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Analysis on the Driving Factors of China's Provincial Fossil Energy Consumption

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Abstract

In order to analyze the driving factors of fossil consumption at the provincial level in China, based on the statistical data of total energy consumption (Calculation of Coal Consumption in Power Generation) from 2000 to 2017, this paper selects four factors with strong influence, namely, gross national income, the proportion of industry in the national economy, the total population and technological research and development, after consulting relevant journal papers. And establish the multiple regression model, the fit of the regression analysis is made on the optimal regression curve, and through the economics inspection, statistical methods such as the selection factors have a strong ability to explain. According to the analysis results, the future fossil energy consumption in China can be predicted accurately, and the future energy saving planning can be improved.

Keywords

Fossil Energy Consumption; Regression Analysis; Driving Factors.

1. Introduction

Energy is an important material basis and production factor supporting economic growth. China has relatively abundant coal resources, and coal consumption accounted for 90% in the early days of the founding of the People's Republic of China. Since the reform and opening, China's rapid economic growth, emerged a surge in energy demand, fossil energy consumption continues to grow. Research on the driving factors of total fossil energy consumption has become an important topic of close attention by the Chinese government. The Fifth Plenary Session of the 17th Central Committee of the Party and the "Twelfth Five-Year Plan" outline proposed "rational control of total energy consumption". This is of great significance to fully implementing the Scientific Outlook on Development, accelerating the transformation of the economic development pattern, continuing to seize and make the best of the important period of strategic opportunities for China's development, overcoming resource and environmental constraints, and promoting long-term, steady and relatively fast economic and social development.

2. Econometric Model

2.1. Interpreted Variable Selection

According to the *2017 China Energy Statistics yearbook*, the total energy consumption from 2000 to 2017(calculation of coal consumption in power generation) (10,000 tons of standard coal), which refers to all kinds of primary energy consumed by residents in various industries throughout the country, and is composed of crude oil, raw coal and natural gas, therefore, the total amount of energy consumption is chosen as the explanatory variable.

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2.2. Explanatory Variable Selection

According to Zhao Huiqing's [1] analysis of the driving factors of China's total energy consumption through the application of LMDI decomposition method, it is believed that the industrial structure, especially the proportion of heavy industry which is more dependent on energy and the total population are the important driving factors.

In addition, by consulting journals and taking full account of the existing research conclusions, important indicators such as economy and technology are screened out. According to above analysis, gross national income, industry share of GDP, population, the number of domestic and foreign patent accept as explained variable.

2.3. Data Source and Descriptive Statistical Analysis

The data of total energy consumption in this study came from *China Energy Statistical Yearbook*, and the data of other explanatory variables mainly came from *China Statistical Yearbook*, *China Science and Technology Statistical Yearbook*, *China Energy Statistical Yearbook*, and *China Industry Statistical Yearbook*.

In this study, the total energy consumption in China(Y) is taken as the explanatory variable, and the four factors that affect the total energy consumption are taken as explanatory variables: gross national income (X_1), the proportion of industry (X_2), the total population (X_3), and three kinds of patent acceptance documents at Domestic and abroad(X_4), a multiple linear regression model between the total energy consumption and the influencing factors was established.

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \beta_4 X_{4t} + \varepsilon_t \quad (1)$$

β_i, i=0,1,2,3,4are regression coefficients; ε_t is the random error term.

Table 1 shows the descriptive statistical results of all model variables from 2000 to 2017.

Table 1. Description statistics of model variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Y	18	317903.78	103776.23	146964	448529
X1	18	383130.7	240781.35	99066.067	831381.2
X2	18	38.8	2.881	32.879	42.033
X3	18	133024.89	3741.224	126743	139008
X4	18	1357961.6	1161695.3	170682	3697845

3. Model Results and Related Tests

3.1. Basic Model Estimation Results

3.1.1. Model Goodness of Fit Test Results and Analysis

In this paper, Stata software was used for model regression analysis, and the collected data were imported in Excel form to obtain the linear regression results in Table 2 below.

As can be seen from the table, the goodness of fit value R^2 is 0.996, and the sample has a high goodness of fit. On the whole, the explanatory variable has a strong explanatory ability to the explained variable. Prob > F=0.0000<0.0001, indicating that the confidence is above 99.99%. According to the regression variables obtained in the table, the multiple linear regression equation is shown in the formula:

$$Y_t = -3091098 + 0.253 X_{1t} + 9950.398 X_{2t} + 22.17 X_{3t} - 0.17 X_{4t} \quad (2)$$

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Table 2. Linear regression analysis

Y	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
X1	.253	.095	2.66	.02	.047	.46	**
X2	9950.389	2257.403	4.41	.001	5073.566	14827.211	***
X3	22.17	3.484	6.36	0	14.642	29.698	***
X4	-.017	.016	-1.05	.312	-.052	.018	
Constant	-3091098.4	400850.38	-7.71	0	-3957083	-2225113.8	***

Mean dependent var	317903.778	SD dependent var	103776.231
R-squared	0.996	Number of obs	18.000
F-test	730.267	Prob > F	0.000
Akaike crit. (AIC)	378.307	Bayesian crit. (BIC)	382.759

*** p<.01, ** p<.05, * p<.1

Calculate the residual value of the regression equation, obtain its statistical value, and get the following Figure 1. It can be seen that its distribution belongs to the normal distribution.

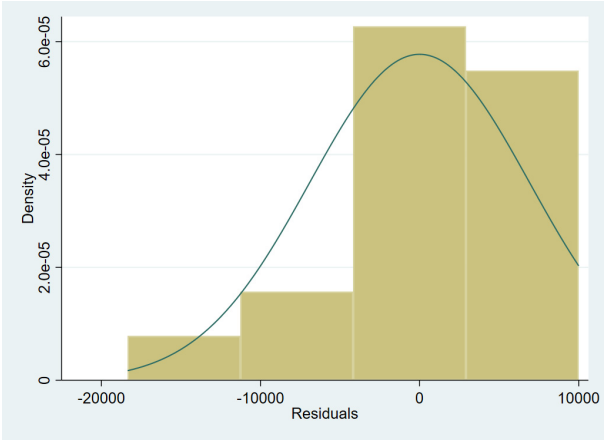

Figure 1. Statistical value curve

3.1.2. Parameter Significance Test Results and Analysis

Statistics of the model F =730.27> F_{∂} (4, 13) =5.21. It indicates that there is a significant linear correlation between the explained variable Y of the energy consumption regression model and their variables on the whole.

And X_4 P-Value=0.312>0.1. This indicates that this variable is not significant at the confidence level of 10%, but practical experience shows that this variable has a significant impact on the total energy consumption, which indicates that the model may have serious multicollinearity, and the interaction between these influencing factors is strong. Correlation analysis of explanatory variables was carried out, As shown in the following table 3.

Table 3. Matrix of correlations (1)

Variables	(1)	(2)	(3)	(4)
(1) X1	1.000			
(2) X2	-0.844	1.000		
(3) X3	0.978	-0.744	1.000	
(4) X4	0.987	-0.899	0.946	1.000

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It can be clearly observed that there is a strong correlation between X_4 and other explanatory variables, and there is also a strong correlation between other explanatory variables, in order to improve the explanatory ability of explanatory variables, one of the explanatory variables should be deleted from the explanatory variables with collinearity to reduce the influence of Multicollinearity and improve the accuracy of t test interpretation and prediction interval.

3.1.3. Test Results and Treatment of Multicollinearity, Autocorrelation and Heteroscedasticity

Through correlation analysis, it is found that X_4 has a high correlation with other variables and there is multicollinearity. When there is multicollinearity among independent variables, the estimation value of regression parameters and the accuracy of prediction interval will often be affected. Therefore, eliminating multicollinearity becomes an important link in parameter estimation in regression analysis. Common method to eliminate multicollinearity is removed is not important, the use of variables, the relationship between the use be explained variable lag value instead of the lag value of the explanation, increasing the sample size and the method of stepwise regression, this paper USES the skip some important explanatory variables solution, even if the interpretation of the correlation between maximum variables - technical progress, get the rest of the correlation between variables, as shown in the following table 4:

Table 4. Matrix of correlations (2)

Variables	(1)	(2)	(3)
(1) X1	1.000		
(2) X2	-0.844	1.000	
(3) X3	0.978	-0.744	1.000

3.2. Estimates of Improved Models

3.2.1. Goodness of Fit Results

After removing X4, the multiple equation regression analysis is performed, and the following table 5 is obtained.

Table 5. Linear regression

Y	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
X1	.182	.067	2.70	.017	.037	.327	**
X2	11422.356	1779.198	6.42	0	7606.355	15238.356	***
X3	22.455	3.487	6.44	0	14.975	29.935	***
Constant	-3182114.7	392930.99	-8.10	0	-4024867.8	-2339361.5	***

Mean dependent var	317903.778	SD dependent var	103776.231
R-squared	0.995	Number of obs	18.000
F-test	965.836	Prob > F	0.000
Akaike crit. (AIC)	377.780	Bayesian crit. (BIC)	381.341

*** p<.01, ** p<.05, * p<.1

As can be seen from the table, the goodness of fit value R^2 of the sample is 0.995, and the goodness of fit of the sample is high and not much different from the goodness of fit of the regression equation before modification, indicating that the explanatory power of X_4 explanation is not strong. Overall, after one of the explanatory variables is removed, the explanatory power of other explanatory variables to the explained variable is still strong. Prob >

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F=0.0000<0.0001, indicating that the confidence is above 99.99%. According to the regression variables obtained in the table, the multiple linear regression equation was obtained.

$$Y_t = -3182114.7 + 0.182X_{1t} + 11422.356X_{2t} + 22.455X_{3t} \quad (3)$$

3.3. Analysis of Key Driving Factors based on Regression Results

According to the revised regression equation, the regression parameters of X2 are relatively large, indicating that a change in the proportion of industry by 1 unit can cause a change in the energy consumption structure of 11,422.356 units; for every increase in gross national income by 1 unit, total energy consumption will increase by 0.182 units; total population for every increase of 1 unit, the total energy consumption increases by 22.455 units.

4. Conclusion

4.1. Main Conclusion

This paper studies the influencing factors of the statistical data of total energy consumption (calculation of coal consumption for power generation) from 2000 to 2017, and uses stata software to perform regression analysis, and concludes that the main influencing factors are gross national income, total population, and industry proportions, and get the following conclusions:

First, the total energy consumption is positively correlated with explanatory variables such as gross national income, total population, and industry share, and their changes are in the same direction. The industrial share has a strong correlation with total energy consumption, indicating that my country's heavy industry has a strong influence on energy. The degree of dependence is relatively high, which is consistent with my country's heavy industry still experiencing high energy consumption and high pollution. In order to control the total energy consumption and make it in line with the strategic deployment of sustainable development, we should start by adjusting the proportion of the industrial structure and promoting the development of modern industries.

Second, the multiple regression equation obtained through regression analysis has certain parameter stability, which can predict the total energy consumption in a certain period in the future. As an important material basis for economic development, fossil energy is important for my country's future strategic deployment.

4.2. Policy Implications

First, reasonable control of total energy consumption is an inevitable choice for achieving sustainable development in our country. The development of domestic high-intensity fossil energy has caused serious ecological environmental damage, land collapse and degradation, water resources damage and production safety issues. If effective measures are not taken as soon as possible to effectively transform the extensive development mode that relies on over drafting resources and the environment, and reasonably control energy consumption, it will consume my country’s future resources too quickly, and prematurely exhaust most of the development potential, which will seriously affect my country’s economy and society. Sustainable development. Therefore, studying the driving factors of fossil energy in China's provinces is particularly important for rational planning of total energy consumption in the future.

Secondly, reasonable control of total energy consumption is a realistic need to deal with the issue of international climate change. my country has made a solemn promise to the international community that the proportion of non-fossil energy consumption will reach about 15% in 2020. To accomplish this goal, the "Twelfth Five-Year Plan" outline has set the

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proportion of non-fossil energy consumption in 2015 as a binding indicator of 11.4%. The implementation of total energy consumption regulation is conducive to ensuring the realization of the above goals, internally can promote the acceleration of the transformation of economic development, and externally can demonstrate my country's confidence and determination to control greenhouse gas emissions, and win the initiative and discourse of international cooperation in greenhouse gas emission reduction. The right to guide and promote the development of international climate change issues in a strategic direction that is beneficial to our country.

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