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Empirical Research on Influencing Factors of New Energy Consumption

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Abstract

This paper takes the data from 2000 to 2017 as samples and uses OLS model to empiricly test the influence of new energy consumption on traditional energy price, consumer price index, energy processing and conversion efficiency, investment in new energy industry and government incentive policies. Firstly, White test is used to judge whether there is heteroscedasticity between the variables. Secondly, stepwise regression method is used to correct the multicollinearity in the model. Finally, the final model is established after the DW test. The results show that investment in the new energy industry and consumer price index are the main factors affecting the consumption of new energy and they tend to be positively correlated with the consumption of new energy. Therefore, the government should increase investment in new energy industry, vigorously promote new energy technology innovation, accelerate new energy utilization efficiency, and at the same time accelerate the process of economic development, improve people's living standards, so as to stimulate new energy consumption and promote the development of new energy industry.

Keywords

New energy consumption, OLS model, Stepwise regression method.

1. Introduction

Since the 21st century, with the increasing attention paid by the state to sustainable development issues such as ensuring energy security and protecting the ecological environment, accelerating the development of new energy has become the common consensus and concerted action of all countries in the world. Countries are gradually increasing the research investment in large-scale development technology of new energy and renewable energy, expecting to occupy the strategic commanding height of global energy development in the future [1]. In recent years, scholars at home and abroad have conducted extensive discussions on energy transformation and renewable energy. Wang Jun [2] indicated that vigorously developing new energy and gradually replacing traditional energy can promote economic growth. According to wang Xiao's research [3], the influence of energy industry investment and energy consumption on economic growth has been found that there is a long-term co-integration relationship among energy investment and energy consumption and economic growth, and energy investment and energy consumption are the granger causes of economic growth. Long [4] showed that coal has a dominant influence on economic growth and carbon emissions, and there was a two-way causal relationship between economic growth, CO_2 emissions and traditional energy consumption. So, it is necessary for China to change the energy consumption structure and vigorously develop new energy. The above studies fully show that the substitution effect of new energy for traditional energy will play an important role in China's economic development. Therefore, the study of the influencing factors of new energy

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consumption is of great significance for the correct formulation of energy policies and the promotion of stable economic growth.

2. Analysis of Influencing Factors

2.1. Analysis of Influencing Factors of New Energy

In recent years, China's new energy industry has developed rapidly. By 2018, China's traditional energy consumption accounted for 82% of the total energy consumption, while new energy consumption accounted for about 15%. New energy refers to the traditional energy outside of the various forms of energy, including solar energy, biomass energy, wind energy, geothermal energy and tidal energy and so on, in the use of new energy, wind power, hydropower, nuclear power and solar power generation accounts for the vast majority of proportion, so there is a high correlation between the study of primary electricity and other energy consumption and the study of new energy consumption. After analysis, primary power and other energy consumption may be related to consumer price index, traditional energy price, energy processing and conversion efficiency, investment in new energy industry and government policies.

The consumer price Index (CPI) reflects the overall price level and, to a certain extent, people's living standard. When the CPI rises, people will increase their consumption of cleaner new energy. in the process of promoting the development and utilization of new energy, attention should be paid to the role of traditional energy price mechanism in the development of new energy [5]. New energy as a substitute of traditional energy, when the price of traditional energy increases, consumers will turn to use relatively cheap new energy. Energy processing and conversion efficiency refers to the ratio of energy output and input in the processing and conversion, which is closely related to its consumption, which is closely related to its consumption. The improvement of production efficiency will promote the large-scale development of new energy, bring economic benefits to the society, and then stimulate consumption [6]. When investment in new energy industry is increased, new energy research and development will introduce more scientific research and technical personnel and more advanced technology, which can promote the development of cheaper and clean new energy and stimulate the consumption of new energy. The scholar [7] used the model to explain that the renewable energy consumption was closely related to the government subsidy strategy. When the policy subsidy was stopped, the growth trend of China's renewable energy consumption was obviously lower than that of continuing the original policy subsidy.

2.2. Variable Selection and Data Sources

This paper selects data from 2000 to 2017 for empirical analysis. In 2000, China's coal and oil consumption accounted for 98.7% of traditional energy consumption, and in 2017, it was 86.2%. It can be said that coal and oil consumption accounted for a very large proportion of traditional energy consumption, and the fluctuation of gasoline price has an important impact on oil consumption. Therefore, the price of traditional energy can be measured by the price of coal and gasoline. Qinhuangdao port is an important coal hub port in China, its coal loading and unloading situation and storage changes are called by the industry as the "barometer" of the coal market and the "weathervane" of the coal price. Therefore, the closing price of Qinhuangdao Port Q5500 thermal coal is selected in this paper to represent the domestic coal price level. The data are from China Industry Information Network. Gasoline No. 92 and Gasoline No. 93 are highly correlated with people's life, and the oil price in Beijing is obviously representative. Since 2012, Beijing has changed gasoline No. 93 to gasoline no. 92. The data of primary electricity and other energy consumption, CPI and energy processing and conversion efficiency are all from China Statistical Yearbook 2018, while the data of electricity, steam, hot

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water production and supply industry investment are from the National Bureau of Statistics. In 1999, issued several measures about new energy incentives, but the big efforts to promote and implement is in 2008 of the renewable energy developments of the eleventh five-year plan "after formally promulgated. So, this paper takes 2008 as the cut-off point. Before 2008, incentive policies are not implemented by default, and after 2008 (including 2008), incentive policies are implemented.

Table 1. Meanings and data sources of model variables

Variable	Symbol	Paraphrase	The data source
Primary power and other energy consumption (tons of standard coal)	Y	Reflect the consumption of new energy sources	(China Statistical Yearbook 2018)
Consumer Price Index (1978=100)	X_1	Reflect price level	(China Statistical Yearbook 2018)
Coal price (yuan/ton)	X_2	Reflect the price of coal	China Industry Information Network
Petrol price (YUAN/litre)	X_3	Reflect the price of oil	Oriental Fortune Net
Energy Processing and Conversion Efficiency (%)	X_4	Reflect the output to input ratio of energy in processing and conversion	(China Statistical Yearbook 2018)
Investment in the production and supply of electricity, steam and hot water (100 million)	X_5	Reflected in the new energy industry investment intensity	National Bureau of Statistics
The government's policy	X_6	It is a dummy variable, one represents the implementation of incentive policies, Zero represents no incentive policy	Public information collation

3. Model

3.1. Model Specification

According to the sample data, the heteroscedasticity White test showed that $nR^2=18.0748$. At $\alpha=0.05$, the critical value is equal to 12.5916 by looking up the distribution table. Then compare the calculated statistics and the critical value. Because of $nR^2=18.0748> \chi^2_{0.05}(6)=10.6446$, So reject the null hypothesis that there is no heteroscedasticity, indicating that the model has heteroscedasticity. In order to eliminate the influence of heteroscedasticity in the model analysis, logarithmic processing was carried out for all variables except the dummy variable X_6 to obtain data series lnY, lnX_1, lnX_2, lnX_3, lnX_4 and lnX_5, which passed the White test. In this paper, the following regression model is set according to the selected variables:

$$lnY_t=\beta_0+\beta_1 lnX_{1t}+\beta_2 lnX_{2t}+\beta_3 lnX_{3t}+\beta_4 lnX_{4t}+\beta_5 lnX_{5t}+\beta_6 X_{6t}+u_i$$

And β_0 is the intercept term, β_1, β_2, β_3, β_4, β_5 and β_6 are the parameters to be estimated for each variable, and u_i is the random error term.

3.2. Multicollinearity Check and Correction

The multicollinearity among explanatory variables will seriously affect parameter estimation, enlarge model error and destroy model robustness. Therefore, it is necessary to test whether there is multicollinearity among explanatory variables. The least square regression was performed on the model, and the regression equation was obtained as follows:

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$$\ln Y=-7.1546+2.2206\ln X_1+0.0907\ln X_2-0.2880\ln X_3-0.0696\ln X_4+0.4048\ln X_5-0.0094X_6$$
$$t= (-0.4076)\ (3.5208)\ (0.7162)\ (-1.4762)\ (-0.0158)\ (2.7097)\ (-0.1040)$$
$$R^2=0.9905$$

Since R^2 is large and close to 1, F=191.7452, the overall linear relationship between primary power and other energy sources and explanatory variables is significant. However, most of the parameter estimates fail the T-test, and the correlation between lnY and $\ln X_1$ is as high as 0.979007 (the correlation coefficient matrix of each explanatory variable is shown in Table 2), indicating the existence of multicollinearity among variables.

Table 2. Correlation coefficients among explanatory variables

	lnY	$\ln X_1$	$\ln X_2$	$\ln X_3$	$\ln X_4$	$\ln X_5$	X_6
lnY	1.000000						
$\ln X_1$	0.979007	1.000000					
$\ln X_2$	0.495448	0.609762	1.000000				
$\ln X_3$	0.742909	0.848643	0.869475	1.000000			
$\ln X_4$	0.943723	0.962981	0.643261	0.854893	1.000000		
$\ln X_5$	0.994863	0.978920	0.492431	0.749999	0.958150	1.000000	
X_6	0.813420	0.883270	0.773492	0.897000	0.866169	0.819611	1.000000

Stepwise regression method was adopted, and the explained variables were regressed respectively. Each parameter estimation could pass the T test, but the judgment coefficient of lnY and $\ln X_1$ was the largest, so the basic equation was based on the model of lnY and lnX1. Variables $\ln X_2$, $\ln X_3$, $\ln X_4$, $\ln X_5$ and $\ln X_6$ were introduced for regression to obtain the t value of explanatory variables. As shown in Table 3, only the absolute value of T value of $\ln X_5$ was greater than the critical value at the significance level of 5%, then lnX5 had a significant impact on lnY, and R^2 was improved, so the variable $\ln X_5$ was retained. On the basis of preserving the variables $\ln X_1$ and $\ln X_5$, variables $\ln X_2$, $\ln X_3$, $\ln X_4$ and X_6 were introduced respectively. And under the condition that the significance level is 5%, It is concluded that all t values of explanatory variables do not pass the test. In summary, explanatory variables lnX2, lnX3, lnX4 and X6 have no significant influence on lnY, so only $\ln X_1$ and $\ln X_5$ are retained.

Table 3. Stepwise regression results

	T values for each variable						
Add the variable	lnX1	lnX5	lnX2	lnX3	lnX4	X6	coefficient of determination
lnX1	23.64635						0.971837
lnX5	2.892465	4.293203					0.987518
lnX2	-0.18357	0.717708	4.017161				0.973105
lnX3	1.986020	0.291290		7.136150			0.972338
lnX4	0.601946	2.725971			19.01268		0.981397
X6	-0.75527	-0.87761				6.908149	0.973540

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Multiple regression was carried out on the model to obtain the regression equation between variables, as follows:

$$\ln Y=-5.4740+2.0059\ln X_1+0.3442\ln X_5$$
$$t= (-2.67140)\ (4.564818)\ (4.293203)$$
$$R^2=0.9875$$

3.3. Heteroscedasticity Test and Correction of the Model

Multiple linear regression was performed on the above equation by software Eviews, and the DW statistic in the regression results is 1.5506. For the model with a sample size of 18 and an explanatory variable of 2 and a significance level of 5%, it can be seen from the DW statistical table that dL=1.046 and dU=1.585. It can be assumed that the model may be autocorrelated because of $d_L<DW<d_U$ in model. So, the T test and F test in the above final model may be unreliable.

In order to solve the autocorrelation problem, Cochrane--Orquet iteration method is adopted to carry out the lagged one-stage autoregression of e_t in the middle residual series, and the regression equation is obtained: e_t =-0.009396 e_{t-1}, which can be known as $\hat{\rho}$ =0.496086. Generalized difference is made to the above equation to obtain the generalized difference equation:

$$Y_t^* = \beta_0^* + \beta_1 X_{1t}^* + \beta_2 X_{5t}^* + v_t$$

And Y_t is lnY. X_{1t} is lnX1, X_{5t} is lnX5. $Y_t^* = Y_t - \rho Y_{t-1}$. $X_{1t}^* = X_{1t} - \rho X_{1t-1}$.

$X_{5t}^* = X_{5t} - \rho X_{5t-1}$. After generalized difference is made with the data, the result is as following.

$$\ln Y=-6.703799+2.306781\ln X1+0.267114\ln X5$$
$$t= (-4.314204)\ (6.921856)\ (4.270311)$$
$$R^2=0.9924$$

At this point, the model passes the T test, F test and DW test. In the regression equation, the determination coefficient is 0.9924, and the modified determination coefficient is 0.9913. 99.13% of the explained variables are affected by the independent variables in the model, indicating that the model has good fitting degree and high reliability to the samples. The F statistic is 911.5, which indicates that the regression equation is significant. The CPI and the investment in new energy have a significant impact on the consumption of primary power and other energy, and they are positively correlated with the consumption of primary power and other energy.

4. Conclusion

In this paper, the regression model is used to study the factors influencing the consumption of new energy in China from 2000 to 2017. The results show that investment in new energy industry and consumer price index are the main factors influencing the consumption of new energy and tend to be positively correlated with the consumption of new energy. Combined with a series of policies on new energy, this paper analyzes the results of the model and puts forward Suggestions on the development of new energy.

4.1. Increase Investment in the New Energy Industry

At present, China's research fund in the field of new energy is insufficient, and many core technologies have not made major breakthroughs. The development and utilization of new energy is restricted by technology, and its input and output costs are high. Compared with

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traditional energy, it is not competitive, and the whole industry lacks competitive products. Therefore, it is necessary to increase investment in research and development of renewable energy. Most importantly, the government should play a leading and exemplary role in encouraging and guiding enterprises to invest in developing new energy sources. Through the allocation of relevant funds, use the strength of relevant research institutions and universities, scientific and technological innovation, break through the large-scale development of new energy related technical bottlenecks. In this way, we will vigorously promote innovation in new energy technologies, accelerate improvement in the efficiency and quality of new energy utilization, reduce development and utilization costs, and enhance the competitiveness of new energy.

4.2. Accelerate Economic Development

The consumption of new energy is closely related to the level of household consumption. The improvement of residents' consumption level is reflected in the improvement of residents' living standard. When the living standard is improved, residents will have greater demand for cleaner and more environment-friendly new energy, thus increasing their consumption of new energy. The lack of demand will not drive the development of new energy industry. Therefore, the government should accelerate the process of economic development and improve people's living standard, to stimulate the consumption demand of new energy and drive the rapid development of new energy industry.

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