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Regional Economic Growth and Energy Consumption Intensity Differences Based on DEA's Empirical Analysis

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Abstract: Today, China's economy is growing faster and faster, the consumption of resources has gradually increased, the relationship between supply and demand of resources is tight, and the pressure of public opinion at home and abroad is also increasing. The purpose of this article is to analyze the differences between regional economic growth and energy consumption intensity based on DEA's empirical analysis, and to use the method of data envelopment analysis to study energy consumption, developed and underdeveloped regions respectively. Regional economic growth is represented by the Gini coefficient, and energy consumption intensity is represented by an index. All three regions were analyzed using a parameter-invariant panel data model. After comparative analysis, there are regional differences in my country's economic development and energy consumption, but these differences do not completely correspond. From 2017 to 2021, the differences between the three regions in my country generally showed a downward trend, and the development gap (Gini coefficient) between the three regions reached a peak of 0.27 in 2019. The energy consumption intensity of various regions shows a downward trend, but from 2019 to 2021, the energy consumption intensity of developing regions has increased in a small range, while other regions are basically in a stable trend at this stage.

1. Introduction

Energy consumption has become one of the important indicators to measure the development of a country and region. Through quantitative analysis and research on economic growth, energy consumption and its structure, the differences in energy consumption in different economic regions of our country are investigated, which can provide reference for my country to formulate energy development strategies, develop regional economy and develop regional economy, and balance

regional energy consumption. Important practical significance [1-2].

Experts and scholars at home and abroad have carried out various researches on the analysis of regional economic growth and energy consumption intensity differences. Kohl S reviewed 262 papers on health DEA applications, with a particular focus on hospitals, thereby filling a decade-long insecurity gap in existing review material. In addition to providing descriptive statistics for the literature, we first had to review publications for research purposes. According to the proposed process, these training locations could be divided into four distinct groups. In addition, the process design of the study is analyzed and the model used is described. Analyze selected inputs and presentations and all relevant background technology [3]. Kefelegn H attempts to analyze the financial impact of universities on local programs from a powerful lexicon. In doing so, the book uses a system review process that follows the stages of planning, finding, tracking, coding, and producing. Findings show that universities are spread across different parts of the country, with significant and significant positive effects on private use, public finances, investment, employment, cities and manufacturing, variable human capital, and ongoing local economic systems. In addition, individuals, companies, local governments and the economy can all be better developed through higher education. These companies also drive the development of agriculture, industry and services in the local economy [4]. Mkoa provides an excellent model to predict surface roughness in manufacturing operations. The process of the proposed solution is an inefficient analysis that is augmented by an outcome control model that formulates short-term custom measurements until the integration point is reached. The face roughness results were obtained from two previous tests in the literature. The experimental design is based on three hack worlds in two test scenarios: feed rate, cutting speed and depth of cut in test 1 data and cutting speed, feed rate and flow rate in experimental data 2, 27 Matlab per test result The software is divided into two parts based on the simulation test, namely: predicting the surface roughness of the cutting joint with vector points far away from the cutting edge, called cutting joint, and obtaining the position of the cutting joint on the edge [5]. It can be seen that the research on the difference analysis of regional economic growth and energy consumption intensity based on data envelopment analysis is still insufficient, so this paper has certain innovative significance.

Based on DEA's empirical analysis, this paper analyzes the difference between local economic development and energy intensity, and draws some conclusions by examining the energy gap in different regions of China. The purpose is to analyze the relationship between economic development and energy consumption intensity. Analyzing the energy consumption levels and regional differences between the two will provide a reference for my country to formulate energy development strategies, develop regional economy, and balance regional energy consumption, and provide a basis for the development.

2. Research on Regional Economic Growth and Energy Consumption Intensity Differences Based on DEA's Empirical Analysis

2.1. Data Envelope Analysis

The basic principle and effect of data envelopment analysis are consistent with the Pareto efficient solution under multi-objective decision-making. The above model constructed under the principle of data envelopment analysis is a very effective method in dealing with economic problems with multiple input parameter variables and multiple output parameter variables. In the usual econometrics and other economic field problems, it is difficult to draw a frontier that is consistent with the actual situation [6-7]. The reason is that this method can consider few output

variables at the same time in the processing process, and treats the effective decision-making unit and the non-effective decision-making unit as the same concept.In terms of design, the advantage of DEA is that it can handle multiple items, especially multiple production problems. At the same time, the stored data analysis method can not only judge whether the corresponding point of a single decision is on the effective production boundary through multiple inputs, but also analyze the efficiency of multiple input factors through optimization metrics. Therefore, the method is more advanced than other methods, and it is more favored in application.

2.2. Status Quo of Regional Energy Consumption in China

(1) Analysis of energy consumption and consumption ratio

Inconsistent development across regions can also lead to differences in energy consumption. Unbalanced regional distribution, huge differences in economic development levels, and long-term contradictions between economic development and energy supply have always been typical characteristics of the regional structure of China's energy economy, and many problems have arisen as a result [8-9].

(2) Energy consumption intensity of each region

Energy consumption refers to the increase in energy demand per unit of GDP, that is, energy consumption per unit of GDP. It is the proportional relationship between the energy consumption level and economic output determined by a country's development stage, economic structure, energy structure, technology, equipment level, management level and other factors [10-11]. Energy consumption intensity reflects the overall energy and economic performance of a country. The southwest region is mainly based on the development of tourism, energy consumption is mainly imported from other provinces, and the transportation cost is high. In the middle reaches of the Yellow River, and the high energy consumption intensity is inevitable. The eastern and southern coastal areas have lower energy consumption intensity due to advanced technology, better energy conservation and emission reduction effects, and improved energy efficiency [12-13].

2.3. Status Quo of China's Regional Economic Development

(1) China's GDP

The regional economic gap has gradually become an important issue that the government and scholars at home and abroad have been paying attention to. At the same time, economic regional differences will inevitably lead to regional differences in energy consumption, so it is necessary to study regional economic differences [14-15]. The development of the Southwest Economic Zone is particularly rapid. As a relatively backward western region, the current regional GDP has far exceeded that of the Northeast Economic Zone. It can be seen that the implementation of the Western Development Strategy has brought earth-shaking changes to the Southwest region[16-17].

(2) China's regional economic and industrial structure

The secondary industry is the main industry of my country's economic development, and its proportion is more important than other industries, but there are still differences in the industrial structure between regions. In the more developed coastal areas, the university sector occupies a larger proportion in the industrial system; the central Yellow River and the middle reaches of the Yangtze River are rich in non-ferrous resources. Resources are abundant. The scale of steel structures and secondary buildings is higher than that of the Changjiang Business District. Economic distribution of other regions Southwest Economic Zone, Northeast Economic Zone, Great Northwest Economic Zone [18-19].

3. Model Selection for Regional Economic Growth and Energy Consumption Intensity Difference Analysis Based on DEA's Empirical Analysis

3.1. Data Selection

This paper selects the Gini coefficient and energy consumption intensity of the regional development gap between developed, developed and underdeveloped regions from 2017 to 2021.

3.2. DEA Model

In the DEA model, the input variables are assumed to be $x=(x_1, x_2, \Lambda, x_m)$, and the output variables are assumed to be $y=(y_1, y_2, \Lambda, y_p)$. Suppose there are n decision units in total. The weight factors of the input indicators in each decision-making unit are: u1, u2, …up, and the weight factors of the input indicators are: v1, v2, …, vm. The operation efficiency evaluation index corresponding to each decision-making unit is constructed as follows:

$$h_j = \frac{\sum_{r=1}^{p} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \tag{1}$$

Therefore, under the constraint that the efficiency of each decision-making unit is less than 1, the optimal evaluation model for the relative efficiency of the j0th decision-making unit is:

$$\max h_{j0} = \frac{\sum_{r=1}^{p} u_r y_{rj_0}}{\sum_{i=1}^{m} v_i x_{ij0}} \tag{2}$$

In the above model, x and y are known numbers, and v and u are variables. The concept of the model is to take the weight factors v and u as variables, constrain the efficiency index h of all decision-making units, and take the efficiency index of the jth decision-making unit as the goal. That is, the evaluation of whether the production efficiency of the jth decision-making unit is efficient is relative to all other decision-making units.

3.3. Analysis of Model Running Results

This paper will analyze the relative differences in regional economic growth, the differences in the contribution of energy consumption to regional economic growth. The regional economic growth is represented by the Gini coefficient. The three regions are all analyzed by the panel data model with constant parameters, and the estimation process of the parameters in the model is completed by establishing the object in the software and calculating the work file with the panel structure. The estimation methods all use the least squares method weighted by interface members.

4. Empirical Analysis of Regional Economic Growth and Energy Consumption Intensity Differences Based on Empirical Analysis of DEA

4.1. Relative Differences in Regional Economic Growth

The Gini coefficient of the development gap between developed, developed and underdeveloped regions in my country and within regions is calculated as shown in Table 1:

Table 1. Regional gini coefficient comparison

	Undeveloped area	Development area	Developed area
2017	0.21	0.18	0.25
2018	0.22	0.19	0.26
2019	0.23	0.18	0.27
2020	0.22	0.19	0.26
2021	0.23	0.18	0.26

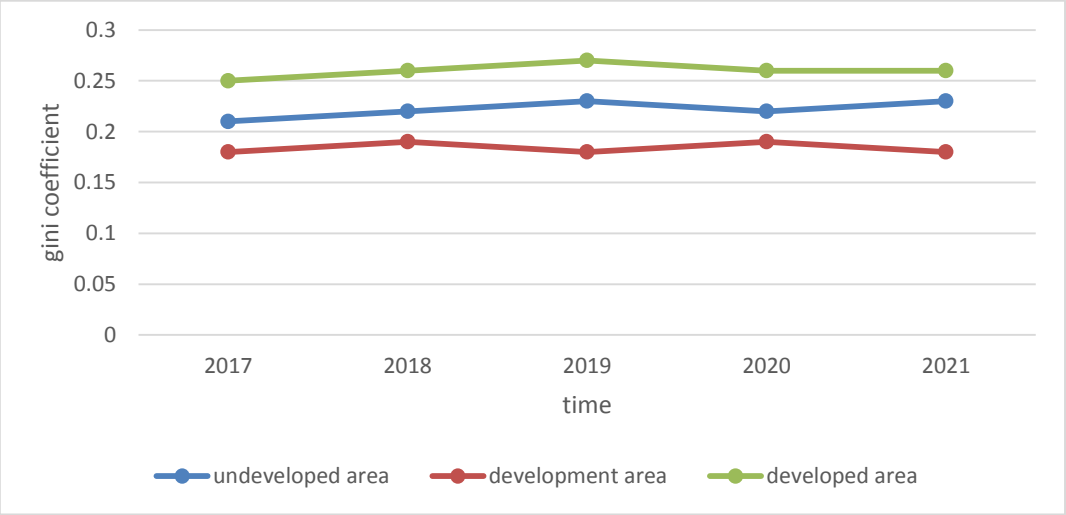

Figure 1. Regional gini coefficient

According to the statistical results in Figure 1, the gap between my country's developed regions and the other two regions is obvious, especially the development gap between developed regions and developing regions is the largest, and the growth gap (Gini coefficient) between developed regions and the development field in 2019 reached 0.09. Figure 2 shows that from 2017 to 2021, the differences in the three regions in my country generally show a downward trend, especially in recent years, the decline is more obvious, showing a convergence trend. The development gap (Gini coefficient) among the three regions peaked at 0.27 in 2019. The driving role of the rise of the Northeast and Central regions has begun to emerge, and the growth gap between the three regions will decrease year by year in 2020.

4.2. Analysis of Differences in Energy Consumption Intensity

The energy consumption intensity of the three types of regions in the country is shown in Table 2.

Table 2. Energy consumption intensity comparison

Area	2017	2018	2019	2020	2021
Undeveloped area	1.6	1.5	1.4	1.3	1.2
Development area	1.5	1.4	1.3	1.4	1.1
Developed area	1.4	1.3	1.2	1.2	1.0

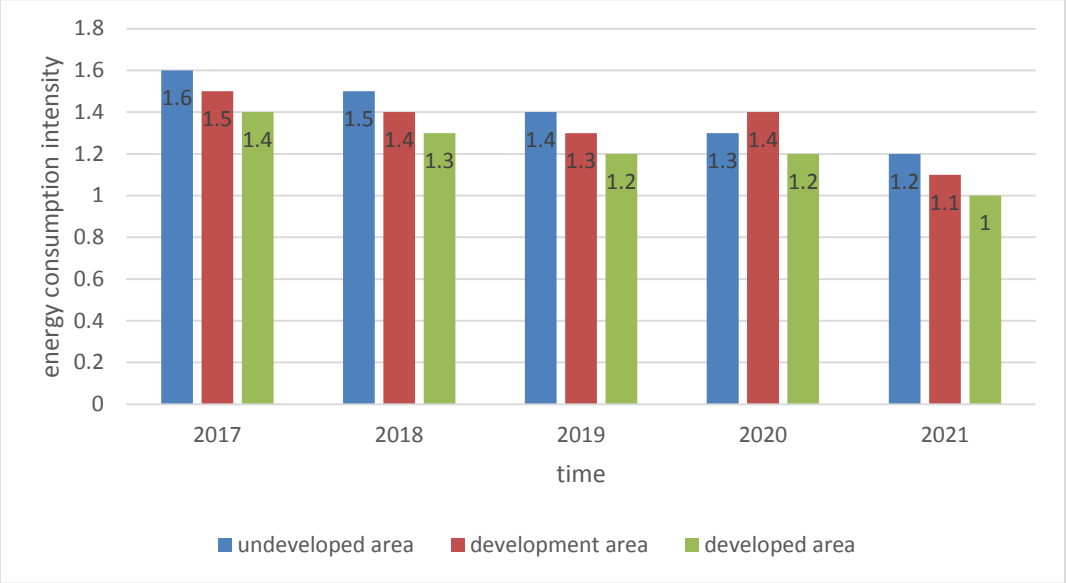

Figure 2. Energy consumption intensity

As shown in Figure 2, energy intensity in some regions shows a slowing trend over time, but from 2019 to 2021, energy intensity in developing regions will increase slightly, while other regions will maintain a stable base. It can be seen that the energy efficiency gap between developed regions and underdeveloped regions continues to narrow.

4.3. Differences in the Contribution of Energy Consumption to Regional Economic Growth

Table 3 shows the estimated results for the whole country and developed, developed and underdeveloped regions.

Table 3. Differences in the contribution of energy consumption to regional economic growth

Explanatory variables	National	Developed area	Development area	Undeveloped area
Constant term	0.2178	-1.2631	0.1254	0.5214
Technological Progress Rate Coefficient	0.0231	0.0123	0.0125	0.0165
Γ	0.6132	0.5132	0.6321	0.3652

It can be seen from Table 3 that the adjustment coefficient of determination of the model is very high, and the estimated coefficients of almost all variables in the model have passed the significance test at the 5% significance level. After adding the first-order autoregressive term AR(1), The D.W

values obtained by the serial correlation test of random errors have also passed the test with a significance level of 1%, which indicates that the confidence of the model is high, and the setting form and estimation results of the model fit the economic reality of our country well. From the perspective of elasticity analysis, relatively speaking, the technological progress in the underdeveloped areas is more significant than that in the developed areas; in terms of physical capital, the capital output elasticity is the highest in the underdeveloped areas and the lowest in the developed areas. It can be seen that the Western Development Strategy has driven Large-scale fixed asset investment.

5.Conclusion

The modern economy relies on huge energy consumption. With the global energy crisis intensifying, how to overcome the energy bottleneck and find a development path suitable for China's own energy needs has become the focus of many people's attention. The gap between energy production and consumption demand has continued to widen. It is an important reality to examine the differences in energy consumption in different economic regions in China through quantitative analysis and research on economic development, energy consumption and its structure, and to provide reference for my country to formulate energy development strategies and develop regional economy.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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