocation of resources in the manufacturing industry. Therefore, the positive and negative effects of the two factors offset each other, and the result is that the contribution rate of government scale is positive, but smaller and smaller. In general, the size of government over the years the average contribution rate was 13.65%, not very high, but the practice of the

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Chinese government is in line with the infant industry protection theory and the right way to avoid "Liszt-trap", Qin and Li think shall carry out the protection of infant industries are mainly concentrated in the central government, local government participation behavior should be effectively curb, so in the development of new energy automotive industry, the local government is more like a catalyst, lead and accelerate the role, is still the market and decisive.

The contribution rate of per capita gross regional product (GP) to the increase of new energy vehicles is significantly different between cities with limited purchase and cities without limited purchase. In cities with limited purchase, the contribution rate of per capita gross regional product (GP) to the increase of new energy vehicles is always around 30%, indicating that in first-tier cities with developed economy, changes in income level will not significantly affect whether residents decide to buy new energy vehicles. In cities with unlimited purchase, the contribution rate of per capita GDP (GP) to the increase of new energy vehicles shows a U-shaped trend, indicating that in the early stage of the promotion of new energy vehicles, income is an important factor affecting consumers' purchase of new energy vehicles. The higher the per capita GDP is, the more people will buy new energy vehicles. In the middle of the new energy cars, with income increasing people will buy but the growth rate of new energy vehicles, the consumer is not only the new energy vehicles of subsidies, and pay more attention to new energy car battery life, exterior trim, after-sales service etc., thus promoting compared medium-term promote early can make new car purchases fell; In the later stage of promotion, with the improvement of the new energy automobile industry and market and the emergence of supply-side policies, consumers began to reconsider new energy automobiles, so the contribution of per capita GDP to the increase of new energy automobile sales also began to increase.

The contribution rate of financial support intensity (FI) to the increase of new energy vehicles in the 23 cities as a whole or in different cities shows an inverted "U" pattern. The intensity of financial support measures the sales volume of new energy vehicles brought by each unit of fiscal expenditure. There are two ways of financial support: one is to directly increase the sales volume of new energy vehicles through government purchase; The other is that government financial subsidies and administrative facilitation act on the supply side and the demand side, indirectly promoting the increase of sales of new energy vehicles. In the early stage of the promotion of new energy vehicles, the government carried out a large number of government procurement and the rapid effect of the demand-side policy led to a significant increase in the sales of new energy vehicles; In the middle stage of the promotion of new energy vehicles, although the demand-side policy is weak, the supply-side policy starts to show its effect. Because the overall effect of the supply-side policy is better than that of the demand-side policy, the contribution rate of the financial support intensity keeps increasing due to the certain supply-side policy in government procurement. In the later stage of the promotion, the government subsidy policy regressed and the government procurement of new energy vehicles was reduced. At this time, it was more dependent on indirect means. Therefore, the contribution rate of financial support intensity was positive, but it showed a downward trend.

4. CONCLUSIONS AND SUGGESTIONS

4.1. The Research Conclusion

(1) According to the calculation results of the super-efficient SBM model, the policy performance of the six cities with car purchase restriction has been excellent over the years, and the policy performance level of each city increased significantly in the first and second years after the introduction of the new energy vehicle license plate preferential policy, indicating that the residents of these cities are sensitive to the license plate preferential policy. In the 17 cities without car purchase restriction, the policy implementation in most of them has achieved certain effect, but there is still much room for improvement compared with first-tier cities.

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Cities without car purchase restriction have similar levels of economic development, but there are significant differences in policy performance values because local governments provide different levels of policy support and the implementation time of policies are also significantly different.

(2) According to the calculation results of complete factor decomposition, the contribution rate of government size in cities with or without purchase restriction is positive, but decreases year by year, indicating that in the promotion process of new energy vehicles, local governments only play a leading and accelerating role, while the market still plays a decisive role. The contribution rate of per capita GDP to the increment of new energy vehicles is significantly different between cities with limited purchase and cities without restriction. In cities with limited purchase, the sales of new energy vehicles will not change significantly with the increase of per capita GDP. In cities without restriction, the contribution rate of per capita GDP shows a u-shaped trend. In both cities, the contribution rate of financial support intensity to the increase of new energy vehicles shows an inverted u-shaped trend, which is closely related to the increase and then the decrease of government subsidy intensity.

4.2. Policy Suggestions

In order to promote the efficient and rapid development of the new energy automobile industry and improve the policy performance of the central and local governments, the following discussion is carried out based on the empirical analysis:

(1) In cities where purchase is restricted, relevant license system should be perfected and improved. Because the income level of consumers in the city of purchase restriction is relatively high, it is relatively insensitive to the general subsidies, while the preferential license is very important, so it is particularly important to perfect and improve the license system. For example, the strategy of combining auction and lottery is adopted according to the actual situation. Those who have strong private car demanders can quickly obtain license plates through auction, while others who are not in urgent need can obtain license plates through lottery. In addition, due to the urban economy developed for purchasing, new energy vehicles promotion earlier, its development experience to the city has a strong reference for purchasing, under the circumstances of subsidies policy tightening, how to innovate the supply side and demand side policy makes the new energy automotive industry towards the marketization and internationalization transformation is an important work.

(2) In cities with unlimited purchase, government procurement should be strengthened. In cities with unlimited purchase, the contribution rate of financial support to the increase of new-energy vehicle sales is about 65%, which accounts for a very high proportion. Increasing the intensity of government procurement will significantly increase the financial support and thus increase the sales of new-energy vehicles. Increasing the purchase of new energy vehicles by local governments, on the one hand, can ensure reasonable profits for the industry, and on the other hand, for those consumers who hold a wait-and-see attitude towards new things, it is also a publicity and promotion of new energy vehicles. In addition, according to the measurement results of super-efficient SBM, cities with high mean policy performance in unlimited purchase cities usually have stable policy performance value, which makes input and output stable and is conducive to the improvement of policy performance value. In cities with low policy performance average, the policy performance value tends to fluctuate year by year, which makes the resource allocation lack of long-term effect, is not conducive to the production of enterprises, and will also change the expectations of consumers. Therefore, stable resource allocation and long-term investment mechanism are the premise to ensure the steady growth of new-energy vehicle sales.

(3) The technological innovation, production and research and development of new energy vehicles should be strengthened in both cities with limited purchase and cities without, so as to

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make consumers accept new energy vehicles from their hearts. In cities where purchases are restricted, most residents have to buy new energy vehicles because of license plate restrictions. In cities with unlimited purchase, as the popularity of new energy vehicles increases, consumers will pay more attention to the performance and safety of new energy vehicles, instead of just paying attention to subsidies. Therefore, the performance of new energy vehicles should be fundamentally improved to enable consumers to take the initiative to accept new energy vehicles. In the application of supply-side policies, more support should be given to technological innovation, such as tax incentives and intellectual property protection. As power battery technology is the core competitiveness of new energy vehicles, and China's power battery technology is not mature, strengthening cooperation between universities and enterprises is particularly important to improve the efficiency of industrial RESEARCH and development. Local governments should attach importance to R&D investment and policy support for key technologies such as power battery, drive motor and electronic control, and strive to break the application bottleneck of power battery technology, so as to obtain broader space for the development of new energy automobile industry.

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