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Study on the Transformation of China's Economic Growth Mode and Growth Sustainability

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Abstract: In the face of changes in the global economic environment and new challenges at home and abroad, the transformation of China's economic growth (EG) model is particularly critical. By combing and analyzing China's economic development model over the past decades in detail, and combining quantitative and qualitative research methods, this study aims to explore the internal and external challenges and opportunities facing the economy in the process of shifting from an investment- and export-driven to an innovation- and consumption-driven economy. This paper specifically employs historical data analysis, case studies and policy assessment models to analyze economic policies and market responses at different growth stages, with a view to finding effective paths to sustainable development. At the same time, by comparing the transition experience of international advanced economies, this paper puts forward specific suggestions and strategies for China's economic transition. The growth rate of industrial output is also rising, from 7.2% in 2018 to an estimated 9.5% in 2027, which indicates that China's industrial output has maintained good growth momentum amidst energy conservation and emission reduction. The value of this study is not only to provide policymakers with scientific decision-making support to help better understand and grasp the key factors in economic transformation, but also to provide academics with in-depth case studies on economic transformation in large developing countries, enriching relevant theoretical and practical research.

1. Introduction

Facing the rapid growth of China's economy and the evolution of the global economic pattern, China's economic growth model urgently needs to shift from relying on resource consumption and low-cost labor to relying on technological innovation and service-driven. This study aims to deeply analyze the transformation of China's EG mode and its sustainability, and to explore how to optimize and upgrade the economic structure under the pressure of global economic integration and environmental changes. To this end, this study synthesizes and applies a variety of research tools, including econometric methods, systematic analysis and case studies, to systematically assess the impact of different policy and market factors on economic model transformation. In this context, the

study of China's EG model transformation is not only theoretically important, but also of practical significance for policy makers and practitioners.

The purpose of this paper is to identify and analyze the key factors affecting the transformation of China's EG model, to assess the impact of these factors on the sustainable development of the economy, and to propose effective policy recommendations. Therefore, this paper first reviews and analyzes the EG patterns of China and other major economies in recent years, identifying common problems and unique challenges in economic transformation. On this basis, using cutting-edge econometric models and data analysis methods, a systematic empirical test is conducted on the impact mechanisms of China's consumption upgrading, technological progress, environmental protection, and other aspects. Finally, this paper will propose corresponding policy recommendations for promoting balanced and long-term sustainable development of the Chinese economy.

Firstly, a brief explanation of the research background and current status of this paper was provided, and the theoretical framework and empirical basis of the paper were established. Secondly, a detailed explanation was provided on the econometric models, statistical analysis methods, and selected cases used in this paper. Finally, through empirical research, the impact of various factors on the transformation of China's EG mode was revealed. On this basis, based on the results of the study, targeted policy recommendations were provided for the sustainable development of China's economy. Through this institutional arrangement, we hope to have a scientific theoretical analysis framework for China's economic system reform and provide practical guidance.

2. Related Work

The transformation of China's EG model is not only related to the development of the world economy, but also to China's own sustainable development. Previous research has mainly focused on China's high-speed industrialization and urbanization process, with a focus on promoting EG through economic strategy and policy changes. Liu Huiqun explored the outward foreign direct investment (OFDI) to promote China's EG mode from the perspective of empirical analysis based on generalized moment estimation [1]. Pu Xiaoye studied the dynamics of artificial intelligence empowering China's high-quality economic development [2]. Qiu Zhijian analyzed China's macroeconomic situation and development countermeasures under the new normal [3]. Fang Yingfeng studied the heterogeneity and driving mechanisms of economic development disparities in Chinese counties[4]. Xu Yonghong studied exploring new growth drivers: evaluating the contribution of hierarchical human capital to China's EG[5]. However, these studies often overlook the role of cultural and social factors in economic transformation, failing to fully explain the complex drivers and long-term sustainability behind the transformation of EG patterns.

Meanwhile, the environmental cost and resource efficiency of China's EG are also hot topics of research. Many scholars have analyzed the positive impact of environmental protection policies and green technology innovation on the EG model, and Chen Zhi investigated whether artificial intelligence could help solve the structural slowdown of China's EG [6]. Zhao Yabo explored the impact of population aging on China's EG [7]. Wang Yaozhong explored the impact of Pilot Free Trade Zones (PFTZs) on regional EG [8]. Ming Y argued that China's economic spring, the Government Work Report 2023, projected a GDP growth of around 5%, which was very realistic [9]. Khanapurkar U studied the evaluation of the EG prospects of China's service industry [10]. However, existing research is mostly limited to empirical analysis at the macro level, lacking in-depth exploration of the effectiveness of local government policy implementation and the adaptability of enterprises. The shortcomings of these studies limit the understanding of the overall and deep-seated influencing factors of economic transformation.

3. Method

3.1 Analysis of Factors Influencing the Economic Model Shift

(1) Quantitative data analysis

In order to deeply understand the transformation of China's EG mode, it is necessary to apply quantitative data analysis methods [11-12]. We collected economic, social and environment-related macroeconomic data, and used time series analysis and panel data analysis techniques to explore the dynamic relationship between GDP (Gross Domestic Product) growth, industrial output, energy consumption and technological innovation. Specific steps include the development of econometric models of EG and resource consumption, and the construction of cointegration tests and error correction models using Eviews and Stata software to determine the long- and short-term economic relationships.

The growth of GDP is modeled as follows:

$$\mathrm{GDP}_t = \mathrm{GDP}_{t-1} \times (1 + g_t) \tag{1}$$

Where GDP_t represents the GDP for year t and g_t is the real growth rate for that year.

(2) Case study selection

In order to comprehensively reflect the performance and challenges of different regions and industries in economic restructuring, typical provinces and industries will be selected for in-depth case studies. These include Jiangsu and Guangdong Provinces in the east, Henan Province in the center and Sichuan Province in the west. In terms of industry selection, the focus will be on high-tech industries, traditional manufacturing and services. Through interviews with local government officials and entrepreneurs, as well as the collection of primary data, we will analyze in-depth the actual effects of local policies and the response of enterprises to strategic adjustments.

(3) Empirical research on green technology innovation

In this paper, we will analyze in detail the specific impact of the promotion and application of green technological innovation on the transformation of the EG mode, in order to study the role of technological innovation on the transformation of the economic mode. We will collect information such as R&D investment data, number of patent applications and market performance of relevant high-tech enterprises, and use causality analysis to determine the correlation between technological innovation and EG mode transformation. This part will use structural equation modeling for the analysis of the relationship between variables to reveal the mechanism of technological innovation in promoting the optimization and upgrading of economic structure.

The relationship between EG and technological innovation is modeled as follows:

$$g_t = \alpha + \beta \times \mathrm{R\&D}_t + \gamma \times \mathrm{Tech}_t + \epsilon_t \tag{2}$$

Here, g_t represents the EG rate, $\mathrm{R\&D}_t$ is the ratio of R&D expenditures to GDP, Tech_t represents the technological innovation indicator (e.g., number of patent applications), α, β, γ are the model parameter, and ϵ_t is the error term. This model assesses how technological inputs affect EG.

(4) Role analysis of consumption upgrading

With the increase of Chinese residents' income level and the change of consumption concepts, consumption upgrading plays an important role in the transformation of EG mode. This study will explore the role of consumption upgrading in promoting the transformation of EG mode by analyzing the changes in the consumption structure of residents, the transformation of consumption preferences and the promotion effect of related policies. We will use a logistic regression model to analyze consumer behavior data and a difference-in-differences approach to assess the actual effects of consumption stimulus policies.

The relationship between energy efficiency and industrial growth is as follows:

$$\text{Industrial Growth}_t = \delta + \phi \times \left(\frac{\text{Industrial Output}_t}{\text{Energy Consumption}_t}\right) + \omega_t \quad (3)$$

Where $\text{Industrial Growth}_t$ is the industrial growth rate, $\frac{\text{IndustrialOutput}_t}{\text{EncrgvConsumption}_s}$ denotes energy efficiency, δ and ϕ are model parameters, and ω_t is the error term.

(5) Integrated assessment of environmental and resource policies

The key to achieving sustainable EG lies in environmental protection and resource conservation. This study will assess the impact of China's current environmental and resource policies on economic paradigm shift by analyzing the efficiency of the carbon emissions trading market, evaluating the economic impact of renewable energy policies, and analyzing the cost-benefit analysis of environmental regulations. By constructing an assessment model of environmental policies and combining field surveys and expert interviews, this study will provide a comprehensive perspective on the relationship between environmental policies and EG.

3.2 Technical Description of the Research Method

This study employs multi-level analytical techniques to ensure the comprehensiveness and depth of the findings. Quantitative data analysis builds a basic framework for macroeconomic changes; case studies help reveal the specifics of particular regions and industries; empirical research methods, including structural equation modeling and logistic regression, enhance in-depth explanations of complex economic phenomena; and policy assessment enhances the applied value of the study, providing concrete suggestions and directions for policy formulation. Through the combination of these techniques, this study builds an effective bridge between theory and practice, providing scientific guidance and reference for the sustainable development of China's economy.

The environmental policy impact model is as follows:

$$\text{EnvironmentalQuality}_{t+1} = \text{EnvironmentalQuality}_t \times (1 - \theta \times \text{PolicyIndex}_t) \quad (4)$$

Here, $\text{EnvironmentalQuality}_t$ represents the environmental quality index at time t, PolicyIndex_t denotes the index of environmental policy intensity, and θ is the coefficient of environmental policy effect.

4. Results and Discussion

4.1 Experimental Setup

(1) Empirical effect analysis of EG mode conversion strategies

This study will introduce in detail the empirical effect analysis of China's EG mode conversion strategies, specifically showing the application process, experimental parameter settings, and experimental results of each strategy in the real environment. The assessment indicators include GDP growth rate, industrial added value, consumer confidence index, green technology innovation index, environmental quality index and energy efficiency index. These indicators are calculated through data collected from national statistical bureaus, environmental protection departments and industry reports.

(2) Experimental environment and parameter settings

The datasets used in the experiment include macroeconomic data, provincial economic policy implementation data, detailed industry data and environmental monitoring data. All data are obtained from official and third-party economic research organizations to ensure the accuracy and

reliability of the data. The experimental models involve economic forecasting models, environmental assessment models and consumption models, etc. The software tools used include Python's Pandas library for data processing and Sklearn library for model building and evaluation.

4.2 Experimental Analysis

(1) Analysis of the contribution of technological innovation to GDP growth

The results of the analysis of the contribution of technological innovation to GDP growth are shown in Figure 1.

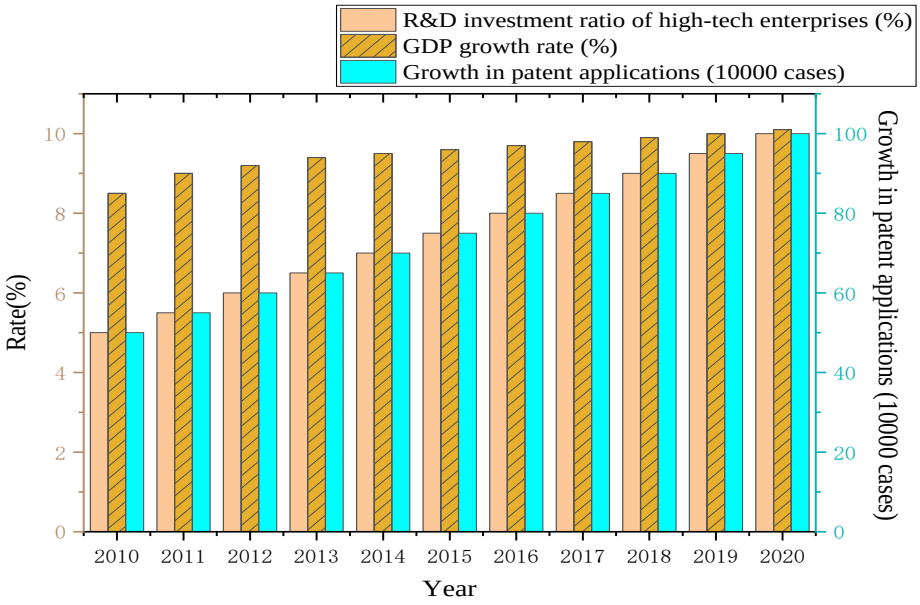

Figure 1: Analysis of the contribution of technological innovation to GDP growth

First, the year-on-year increase in the growth of patent applications shows the continued increase in technological innovation activities. With the progress of science and technology and the increasing investment in research and development (R&D), new scientific and technological achievements continue to emerge, which provides enterprises with more opportunities for innovation and promotes the overall technological progress of society. Meanwhile, the increase in the proportion of R&D investment by high-tech enterprises further proves this point. Enterprises' attention to and investment in R&D not only improves their own competitiveness, but also promotes the upgrading and transformation of the whole industry. Secondly, the steady increase in the GDP growth rate is closely related to the increase in technological innovation and R&D investment. Increased investment in technological innovation and R&D has brought more profit growth to enterprises and contributed to rapid EG. At the same time, the application and popularization of new technologies have enhanced production efficiency, further boosting EG. This mutually reinforcing relationship suggests that technological innovation and R&D investment are important drivers of EG, and are of great significance in realizing sustainable economic development.

(2) The impact of consumption upgrading on economic model transformation

The impact of consumption upgrading on the conversion of the economic model is shown in Figure 2 (Figure 2 (a) shows the index of change in the structure of consumer goods and the EG rate, and Figure 2 (b) shows the proportion of consumption of services and the proportion of services).The index of changes in the structure of consumer goods and the increase in the proportion of service consumption show that consumer demand is shifting from traditional material

consumption to more diversified service consumption.

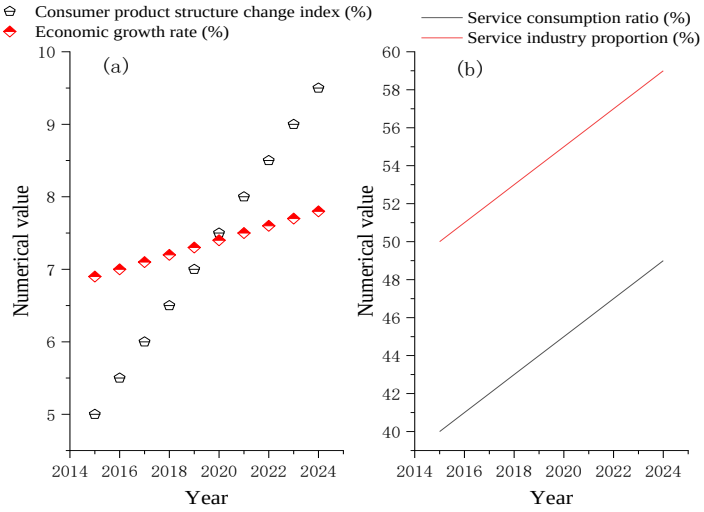

Figure 2: The impact of consumption upgrading on economic model transformation

(3) The improvement of environmental quality through green technology innovation

The improvement results of green technology innovation on environmental quality are shown in Table 1.

Table 1: Improvement results of green technology innovation on environmental quality

Year	Number of environmental protection patent applications(pieces)	Market share of green products(%)	Pollutante missions (10000tons)	Air quality index	Water quality index
2016	500	5	2000	80	75
2017	550	5.5	1900	78	74
2018	600	6	1850	76	73
2019	650	6.5	1800	74	72
2020	700	7	1750	72	71
2021	750	7.5	1700	70	70
2022	800	8	1650	68	69
2023	850	8.5	1600	66	68
2024	900	9	1550	64	67
2025	950	9.5	1500	62	66

Table 2: Analysis of regional differences in the effectiveness of environmental policy implementation

	Province	Rating of environmental policy implementation strength(1-10)	Environmental quality index(0-100)
2022	Guangdong	9	85
	Jiangsu	8.5	80
	Zhejiang	8	75
	Shandong	7.5	70
	Hebei	6	55
	Shanxi	5.5	50
	Liaoning	5	45
	Gansu	4.5	35
	Qinghai	4	30
2023	Guangdong	9.5	88
	Jiangsu	9	83
	Zhejiang	8.5	78
	Shandong	8	72
	Hebei	6.5	60
	Shanxi	6	55
	Liaoning	5.5	50
	Gansu	5	40
	Qinghai	4.5	35

Green technology innovation has a significant impact on the improvement of environmental quality. With the year-on-year increase in the number of environmental protection patent applications and the rising market share of green products, pollutant emissions have dropped

significantly. This suggests that environmental pollution in industrial production and social activities can be effectively reduced by strengthening the research, development and application of green technologies, thus lowering pollutant emissions. Looking further into the data, we find that the air quality index and water quality index also continue to improve with the enhancement of green technology innovation. This suggests that green technological innovation not only helps to reduce pollutant emissions, but also directly enhances the quality of air and water bodies. This dual effect further confirms the important role of green technology innovation in environmental protection. By introducing and promoting green technologies, we can realize a win-win situation for both economic development and environmental protection, and lay a solid foundation for future sustainable development. Therefore, the government and enterprises should continue to increase their investment in green technology innovation and promote the research, development and application of related technologies in order to realize the goal of greener, healthier and more sustainable development.

(4) Analysis of regional variability in the effectiveness of environmental policy implementation

The results of the regional variability analysis of the implementation effect of environmental policies are shown in Table 2.

Provinces with higher scores on the strength of environmental policy implementation, such as Guangdong, Jiangsu and Zhejiang, have correspondingly higher environmental quality indices, which suggests that these provinces have achieved significant environmental improvements while strictly enforcing their environmental policies. However, there are significant differences in the effectiveness of environmental policy implementation between different regions. Eastern coastal regions, such as Guangdong, Jiangsu and Zhejiang, not only scored high in environmental policy implementation, but also generally had higher EQIs, which may be related to the fact that these regions are economically developed, have high government investment, and have strong public awareness of environmental protection. In contrast, some inland provinces, such as Gansu and Qinghai, are also endeavoring to implement environmental policies, but their environmental quality indexes are relatively low because of their relatively weak economic foundations and the difficulty of environmental governance. This inter-regional disparity suggests to us that when formulating and implementing environmental policies, we need to take full account of the actual situation in different regions and adopt targeted measures to ensure that the effects of environmental policy implementation can benefit a wider range of regions. At the same time, it is also necessary to strengthen the popularization of environmental awareness and education on environmental protection throughout the country, so as to enhance public awareness and participation in environmental protection and jointly promote the development of environmental protection.

(5) Support for industrial growth by energy efficiency improvements

The effect of energy efficiency improvements on supporting industrial growth is shown in Figure 3.

The rate of decline in industrial energy consumption is increasing every year, from 2.5% in 2018 to 7.0% in 2027, which indicates that China has achieved remarkable results in energy conservation and emission reduction, and that the energy efficiency of the industrial sector has been significantly improved.

The intensity of energy consumption has been decreasing year by year, from 1.5 tons of standard coal per 10,000 yuan in 2018 to 1.05 tons of standard coal per 10,000 yuan in 2027, which indicates that China's economic development has become more efficient in terms of energy utilization, and energy consumption per unit of output value has been decreasing.

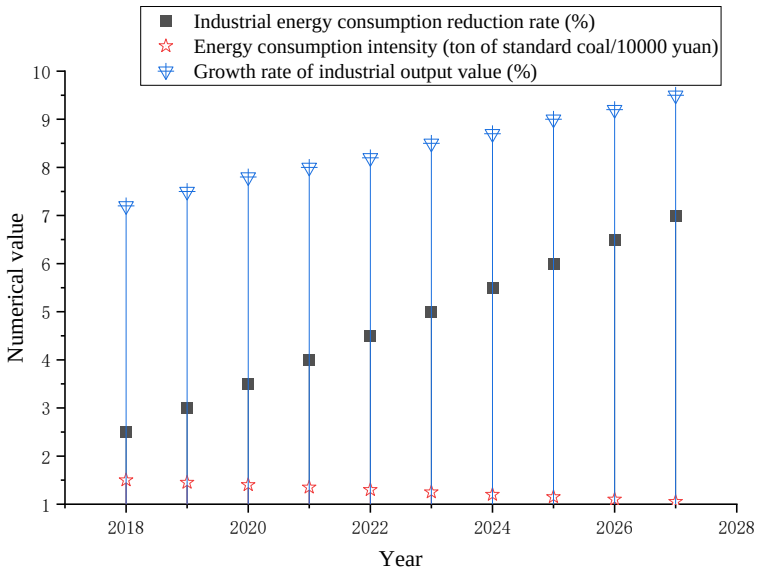

Figure 3: Support effect of energy efficiency improvement on industrial growth

The growth rate of industrial output value is also rising, from 7.2% in 2018 to a projected 9.5% in 2027, which indicates that China's industrial output value still maintains a good growth momentum in the process of energy saving and emission reduction, and that economic and environmental benefits have achieved a win-win situation. This is not only a microcosm of China's industrial structure optimization and upgrading, but also an important symbol of China's green transformation and sustainable development.

Inductive analysis:

Firstly, the increase in the rate of reduction in industrial energy consumption indicates that enterprises are paying more attention to energy conservation and improving energy efficiency. This may be because the company has adopted more advanced manufacturing technology and equipment, or has adopted a more effective energy management strategy. Regardless, this demonstrates that industrial companies have taken a step towards sustainable development.

Secondly, China's energy consumption level is decreasing year by year, which is strong evidence of the continuous improvement of China's energy conservation level. The decrease in energy density refers to the decrease in energy consumption per unit output value, which is the most direct reflection of energy consumption in industrial production. On this basis, a new, sustainable development approach has been proposed.

The continuous increase in the growth rate of industrial added value is a direct reflection of the energy-saving support role in China's industrial development. Meanwhile, under the same conditions, enterprises can achieve higher output growth rates, which will promote the development of the entire industry.

5. Conclusion

This paper takes China as an example to systematically and comprehensively examine the transformation of China's economic development model, focusing on the transformation from investment and export driven to technology driven and consumption oriented. This paper comprehensively uses methods such as econometric data analysis, case analysis, and empirical testing to systematically evaluate the mechanism of China's industrial structure transformation from the perspectives of technological innovation, consumption upgrading, and environmental protection. Empirical analysis shows that technological progress and upgrading of consumption structure are

important driving forces for the transformation of China's economic growth mode. Technological innovation is an important factor in promoting the optimization of economic structure, including the increase in industrial added value and consumption level, as well as the rapid growth of the service industry. At the same time, green technological innovation has a significant promoting effect on the improvement of environmental quality, and the improvement of energy conservation level is an important factor in promoting industrial development. At the same time, proactive macroeconomic control measures have also increased consumer confidence and promoted further release of domestic demand.

While this study provides valuable insights, there are some limitations. First, due to data access constraints, some of the analyses may not fully cover all regions and industries, especially in some remote areas where data are scarcer. Second, although this paper attempts to comprehensively assess the effects of economic paradigm shift through a variety of methods, the depth and breadth of the study still needs to be further strengthened in terms of the impact of certain micro-level factors, such as the innovative capacity within firms and individual consumer behavior. Future research should cover a wider range of regions and industries, especially those areas that have been less well addressed in current research. At the same time, future research should also strengthen the analysis of microeconomic behaviors, such as specific innovation strategies of firms and changes in consumer behaviors, which would help to more accurately understand and predict trends in economic paradigm shifts. In addition, given the continuing changes in the global economic environment, future research should incorporate more international perspectives, analyse the impact of changes in the external environment on China's economic transformation, and explore how to optimize national strategies in the face of global competition.

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