Research on the Relationship between Energy and Economic Growth in Henan Province

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Abstract: Lack of energy is one of the factors that constrain economic development. With the development of the economy, the contradiction between people's demand for energy and limited energy has become increasingly prominent. Based on this background, this paper adopts the data of energy consumption and economic indicators of Henan Province in recent years, and uses the empirical method to conduct a Granger causality test analysis of the relationship between economic growth and energy consumption in Henan Province, and finally draws conclusions and proposes solutions and contradictory countermeasures.

1. Introduction

The development of society is inseparable from the support of energy, and the development of the economy depends more on energy. Since China’s reform and opening up, economic growth has maintained a relatively fast growth rate. As one of the countries with the fastest economic development in the world, China’s demand for energy has changed from export to import. This fully shows that with the development of the economy, the country's energy has been unable to meet the needs of economic growth. Energy is scarce, and solving the effective use of energy has become an urgent issue.

At present, the mode of energy consumption to promote economic development has been widely concerned by scholars from various countries, and the drawbacks of relying on energy to develop the economy have gradually emerged. For the relationship between economic growth and energy consumption, experts and scholars agree that the two have a mutual influence, and this effect has both positive and negative effects. For example, while the economy is developing at a high speed, China's energy is gradually decreasing and the ecological environment has also been destroyed. Therefore, it is necessary to correctly handle the relationship between energy consumption and economic growth, which is important for China's road to transforming its economic development mode.

Henan Province is one of the major energy-consuming provinces. In 2017, the province's total energy consumption reached 232 million tons of standard coal, with an average annual growth rate of 4.1% and a primary energy self-sufficiency rate of 49.1%. [1] This paper analyzes the problems of energy consumption and economic growth in Henan Province and provides an effective basis for the establishment of a rational and sustainable industrial economic development in Henan Province.

2. The theoretical basis

Energy mainly refers to substances that are used for energy conversion in nature, including energy in terms of minerals, energy in atmospheric circulation, geographic energy, and nuclear physical energy. Energy is the material basis of human activity, including all fuel, sunlight, water and wind. Energy can be divided into primary energy and secondary energy according to whether processing conversion has been carried out. “Primary energy” mainly refers to the existing energy in the natural world, including oil, natural gas, hydropower and coal. The “water, biomass and wind energy” in primary energy is also called renewable resources, among which “ Coal, natural gas and oil are called non-renewable resources. Secondary energy is mainly derived from indirect or direct conversion of primary energy, including electrical energy, gasoline, diesel, and energy sources such

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as lasers and biogas.

The theory of economic growth is a theory that studies and explains the laws governing the law of economic growth and the factors that constrain economic development. Usually, it is measured by the growth rate of GDP or GDP per capita for a certain period of time. GDP refers to the total amount of labor provided by a country or a region over a certain period of time and the monetary performance of the final product produced. From a macro perspective, economic growth depends on the substances or energy that a country or region can use. The material aspects mainly include “coal, metal, oil, natural gas”, etc.; energy mainly includes “water energy, nuclear energy, wind energy, solar energy and geothermal energy”. In the acquisition of these energy and substances, they are affected by factors such as “technical conditions, creative factors, natural conditions, labor quality and new methods”.

By consulting the previous research results, the positive effect of energy consumption on economic growth is mainly that energy consumption supports economic growth. At the same time, energy is the source of economic development. For example, energy promotes rapid improvement of technology and is the basic guarantee for improving people's living standards. The mutual restraint between economic growth and energy is reflected in the fact that energy consumption is limited by the economic level, and the development of the economic level in turn acts on energy consumption. The economic growth brought about by unreasonable energy exploitation will lead to the destruction of the ecological environment, which will eventually lead to high economic growth costs.

With the continuous maturity of research methods such as econometrics, the research on energy consumption and economic growth has developed qualitatively, but the results of the research are different. The main reason for the difference is that different countries have different economic development models. At the same time, the energy consumption policies and energy consumption structures of different countries are also very different. In addition, the survey data selected by experts and scholars are different, so the research results have certain differences.

3. Analysis of the current situation of energy consumption and economic growth in Henan Province

At present, as a developing country, China's energy consumption is mainly based on coal resources. China's coal resources are relatively abundant, and the consumption of coal resources ranks first in total energy consumption, and it is as high as 90% of total energy consumption in the initial stage of reform and opening up. With the exploitation of energy sources such as oil and natural gas, the proportion of coal resource consumption has gradually decreased. Coal resources are non-renewable resources, and once exhausted, they will affect the development of China's economy. In recent years, China has also proposed a path of new industrialization development, from the traditional energy-dependent economic development to the technology-intensive economic development. At present, China's per capita coal energy consumption has grown rapidly, from 0.09 tons in 1978 to 3.27 tons in 2017. 2017 is an important year for the implementation of the 13th Five-Year Plan and a deepening year for promoting structural reforms on the supply side. The main goal of Henan's energy work is: the province's total energy consumption is controlled within 245 million tons of standard coal, up 2.9% year-on-year; the province's total energy production has reached 110 million tons of standard coal, an increase of 6.7%, and energy dependence on foreign countries 55 %about. [3]

It can be seen from Table 1 that in addition to the steady and rapid growth trend of total energy consumption and per capita energy consumption in Henan Province, compared with the national per capita energy consumption, the per capita energy consumption in Henan Province is too low.

In 2017, in the face of complex economic situation, Henan Province withstood the pressure, implemented the central government's decision-making arrangements, actively adapted to the normal state of economic development, adhered to steady progress, adopted many measures to promote economic growth, grasped the key, and promoted Henan Province. The economy is growing. In 2017, the total production value of Henan Province reached 3,701.25 billion yuan, an

increase of 6.3% at comparable prices, 1.4 percentage points higher than the national level.

Table 1 Energy consumption of Henan Province from 2007 to 2017

Year	Total energy consumption (10,000 tons of standard coal)	Per capita energy consumption (tons per person)	China's per capita energy consumption (ton / person)
2007	4557.70	0.74	1.06
2008	4665.72	0.75	1.06
2009	4878.82	0.78	1.09
2010	5118.33	0.81	1.12
2011	5315.97	0.83	1.18
2012	5457.09	0.85	1.35
2013	6016.89	0.93	1.56
2014	6518.01	1.00	1.72
2015	7096.39	1.08	1.87
2016	7752.06	1.16	2.01
2017	8341.57	1.24	2.15

The data required by reviewing the China Statistical Yearbook and the Henan Statistical Yearbook are summarized in Table 2, which includes the total GDP of Henan Province from 2007 to 2017, and the unit is expressed in terms of “100 million yuan”. At the same time, including the energy consumed by each unit of GDP in Henan Province, “ton/10,000 yuan” is used as the unit.

Table 2 Energy consumption of GDP in Henan Province

Year	Henan Province's GDP (100 million yuan)	Energy consumption per unit of GDP in Henan Province (ton/10,000 yuan)
2007	5542.96	1.79
2008	7712.34	1.72
2009	12902.09	1.68
2010	13246.71	1.58
2011	13519.72	1.51
2012	13923.1	1.39
2013	14759.3	1.26
2014	15375.84	1.21
2015	26131.1	1.16
2016	27364.18	1.05
2017	37010.25	0.94

It can be seen from Table 2 that the GDP of Henan Province has increased from 554.296 billion yuan in 2007 to 3,701.025 billion yuan in 2017, and the growth rate is very rapid. The amount of energy consumed per unit of GDP in Henan Province is gradually decreasing, from 1.79 tons per million in 2007 to 0.94 tons per year in 2017.

4. Empirical Analysis of the Relationship between Energy Consumption and Economic Growth in Henan Province

According to the relevant theories of economic growth and energy consumption, both energy consumption and economic growth have a relationship of mutual promotion and common development, but this is only a qualitative analysis of the theoretical aspects. This part mainly uses Eviews7.2 software to conduct empirical quantitative analysis of the two. Establish the assumptions as follows:

Energy consumption and economic growth play a mutually reinforcing role. Increasing investment in energy consumption will promote economic growth. At the same time, as the economy grows, energy consumption will be the most basic factor of production, and its consumption will increase. .

This paper mainly studies the relationship between the total energy consumption and economic growth (GDP) in Henan Province. Therefore, the selected data comes from Tables 1 and 2, in which economic growth selects GDP data, and energy consumption is expressed in EC, and the unit is "10,000 tons of standard coal".

This paper selects the GDP data (100 million yuan) and energy consumption data (10,000 tons of standard coal) from Henan Province from 2007 to 2017 for empirical research. These data are all from the Henan Statistical Yearbook, and in order to eliminate the impact of price factors, GDP data is based on 2005, and the constant price is calculated. When the fixed capital stock is used instead of the capital flow, the capital depreciation rate is 5%. The energy consumption data uses the coal consumption data in thermal power generation in the Henan Statistical Yearbook. Labor input data is the number of labor practitioners at the end of each year.

First determine the smoothness of the data, and use the ADF unit root detection method to determine the stability of the variable. If a time series has a stable variance, auto-covariance, and mean, then the sequence is stationary, and the sequence is called a zero-order single-sequence, and vice versa. There are usually three methods for detecting unit roots: ADF test, DF test, and PP test. This paper uses the ADF test to express energy consumption in EC, and the economic growth sequence is expressed in GDP. The logarithm of EC and GD are LNEC and LNGDP, respectively. The results show that the variable LNEC and the variable LNGDP are smoothed after the second-order difference and pass the ADF test at a significant level of 5%.

Table 3 ADF test

variable	Difference number	(C,T,K)	ADF	5% threshold	1% threshold	Conclusion
LNEC	2	(C,0，1)	-3.45	-1.97	-2.75	smooth
LNGDP	2	(C,0，1)	-2.74	-1.96	-2.74	smooth

According to the ADF test, the second-order difference between LNEN and LNGDP is stable.

The regression model between LNEN and LNGDP is established by least squares method to obtain equation (1).

$$InGDP = -7.89 + 1.93InEC \quad (1)$$

Among them, R2 is 0.89, indicating that the fitting effect is good. Et represents the residual of the regression model, as shown in equation (2).

$$e^t = InGDP - 1.93InEC + 7.89 \quad (2)$$

The ADF test was performed on et, and the results are shown in Table 4.

Table 4 ADF test of residual e^t

variable	ADF	Inspection type	10% threshold	P
e^t	-1.698274	(0,0.0)	-1.921736	0.0693

It can be seen from Table 4 that the residual sequence shows stationarity at a significant level of 10%, so it is considered that there is a long-term stable equilibrium between Henan energy consumption (standard coal consumption) and economic growth (GDP) from 2007 to 2017. relationship.

After the ADF test, the Johansen cointegration test was carried out, and the test results are shown in Table 5.

Table 5 Johansen cointegration test

Assume the number of cointegration relations	Eigenvalues	Trace statistics	5% threshold	Probability
NA*	0.706220	21.66365	20.26184	0.0319
At most one	0.121074	2.064875	9.164546	0.7648

According to the above test results, there is a cointegration relationship between LNEC and LNGDP, so it is considered that Henan's energy consumption has a causal relationship with economic growth. But we use the Granger causality test to determine how the two interact. The results obtained are shown in Table 6.

Table 6 Granger causality test

Null hypothesis	F Statistics	Significant level	in conclusion
LNGDP does not Granger Cause LNEC	0.706220	0.2039	Accept the hypothesis
LNEC does not Granger Cause LNGDP	9.60361	0.0078	Rejection hypothesis

From the results of the Granger causality test in Table 6, it can be concluded that there is a one-way causal relationship between economic growth (GDP) and energy consumption in Henan Province. In other words, economic growth does not lead to energy consumption, and energy consumption will certainly bring economic growth. Henan Province lacks energy, and energy consumption depends mainly on support from other provinces. At the same time, in the development of the tertiary industry in Henan Province, the tertiary industry's total production value reached 40% of the total output value, but the tertiary industry is mainly low-energy-consuming industries. The GDP of the primary and secondary industries accounts for a large proportion, but the energy consumed by these two industries accounts for only 20% of total energy consumption. In summary, economic growth (GDP) is not the cause of energy consumption in Henan Province, but energy consumption can drive economic growth in Henan Province. This is mainly reflected in the secondary industry in Henan. According to recent data, Henan's secondary industry has grown at a rate of 3%. The secondary industry is mainly based on industry. We all know that the development of industry is inseparable from the support of energy.

5. Conclusion

Due to the large demand for energy in Henan Province, the energy production of Henan Province has not been able to meet its own demand for a long time. Its energy consumption mainly depends on external support. According to the previous empirical analysis, only the secondary industry in Henan Province relies on energy consumption to promote its own economic development, while the economic development and improvement of the primary and tertiary industries have little to do with energy consumption. The empirical results show that the impact of energy consumption in Henan Province on economic growth is small, indicating that Henan Province has low energy utilization. According to the relevant data of Henan Province, the reason why the energy utilization rate in Henan Province is relatively low is mainly: in recent years, the secondary industry in Henan Province has developed rapidly, and its proportion in the total production value has increased. Heavy industry such as Pingmei and Yongmei The development has increased the dependence and utilization of energy in Henan Province. But as the industry moves toward heavy industry, the economic growth brought about by energy consumption has also brought about some negative effects. For example: environmental issues and ecological issues. And due to industry characteristics, the utilization rate of energy in heavy industry has been lower than that of light industry. At the same time, there is a shortage of resources and waste in rural areas of Henan

Province. According to relevant survey data, the utilization rate of rural energy in Henan Province is only 25%, which is lower than the national average.

In the past few years, Henan Province has vigorously carried out investment promotion in coastal areas, developing petrochemical projects and large-scale steel projects, and these projects have a great relationship with energy consumption. Therefore, at present, Henan Province can only improve the efficiency of energy utilization and improve the energy utilization technology of its own industrial development, in order to fundamentally provide high-quality energy support for industrial development, and accelerate the development of new industrial development, making economic development in Henan Province. A bigger contribution.

At present, due to the low utilization rate of energy in Henan Province, in the process of industrialization development in Henan Province in the future, the contradiction between energy supply and demand will become the main influencing factors affecting industrial development. The energy consumption of Henan Province is mainly coal, which accounts for 60% of the total energy consumption in Henan Province. Therefore, it can be judged that there is an unreasonable phenomenon of energy consumption in Henan Province. Coal resources are non-renewable resources. The use of coal resources should be gradually reduced, and instead, it should seek alternative resources and develop new resources, such as: ocean energy, light energy. And biomass energy, etc. Efforts to optimize energy use structures, invest in and develop those that are low-pollution, widely distributed, and renewable. The development and utilization of renewable resources, on the one hand, energy-saving and low-energy to promote economic development, on the other hand, reduce environmental pollution. Energy efficiency can be provided from both aspects of improved management and improved technology. From a management point of view, it is necessary to formulate guidelines, targets, and various policies and measures for energy conservation and emission reduction, implement a system of rewards and punishments, reward low-energy, high-output enterprises, and vice versa, thereby continuously improving energy. From the perspective of technological development, it is mainly through the use of high technology to rationally modify the production process, remove high energy consumption, or reduce the energy consumption of high energy consumption, and strengthen investment in coal cleaning, such as: Use clean energy and briquette, coal-fired desulfurization, etc.

In addition, it is necessary to strengthen the governance of the current link pollution and ecological damage in Henan Province. Especially in the treatment of industrial pollution in the secondary industry, and increase investment and supervision of air pollution control, and strengthen investment in pollution control technology and research and development equipment, and resolutely ensure that emissions of pollutants are stopped at the source, fundamentally Reduce pollution.

To sum up, in view of the problems of energy consumption and economic growth in Henan Province, the Henan provincial government should speed up the transformation of economic development mode and transform traditional high energy consumption and high pollution industries into low energy consumption and low emission industries. The government should make full use of the tax policy, and give preferential policies to taxation for enterprises that make great contributions to energy conservation and emission reduction, thereby attracting more enterprises to save energy and reduce emissions. By encouraging enterprises and individuals to participate in energy conservation and emission reduction activities, the policy will increase capital investment in energy conservation and emission reduction projects, and implement tax reduction and tax exemption for energy conservation and emission reduction projects. In addition, Henan Province should also introduce foreign advanced energy-saving technologies and strengthen international cooperation in energy-saving projects to solve the contradiction between energy supply and demand.

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informationization in Henan Province (No. 2019-ZDJH-053).

References

[1] Henan Provincial Government Office. Henan Province “13th Five-Year Plan” Energy Development Plan [EB/QL]: http://www.askci.com/news/chanye/20170204/17241789566.shtml.

[2] Henan Statistical Network. Analysis of economic performance of Henan Province in 2017 GDP growth is 1.4 percentage points higher than the national [EB/QL]: http://www.askci.com/news/finance/2016/01/22/95549ruaz .shtml.

[3] Dahe.com. In 2017, Henan's total energy consumption is determined together [EB/QL:]http://news.dahe.cn/2017/01-15/108159138.html.