Research on Key Influencing Factors of China's New Energy Automobile Industry Development

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Abstract. The new energy automobile industry has the advantages of sufficient energy, small pollution, renewable, wide market, large scale and good efficiency. It can achieve the goal of economic development and ecological harmony, and is the most dynamic industry in strategic emerging industries. Sustainable development has an important supporting role. This paper aims to provide a theoretical basis and policy support for the sustainable development of China's new energy automobile industry by constructing an empirical model of key influencing factors.

Keywords: new energy automobile industry; regression analysis; economic development.

1. Introduction

In 2018, China's total sales of new energy vehicles exceeded 1.2 million units, a year-on-year increase of 61.7%. From the perspective of monthly sales, it basically keeps rising. From the perspective of subdivision types, pure electric vehicles are currently the mainstay, accounting for more than 67% of the total monthly sales of new energy vehicles, and the ratio is on the rise. In January and February of 2019, sales of new energy vehicles increased by 120% and 56% year-on-year, and sales accounted for 4.1% and 2.9% of total vehicle sales for the month. This paper aims to provide a theoretical basis and policy support for the sustainable development of China's new energy automobile industry by constructing an empirical model of key influencing factors.

2. Model and Data

2.1 Establish a Production Model for the New Energy Automobile Industry

Multiple factors need to be considered in the analysis of the production development of new energy vehicles. Therefore, the following multiple regression models are established.

$$Q=f(Q_{oil}, Char_S, Equi, Patent, Per_{income}, Lm, \varepsilon) \quad (1)$$

Q is the output of new energy vehicles, Q_{oil} is the output of crude oil, Chars is the number of charging piles, Equi is the output of air pollution control equipment, Patent is the patent application quantity of new energy vehicles, Per_{income} is the per capita income of Chinese residents, and Lm is the output of Chinese lithium mines, ε is the coefficient vector to be estimated for the function.

For (1) import time subscript t, a logarithmic regression model can be obtained:

$$Q_t = \alpha Q_{oil} + \beta Char_{st} + \gamma Equi_t + \lambda Patent_t + \theta Per_{incomet} + \delta Lm_t + u \quad (2)$$

α, β, γ, λ, θ, δ is respectively the coefficient of Q_{oil}, $Char_{st}$, $Equi_t$, $Patent_t$, $Per_{incomet}$, Lm_t.

2.2 Data Source and Description

The data of new energy vehicle production comes from the China Automotive Industry Yearbook, data on crude oil production and per capita income of comes from China Statistical Yearbook. The data on the production of air pollution control equipment comes from the wind database, and the number of patent applications is from the China Intellectual Property Network. Lithium ore production comes from China Bulk Commodity. The time series length is 2010-2018. For regression, the data is processed into the monthly data by the software eviews9.0.

3. Empirical Analysis

3.1 Unit Root Test

The empirical analysis of the measurement part of this paper uses Eviews 9.0.

In this study, the ADF (Augmented Dickey Fuller Test) statistic method was used to test the stationarity of the variable time series data. Table 1 shows the ADF unit root test results of the variable horizontal sequence and the differential sequence. It can be seen from the test results that Q, Q_{oil}, $Char_s$, Equi, Patent, Per_{income} and Lm, the horizontal sequences are all non-stationary sequences, and the first-order difference sequences of all sequences are stable at a significant level of 5%, that is, all variables are the process of I(1).

Table 1. Augmented Dicky-Fuller Unit Root Test Results

LS	TF	ADF	Prob.	DS	TF	ADF	Prob.	conclusion
Q	C,T,2	-2.21	0.48	$\triangle Q$	N,N, 1	-7.49	0.02	I(1)
Q_{oil}	C,T, 2	-3.12	0.11	$\triangle Q_{oil}$	N,N,1	-9.31	0.00	I(1)
$Char_s$	C,T, 2	-3.12	0.11	$\triangle Char_s$	N,N,1	-9.31	0.00	I(1)
Equi	C,T, 2	-2.90	0.17	△Equi	N,N,1	-9.55	0.00	I(1)
Patent	C,T, 2	-2.07	0.55	△Patent	N,N,1	-8.31	0.00	I(1)
Lm	C,T, 2	-1.59	0.79	△Lm	N,N,1	-15.50	0.00	I(1)
Per_{income}	C,T, 2	-1.92	0.63	$\triangle Per_{income}$	N,N,1	-8.31	0.00	I(1)

Note: (1) LS: level series; DS: differential series; TF: test form

(2) The test form (C, T, q) represents the intercept term, the trend term and the lag order, respectively, and the intercept term or trend term is recorded as C and T, respectively, otherwise N;

(3) △ represents the first-order difference;

(4) Prob.: the accompanying probability of the ADF.

3.2 Regression Analysis

Regression fitting of the established regression model by eviews software:

(1) Gradual regression, Qoil, Chars, Equi and new energy vehicle production Q can establish a better regression model, the model can pass the test of probability and determinable coefficient and F statistic.

Table 2. Through Qoil, Chars, Equi and new energy vehicle production Q establish a better regression model

Dependent Variable: *Q* Method: Least Squares				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Q_{oil}	-27.32476	6.537741	-4.179541	0.0001
$Char_s$	1.130994	0.108716	10.40324	0.0000
Equi	0.798544	0.075728	10.54493	0.0000
C	263.1525	64.45345	4.082830	0.0001
R-squared			0.972018	
Adjusted R-squared			0.970783	
F-statistic			787.3774	

(2) During the regression process, adding the production of lithium ore, the regression result is:

Table 3. The results of adding the production of lithium ore

Dependent Variable: Q Method: Least Squares				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Qoil	-18.82316	13.15363	-1.659097	0.0118
Chars	1.023118	0.248706	4.113758	0.0001
Lm	-0.135645	0.280888	-0.482915	0.6307
Equi	0.814054	0.082654	9.848972	0.0000
C	210.0122	127.09881	1.503730	0.0108
R-squared			0.972115	
Adjusted R-squared			0.970245	
F-statistic			583.9323	

It can be seen from the regression results that when t the production of lithium ore is added, the probability of the regression result cannot pass the 5% test standard, so this variable is eliminated.

(3) When joining the per capita income of economic variables, the regression result is:

Table 4. The results of joining the per capita income of economic variables

Dependent Variable: Q Method: Least Squares				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Q_{oil}	-17.92965	7.372131	-2.432085	0.0177
$Char_s$	1.165231	0.108063	10.78287	0.0000
Per_{income}	-0.744391	0.487541	-1.526827	0.1316
$Equi$	0.814876	0.074291	10.96870	0.0000
C	178.0122	71.09881	2.503730	0.0148
R-squared			0.974460	
Adjusted R-squared			0.972526	
F-statistic			503.6440	

It can be seen from the regression results that when the per capita income is added, the probability of the regression result cannot pass the 5% test standard, so it is eliminated.

(4) When the number of patent applications for economic variables is added, the regression results are:

Table 5. The regression results of add number of patent applications for economic variables

Dependent Variable: Q Method: Least Squares				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Q_{oil}	-17.92965	7.372131	-2.432085	0.0177
$Char_s$	1.165231	0.108063	10.78287	0.0000
$Patent$	-0.053908	0.032225	-1.995587	0.0423
$Equi$	0.814876	0.074291	10.96870	0.0000
C	178.0122	71.09881	2.503730	0.0148
R-squared			0.973558	
Adjusted R-squared			0.971980	
F-statistic			616.7189	

It can be seen from the regression results that when the number of patents for economic variables is added, the probability of regression results is passed the 5% test standard, and the model is added to the economic variable.

The regression model was built by eviews software and the regression model was:

$$Q_t = -17.93Q_{oil} + 1.17Char_{st} + 0.81Equi_t - 0.05Patent + 178.01 \quad (3)$$
$$R^2=0.97 \qquad F=616.72$$

The empirical results show that the four explanatory variables pass the significance test at the 5% level, and the fitting effect is remarkable. Based on the empirical results, the following conclusions can be drawn:

(1) There is a substitution effect between new energy vehicle production and crude oil production

From the empirical results, when the crude oil output increases by one unit, the output of new energy vehicles will be averagely reduced by 17.93 units. That is to say, in the process of economic development, with the gradual popularization of new energy vehicles among consumers, it has a certain impact on the oil and gas industry.

(2) There is a complementary effect between the output of new energy vehicles and the number of charging piles.

From the empirical results, when the number of charging piles increases by one unit, the output of new energy vehicles will averagely increase by 1.17 units. New energy vehicles are emerging industries, but most of the service systems of new energy vehicles are still using the original system of traditional vehicles, or they are still in the initial stage of construction. The emerging products involved in new energy vehicles – charging piles are provided by third parties. The increasing number of charging piles will make consumers more convenient to use cars, increase the demand for automobiles, and thus increase the production and sales of new energy vehicles.

(3) The same trend of output of new energy vehicles and air pollution control equipment

From the empirical results, when the output of air pollution control equipment increases by one unit, the output of new energy vehicles will averagely increase by 0.81 units. The problem of air pollution has never been so noticeable around the world as it is now, and it has become a fixed international issue in multilateral agreements. The issue of controlling environmental pollution has been highly valued by relevant departments, and the provisions of international and domestic environmental laws and regulations have been continuously formulated. The gradual increase in the number of air pollution control equipment may indicate that the degree of environmental pollution has increased, and that automobile exhaust has caused an important factor in environmental pollution. How to reduce pollution and protect the environment is imperative. New energy vehicles can replace large-displacement traditional cars. Therefore, there is a positive change relationship between the output of new energy vehicles and the production of air pollution control equipment.

(4) There is a reverse relationship between the output of new energy vehicles and the number of patent applications for new energy vehicles.

From the empirical results, when the number of new energy vehicle patent technology applications increases by one unit, the output of new energy vehicles will be averagely reduced by 0.05 units. The use of patents requires a certain fee within the scope of the patent law protection period. The more patents of new energy vehicle technology will increase the cost of new energy vehicle manufacturers, so there is a reverse relationship between the two.

4. Suggestions

4.1 Improve Brand Awareness, Promote Brand Awareness and Convert Purchases

Since new energy vehicles are new to most consumers, especially in the face of new brands, consumers are more concerned about vehicle performance and ease of use. And new energy vehicles are more expensive than traditional cars, and there are big challenges in the process from brand recognition to conversion. Enterprises can learn from some industry models and reduce the threshold for users to understand and try new energy vehicles through leasing. They can let more users use new cars faster, experience various performances and intelligent functions of automobiles, and realize rent promotion. Sell, quickly occupy the market and gain first-mover advantage.

4.2 Improve Technology and Optimize After-sales Service

4.2.1 New Energy Vehicles are Emerging Industries and Currently Need to be Improved in Terms of Technology

A car battery expert said that 80% of the current new energy vehicle after-sales problems are caused by batteries, and current new energy auto companies are pursuing vehicle sales, and battery after-sales service is stretched, resulting in waiting for vehicles to replace batteries during some warranty periods. The time is up to several weeks or even months (if it is necessary to stock up from abroad), and the owners still have to pay high fees, so new energy auto companies need to continuously improve technology and optimize after-sales service.

4.2.2 Creating a Scene Service Platform

Enterprises should position the market in the product planning stage with the scenario demand and user service platform, and build a service platform for comprehensive travel scenarios around “car, pile, and network” to form a large enough user scale and strong enough user stickiness. On the basis of the platform, various value-added services (such as life services, smart internet services, vehicle and battery financial services, energy services and brand care services, etc.) are extended to ensure that not only sell cars but also sell services.

4.2.3 Exploring Cutting-edge Technology

Enterprises also need to work hard to explore the application of cutting-edge technologies (such as artificial intelligence, cloud technology, 5G, Internet of Things, big data, etc.) in the new energy vehicle industry chain, and open up various links to achieve the integration and reconstruction of automotive ecology. In order to achieve this, new vehicles can consider building new energy automobile industrial parks, and research and practice the application of emerging technologies to vehicle and related services.

4.2.4 In the Short Term, Actively Explore Opportunities for Cooperation between the Three Parties to Jointly Develop the Market

At present, new energy vehicles are still new. The exploration of this industry still requires huge capital and manpower. It is difficult for any company to cope with challenges alone. Enterprises should actively cooperate to make cakes bigger.

4.2.5 In the Long Run, All Parties Will Form a Certain Camp, and Gradually Compete and Divide the Market with the Camp as a Unit

In the process of building new forces, traditional car companies, and newly entering enterprises to jointly build a new energy vehicle ecosystem, the entire player market will gradually show different camps. After the cake of the new energy vehicle smart travel market is big enough, it will be divided into market cake wars by the camp. If the new forces of car making want to gain the desired harvest in the market, they should reasonably choose partners and camps.

4.3 Increase After-sales Outlets to Form an After-sales Supply Chain

At present, the after-sales service system of new energy vehicles mostly follows the original system of traditional automobiles, or is still in the initial stage of construction. At the same time, new energy vehicles involve many emerging technologies and products (such as batteries and charging piles) provided by third parties. However, there is currently no mechanism for effective joint communication between the parties. the after-sales stores set up by various automakers can serve far more cars than the millions of new energy vehicles sold without the market.

4.4 Cultivate Technical Talents.

With the rapid development of new energy vehicles, it has become the best choice for many people to travel. However, the speed of training of technical talents in this industry is far behind the society's need for the rapid growth of new energy vehicles, so that manufacturers want to solve problems for the owners in time, but they seem to have enough energy.

Acknowledgments

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