Research on the Influencing Factors of National Energy Economy Based on Fixed Effect Model

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Abstract: This paper analyzes and studies the influencing factors of national energy economy. By constructing a fixed effect model and taking China as an example, it makes a statistical analysis of the influencing factors of China’s national energy economic efficiency. This paper introduce China’s empirical data from 2000 to 2010 to deepen the understanding of energy issues, and then analyze the inherent causes of the situation from the actual situation of the country. This study can quantitatively analyze the status quo and differences of energy economic efficiency among countries and regions, and study the relationship between its influencing factors on energy economic efficiency, which can promote the sustainable and coordinated development of the country.

1. Introduction
Energy economics believes that the greater the energy consumption, the more product output, the more social output, and the more abundant the society, the more people can enjoy material civilization and spiritual civilization. The continuous growth of energy consumption is an important condition for modernization. Energy is the driving force and engine of the national economy. The country’s energy system is developing in the direction of clean energy. The energy issue has become the focus of national social development. Therefore, a country’s energy consumption level is an important indicator of its level of modernization. Differences in various economic development levels and industrial structures between different regions of China have led to different regional characteristics of energy economic efficiency. In view of this, studying energy issues is not only necessary and urgent, but also has great practical significance.

2. Model construction
Most domestic and international research models of economic growth are based on the Cobb Douglas production function. The basic form of the Cobb Douglas production function is:

\[ y = AK^aL^b \]

This paper selects per capita GDP as a measure of economic growth, and introduces the input quantity of capital \( k \) and the input quantity of labor \( l \) into the model as control variables, and selects the fixed capital investment amount and the number of employed persons to express these two quantities. In order to eliminate the heteroscedasticity of time series data, a natural logarithmic transformation of each variable is required.

The total energy demand is represented by \( y \) in the model, which means that the total amount of one-time energy consumption consists of coal, oil, natural gas and hydropower. After consulting relevant information, the factors affecting energy demand are obtained:

1) Energy price, measured by the ex-factory price index of energy products, is represented by \( x_1 \) in the model, which is calculated by weighting the ex-factory price index of coal, petroleum and electric...
power industries.

(2) The total industrial output value (100 million yuan) of the price removed is expressed in the model by \( x_2 \), which is calculated by dividing the total industrial output value calculated by the current price by the price index of the industrial output value of the year.

(3) The per capita disposable income of urban households excluding prices, expressed in \( x_3 \), is also calculated from the absolute number of household disposable income in each year using the price index.

(4) The number of scientific research and comprehensive technical service personnel (million), expressed in \( x_4 \), directly from the annual statistical yearbook.

(5) Total energy production (10,000 tons of standard coal), expressed in \( x_5 \), directly from the annual statistical yearbooks.

To sum up, the following regression equations are established by using the fixed effect model:

\[
\ln GDP = \beta_0 + \beta_1 \ln x_1 + \beta_2 \ln x_2 + \beta_3 \ln x_3 + \beta_4 \ln x_4 + \beta_5 \ln x_5 + \mu
\]

3. Model results

This paper measures the overall efficiency of total factor-energy economic efficiency. The sample panel data is from 2000 to 2010. The input factors mainly include energy price, total industrial output value, number of service personnel, per capita disposable income of urban households, and total energy production. The output factor is GDP. Among them, the total energy consumption is expressed by the total energy consumption at the end of each year in each region, and the labor force is expressed by the total number of employed people at the end of each year.

Through the analysis of the obtained data, the mean, maximum, minimum, standard deviation and observation number of the GDP, \( x_1 \), \( x_2 \), \( x_3 \), \( x_4 \) and \( x_5 \) sequences are obtained.

|       | GDP   | \( x_1 \) | \( x_2 \) | \( x_3 \) | \( x_4 \) | \( x_5 \) |
|-------|-------|-----------|-----------|-----------|-----------|-----------|
| Mean  | 41548.00 | 9903.685  | 582.5226  | 7490.742  | 1190.387  | 4449.177  |
| Max   | 93173.00 | 31256.00  | 2232.900  | 83280.00  | 13911.00  | 21859.00  |
| Min   | 16413.00 | 516.3000  | 46.00000  | 58.00000  | 7.000000  | 5.000000  |
| Std. Dev. | 19179.81 | 7225.511  | 507.4645  | 14618.86  | 2142.199  | 5498.076  |
| Observations | 62 | 62 | 62 | 62 | 62 | 62 |

Based on 31 horizontal elements and 2 years of observations, the model performs least squares estimation and obtains the following estimation results.

|       | \( \text{ln} \) GDP | \( \text{ln} x_1 \) | \( \text{ln} x_2 \) | \( \text{ln} x_3 \) | \( \text{ln} x_4 \) | \( \text{ln} x_5 \) |
|-------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Constant value | 40920.02 | 0.548271 | -10.27729 | 0.039974 | 0.361489 | 0.102285 |
| T statistic | 9.431847 | 2.022579 | -1.269797 | 1.566303 | 2.155666 | 2.556029 |
| P value | 0.0000 | 0.0035 | 0.2158 | 0.0062 | 0.0034 | 0.0031 |

From the above regression analysis results, we can see that the determinant coefficient \( R^2 = 0.999099 \), which shows that 99.9% of the total change of GDP per capita can be explained by the explanatory variables such as economic development level, urbanization level, market operation environment, education input and macro-environmental policy in the model, which shows that the equation fits well. Because the value of F statistic is 769.6429, and its corresponding probability is 0, which is less than the significance level of 0.05, the original hypothesis is rejected, indicating that the linear relationship between the explanatory variables including the control variables and the explanatory variables is significant, that is, the equation is significantly linear in general. Specifically speaking, we find that the explanatory variables \( x_1 \), \( x_3 \), \( x_4 \) and \( x_5 \) have positive effects on the explanatory variables, and from their corresponding T statistics and P values, these explanatory variables have significant effects on the
explanatory variables. However, the influence of x2 on interpreted variables is negative, and the absolute value of T statistics is less than 2, and the P value is greater than 0.05, so the original hypothesis of non-linear correlation can not be rejected.

4. Results analysis
This paper focuses on the effects of these influencing factors on energy economic efficiency from five variables: economic development level, urbanization level, market operating environment, education input, and macro environmental policy.

From a national perspective, the energy economic efficiency decreases first and then rises with the growth of GDP. It shows that China developed at the beginning of its extensive economic development model, and its energy economic efficiency continued to decline. When the economy developed to a certain extent, the economy began to develop into an energy-saving and intensive economic development model.

The urbanization rate coefficient of urbanization level is negative and the effect is not significant, indicating that urbanization plays an important role and status for economic development. Urbanization brings people's living standards and lifestyle changes, but urbanization. The problems brought by it are also many, and the two are not significant. For example, a large number of urban infrastructure and residential buildings require a large amount of high-energy building materials, and unreasonable urban planning causes a lot of resources and energy waste, resulting in energy. Economic efficiency has declined.

The coefficient model of the proportion of GDP in the secondary industry in the industrial structure is negative and significant. The economic development in the central and western regions is in the middle and late stages of industrialization. Heavy industry accounts for a large proportion. High input, high pollution and high energy consumption result in low energy and economic efficiency. The high proportion of the secondary industry will not be conducive to the improvement of energy economic efficiency; the coefficient of education input is positive, and the investment of education will promote the efficiency value of energy economy. This shows that China should increase investment in education, increase human capital, and cultivate people's awareness of economic and environmental protection, which will help improve energy and economic efficiency.

5. Conclusion
This paper uses the fixed effect model to measure the inter-provincial energy economic efficiency of China, and deeply analyzes the effect of influencing factors on energy economic efficiency. Through the measurement of scientific analysis of the status quo and differences of energy economic efficiency among countries, the relationship between its influencing factors on energy economic efficiency, and the promotion of sustainable and coordinated development of the country are proposed, so as to propose targeted policy recommendations.

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