

Study on the Relationship between Energy Structure Change and Economic Structure in China

Cheng Chen^{1, *}

¹ Msc of Finance, Corporate Finance, Queen Mary university of London, London E1 4Ns, UK

* Corresponding Author Email: Te22228@qmul.ac.uk

Abstract. Since 1978, China's economic growth rate has attracted international attention. While China's economy has maintained rapid growth, energy consumption has shown an opposite trend, namely, the growth rate of energy consumption has slowed down, and the energy consumption intensity of the national economy has continued to decline. The tertiary industry is underdeveloped, and the producer service industry is stagnant, with outstanding problems. It is worth noting that the proportion of China's industrial added value in GDP(Gross Domestic Product) exceeded the peak value of developed countries during the Wang Yehua period. Under the new normal of economic growth shift and tight resource and environment constraints, structural contradictions will become more prominent in the coming period. In order to practice the low-carbon economic model, the government puts forward the requirements of ensuring China's energy and economic security and accelerating the transformation of energy revolution and economic development mode. However, structural adjustment is not a simple superposition of policies and measures. This paper studies the relationship between energy structure change and economic structure in China. Structural adjustment is not simply the superposition of policies and measures. We must also with comprehensive consideration of energy supply security and use security, so as to provide decision-making basis for ensuring energy security and carrying out national macro-control.

Keywords: China Energy, Structural changes, Economic structure, Correlation.

1. Introduction

In today's world, the traditional fuel energy is gradually decreasing, the energy consumption structure is unreasonable, and the economic development is unbalanced. Countries are constantly optimizing the energy consumption structure and economic structure to adapt to the international situation, promote industrial upgrading, and achieve "win-win" between economy and environment. Since 1978, China's economic growth rate has attracted international attention[1]. From the perspective of economic structure, the proportion of heavy industry in China is too high, the tertiary industry is underdeveloped, and the producer service industry is stagnant, with outstanding problems. It is worth noting that the proportion of China's industrial added value in GDP exceeds the peak value of developed countries during the Wang Yehua period, and the backward economic structure will not only increase the pressure on crazy social resources, but also affect the overall quality and development of the national economy [2-3]. The continuous decline of energy intensity is unprecedented in the economic growth of other developing countries and developed countries. Therefore, it is still necessary to analyze and explain the factors behind the decline of energy intensity that affect the improvement of energy efficiency. This has practical reference significance for the future energy economic development of China and the economic development of other developing countries. In fact, energy intensity gradually decreases with the improvement of technology and management level. Nevertheless, the short-term decline in energy supply or the increase in energy prices caused by rising demand will also cause energy consumers to reduce energy consumption or replace energy, thus promoting some existing tertiary industries has declined relatively. However, some emerging industries that adapt to the progress of modern society, such as finance and insurance, will continue to develop rapidly, and logistics and e-commerce will also make breakthroughs and become fast-growing industries. The energy production volume and energy self-sufficiency rate play a promoting role in energy security. The larger the energy production volume, the higher the self-sufficiency rate, and the less susceptible the energy supply is to external factors, resulting in a higher

level of energy security. The characteristics of high dependence, natural Scarcity, and uneven distribution have increased the degree of oil insecurity, and its growing gap between supply and demand has also brought a huge impact on China's energy security[4]. It can be seen that structural adjustment is not simply the superposition of policies and measures. We must also pay attention to the relationship between energy structure changes and economic structure, find out the influence degree of consumption structure with a view to providing decision-making basis for ensuring energy security and carrying out national macro-control [5]. Therefore, it is very important to analyze the current dynamic relationship and synergistic effect between them and study their coincidence for the future coordinated development of energy and industry.

2. Changes in Energy Structure and Analysis of Economic Structure

2.1. Current status of energy consumption structure

The rapid development of the economy will inevitably lead to energy consumption, which is also an important reason for the world's attention to energy allocation. With the rapid growth of China's GDP, energy consumption has also continued to increase, maintaining a growth rate above the world average[6]. The energy consumption structure mainly considers traditional energy, while coal, oil, natural gas, and new energy nuclear energy, hydropower, and other new energy each account for their respective energy consumption proportions in the economic restructuring, transformation and upgrading, optimization of resource allocation, and improvement of energy efficiency are accelerating, revealing development model and driving force are also changing, showing the characteristics of the New normal, that is, from rapid and extensive development to high-quality, efficient and intensive development [7]. The proportion of thermal power is decreasing, and the rapid development of new energy is shown in Table 1.

Table 1. Energy consumption and GDP growth rate in China

Time	Energy consumption growth rate	Gross domestic product growth rate
2019	4.23	8.2
2020	8.12	9.1
2021	6.49	10.2
2022	8.42	12.6

In the future, our Congress will prioritize the development of renewable energy and new energy, promote wind power, nuclear power, biomass energy, and actively develop traditional energy clean technologies; Consolidate the existing development trend of traditional energy, build Energy development bases such as coal and oil, and safeguard the interests of enterprises that consume coal on a regular basis [8]. Although the change in energy intensity is determined by the economic aggregate and energy consumption in the calculation formula, it is essentially the result of progress in energy-saving technology, improvement in management level, and institutional innovation. Therefore, compared to the economic aggregate and energy consumption, energy intensity is largely an exogenous variable [9].

2.2. Current status of industrial structure

The development and utilization of new energy can not only alleviate the international competition for traditional energy sources with extremely uneven distribution such as oil and gas, and reduce the pressure on energy supply. At the same time, due to its unique advantages of cleanliness, environmental protection, and renewable energy, the utilization of new energy can greatly reduce the degree of environmental damage, which is conducive to improving the national energy security level and ensuring the quantity and quality of national energy use. China's energy consumption structure and industrial structure have undergone significant changes, and the pace of transformation and upgrading has accelerated[10]. Through the analysis of this paper, it can be determined that the main

focus of China's energy intensity research should be on whether the decline of industrial energy intensity is the structural change of various industries or the improvement of energy efficiency caused by technological progress, which ultimately promotes the decline. However, there are still some problems. Its problems include prominent structural contradictions between energy storage and production, high energy consumption per unit of GDP, low energy self-sufficiency rate, and serious energy pollution. With the gradual establishment of the market economy system, China's industrial structure has undergone significant adjustments. According to the trend of changes, the proportion of each of the three major industries has changed significantly. The optimization of the industrial structure is shown in Figure 1.

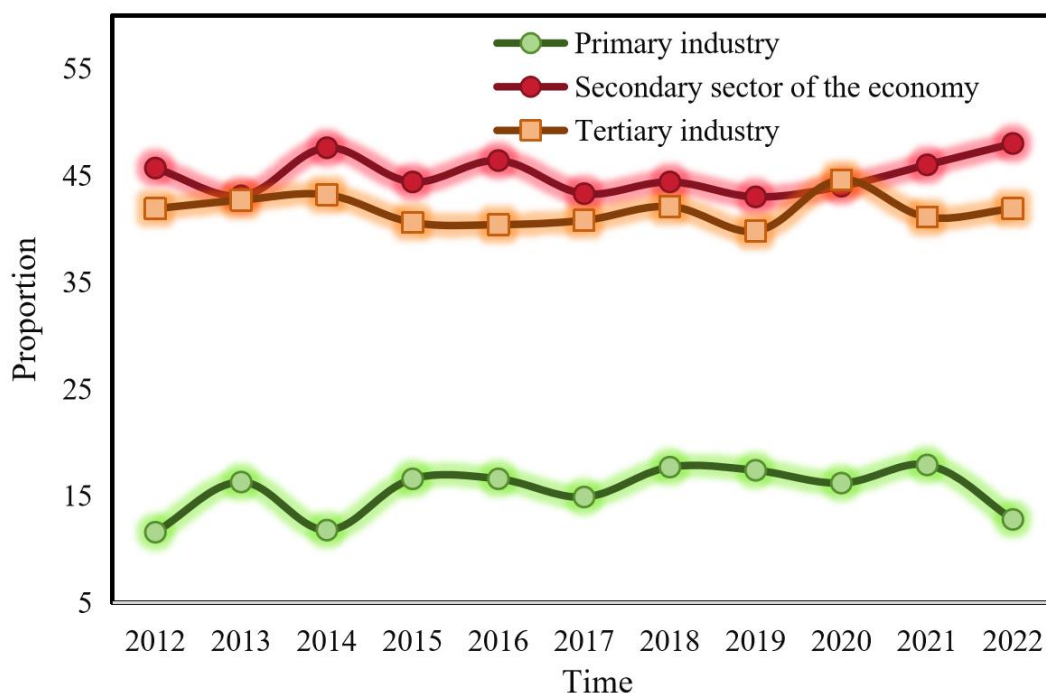


Figure 1. Changes in the proportion of China's three major industries

The proportion of agricultural output value in China's economy is gradually decreasing, but the basic position of agriculture in China has not been affected. In addition, the scientific development of agriculture can provide needed products for industry and cooperate with industry to promote economic development. At the same time, it can continuously improve the ability to provide agricultural products and promote industrial development. Economic aggregate and energy consumption determine energy intensity, but economic aggregate and energy intensity determine energy consumption. In fact, energy intensity gradually decreases with the improvement of technology and management level. Nevertheless, the short-term decline in energy supply or the increase in energy prices caused by rising demand will also cause energy consumers to reduce energy consumption or replace energy, thus promoting some existing tertiary industries has declined relatively. However, some emerging industries that adapt to the progress of modern society, such as finance and insurance, will continue to develop rapidly, and logistics and e-commerce will also make breakthroughs and become fast-growing industries.

3. Research on the Impact of Energy Consumption Structure on Economic Structure

3.1. Regressive analysis

The energy production volume and energy self-sufficiency rate play a promoting role in energy security. The larger the energy production volume, the higher the self-sufficiency rate, and the less susceptible the energy supply is to external factors, resulting in a higher level of energy security. The

characteristics of high dependence, natural Scarcity, and uneven distribution have increased the degree of oil insecurity, and its growing gap between supply and demand has also brought a huge impact on China's energy security. This article uses regression analysis to find the correlation between the consumption proportion of different energy sources and various energy security indicators. Before regression analysis, the original data needs to be dimensionally removed, and then according to the positive and negative characteristics of each indicator, the energy security calculation formula of different energy varieties is obtained 1. The calculation formulas for energy supply security and energy use security are:

$$SupplySecurity(i) = ep_i - ni_i \quad (1)$$

In the formula, $i = c, o, g, n$ represents the consumption proportion of coal, oil, natural gas, and nuclear power.

There is a significant correlation between the evolution of industrial structure and the total energy consumption; The total energy consumption continuously increases with the increase of the coefficient of industrial structure evolution, which reflects that in the current and future period, as the industrial structure evolves, the total energy consumption still needs to further increase. This is mainly because the industrial structure is mainly dominated by the second industry, and energy consumption is also mainly dominated by the second industry, especially industrial consumption, The energy-saving effect of industrial technology cannot offset the increase in energy consumption caused by the expansion of industrial output in the current and future period.

3.2. Impulse response analysis

Impulse response mainly analyzes the change of an endogenous variable or the impact on other endogenous variables in the Vector autoregression to measure the degree of impact. The contribution of different energy consumption structures to ensuring energy use to the environment has become a key issue hindering China's energy security development. Although the change in energy intensity is determined by the economic aggregate and energy consumption in the calculation formula, it is essentially the result of progress in energy-saving technology, improvement in management level, and institutional innovation. Therefore, compared to the economic aggregate and energy consumption, energy intensity is largely an exogenous variable. After the impact of industrial structure, the energy consumption structure reached a negative peak around the fifth period, and subsequently the disturbance continued to decrease. Compared to the impact of industrial structure, the impact of energy consumption structure on industrial structure is significant and has always been a negative impact industrial structure adjustment. The current energy security situation is still severe, And the prominent manifestation is the enormous negative impact of energy use on the environment. In other words, the faster the degree of change in regional energy consumption structure, the lower the rate of growth in total carbon emissions. The impact of industrial structure on the energy consumption structure is not obvious, but it has some effect.

4. Conclusions

Energy intensity reflects the efficiency of energy utilization. In the period of China's institutional reform and gradual opening-up, it is the continuous institutional innovation, management progress and technology introduction and diffusion that promote the sustained and rapid decline of China's energy intensity, which actually reflects the process of China's gradual integration with the world in terms of economic system, management methods and technical level. Under the new normal of economic growth shift and tight resource and environment constraints, structural contradictions will become more prominent in the coming period. The proportion of agricultural output value in China's economy is gradually decreasing, but the basic position of agriculture in China has not been affected. In addition, the scientific development of agriculture can provide needed products for industry and cooperate with industry to promote economic development. At the same time, it can continuously

improve the ability to provide agricultural products and promote industrial development. In order to practice the low-carbon economic model, the government puts forward the requirements of ensuring China's energy and economic security and accelerating the transformation of energy revolution and economic development mode. However, structural adjustment is not a simple superposition of policies and measures. In this regard, this paper studies industrial structure in China, and studies the development trend and dynamic relationship between them. Through the analysis of this paper, it can be determined that the main focus of China's energy intensity research should be on whether the decline of industrial energy intensity is the structural change of various industries or the improvement of energy efficiency caused by technological progress, which ultimately promotes the decline of industrial energy intensity, and should be the subject of further research in this field.

References

- [1] Sun J, Li G, Wang Z.Optimizing China's Energy Consumption Structure under Energy and Carbon Constraints[J].Structural Change and Economic Dynamics, 2021, 47(DEC.):57-72.
- [2] Zhifu M, Jiali Z, Jing M,et al.China's energy consumption in the new normal[J].Earths Future, 2021, 26(19):46-55.
- [3] Ling F, Yan F.Research on the Transmission Way of China's Industrial Energy Consumption and Its Influence Factors——A Grey Correlation Analysis from the Perspective of Industry[J].Journal of Jiangxi Science & Technology Normal University, 2022, 36(16):34-41.
- [4] Shaohui Z, Tian Z.Cross-correlation analysis between energy and carbon markets in China based on multifractal theory[J].International Journal of Low-Carbon Technologies, 2020, 36(11):10-20.
- [5] Wang D.The Impacts of the Growth of the Three Industries and Industrial Price Structural Changes on China's Economic Growth between 1952 and 2019[J].Research on China's Finance and Economy, 2021, 10(4):25-34.
- [6] Liu Y, Wang Y, Mi Z,et al.Carbon implications of China's changing economic structure at the city level[J].Structural Change and Economic Dynamics, 2018, 46(SEP.):163-171.
- [7] Li R, Wang Q, Liu Y,et al.Per-capita carbon emissions in 147 countries: The effect of economic, energy, social, and trade structural changes[J].Sustainable Production and Consumption, 2021, 27(8):12-30.
- [8] Liu Y, Zhang J, Zhu Z,et al.Impacts of the 3E (economy, energy and environment) coordinated development on energy mix in China: The multi-objective optimisation perspective[J].Structural Change and Economic Dynamics, 2019, 05(4):005-013.
- [9] Wu S, Ding S.Efficiency improvement, structural change, and energy intensity reduction: Evidence from Chinese agricultural sector[J].Energy Economics, 2021, 99(41):105313-105320.
- [10] Wang M, Feng C.Investigating the drivers of energy-related CO₂ emissions in China's industrial sector: From regional and provincial perspectives[J].Structural Change and Economic Dynamics, 2018, 46(SEP):136-147.