Population, Resources & Environmental Economics (2024)
Clausius Scientific Press, Canada

DOI: 10.23977/pree.2024.050208
ISSN 2616-2253 Vol. 5 Num. 2

Study on the Transformation of China's Economic Growth Mode and the Sustainability of Economic Growth in Resource-Based Cities

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Keywords: China's Economic Growth, Resource-based Cities, Sustainability Research, Urban Economic Development Models

Abstract: The Chinese economy is shifting from a traditional resource-based economic growth model to a technology innovation oriented economic growth model. In this context, the sustainability of traditional economic development models represented by resource-based cities has attracted much attention. This article used qualitative and quantitative research methods to conduct in-depth research on the opportunities and challenges faced by resource-based cities in their transformation. This article applied methods such as questionnaire surveys, in-depth interviews, and data analysis. On this basis, this study took resource-based cities in China as the research object, collected massive data, and constructed a comprehensive database and in-depth analysis and mining of the transformation process of China's resource-based city economic development model. From the perspective of economic growth rate, it has steadily increased from 5.0% in 2020 to 9.5% in 2029, which clearly reflects the effectiveness of policy guidance in transferring funds and technology to high-tech industries. The research results provide theoretical support and practical guidance for the transformation and upgrading of resource-based cities in China, and have certain reference significance for the transformation and upgrading of similar cities. In order to make beneficial contributions to the sustainable development of resource-based cities in China, it is of great significance to the health, stability, and sustainable development of the Chinese economy.

1. Introduction

In today's accelerating globalization and increasingly severe environmental issues, the transformation of economic growth models has become a global issue. As the world's second-largest economy, the transformation of China's economic growth model not only affects Chinese sustainable development, but also has a significant impact on the global environment and economic landscape. Especially for resource-based cities in China, due to their long-term dependence on a single resource economy, they face a dual dilemma of resource depletion and environmental degradation. Research in various countries generally focuses on the economic transformation of resource-based cities. How to achieve green transformation and sustainable development while

ensuring sustained economic growth has become an urgent problem to be solved. In recent years, scholars have proposed various sustainable development strategies by comparing the experiences of different countries, but there have been few systematic studies evaluating the applicability and effectiveness of these strategies in resource-based cities in China. Therefore, this study aims to fill this gap by analyzing the unique situation of resource-based cities in China in depth and proposing specific policy recommendations.

This article focuses on the strategic choices and policy effects of resource-based cities in China's economic growth transformation. Through the use of system dynamics models and sustainable development evaluation systems, combined with quantitative data analysis and qualitative case studies, this study delves into the economic, social, and environmental benefits of different transformation strategies. The study first analyzes the main economic and environmental issues faced by resource-based cities, and then explores how to promote green development of these cities through policy adjustments, industrial upgrading, and technological innovation. The research findings of this article not only provide decision support for policy makers in resource-based cities, but also provide new theoretical and empirical data for academic research in related fields.

The structure of this article is as follows: firstly, the theoretical basis and practical cases of the transformation of economic growth models in resource-based cities in China and globally are reviewed, and the shortcomings of existing research are analyzed. Secondly, the methodological framework and data sources used in this study are detailed, and the rationality and scientificity of the research design are elaborated. Finally, the hypotheses proposed are verified through empirical analysis; the research results are summarized; specific suggestions are proposed for the sustainable development path of resource-based cities. The entire research not only focuses on theoretical innovation, but also strives to solve practical problems, hoping to provide reference and inspiration for the sustainable development strategies of resource-based cities in China and the world.

2. Related Work

It is crucial to study the transformation of China's resource-based urban economic growth model and its sustainability. These cities have long relied on a single resource economy, facing resource depletion and environmental pressure, and urgently need to find new development paths. Liu Huiqun studied whether outward foreign direct investment has promoted the transformation of China's economic growth mode, and explored this issue through empirical analysis using generalized moment estimation [1]. Pu Xiaoye studied how artificial intelligence empowers the driving force of China's economy to achieve high-quality development [2]. Qiu Zhijian analyzed the macroeconomic situation and development strategies in China under the new normal [3]. Fang Yingfeng analyzed the heterogeneity and driving mechanisms of economic development disparities in Chinese counties [4]. Xu Yonghong evaluated the contribution of hierarchical human capital to China's economic growth [5]. However, previous research has mostly focused on the impact of macroeconomic policies, with less attention paid to the implementation details at the local level and the specific improvement of residents' quality of life, which has limited the targeted and practical nature of policy recommendations.

Economic transformation has profound significance for achieving long-term development and environmental sustainability of resource-based cities. Chen Zhi explored whether artificial intelligence can help solve the structural slowdown of China's economic growth [6]. Zhong Min studied the relationship between the digital economy and export growth, and analyzed it based on data from Chinese cities and customs [7]. Zhao Yabo analyzed the impact of population aging on China's economic growth [8]. Wang Yaozhong studied the impact of China's pilot free trade zones on regional economic growth [9]. Ming Y studied the growth trend of the Chinese economy and

believed that the forecast for GDP growth rate in the 2023 government work report was about 5%, which was relatively realistic [10]. The current research provides a basic framework and theoretical guidance, but there is still a lack of in-depth analysis of the adaptability and effectiveness of transformation strategies under different economic and social backgrounds. Especially in terms of specific industrial transformation and technological innovation, there is a lack of empirical research from a local perspective, which is a key factor in ensuring the successful implementation of policies.

3. Methods

3.1 Framework Construction and Data Collection

In this study, the primary task is to construct an empirical analysis framework to evaluate the efficiency and sustainability of the transformation of China's resource-based urban economic growth model. A system dynamics model is adopted, combined with field investigations and economic statistical data for analysis. This model can simulate the long-term impact of economic policy changes on the economy, environment, and social structure of resource-based cities.

Data collection and preprocessing: data collection covers macroeconomic data, resource consumption records, and environmental monitoring data obtained from the National Bureau of Statistics, local governments, and relevant departments. In addition, questionnaire data from local enterprises and residents are collected through field investigations, which help to understand the actual impact of local policies and the living conditions of local residents. Data preprocessing includes data cleaning, missing value handling, and outlier analysis to ensure the accuracy and reliability of subsequent analysis.

Construction of system dynamics model: the Vensim software is used to build a model, simulating the economic system of resource-based cities by defining different variables (such as investment, employment rate, resource consumption rate, etc.) and their interrelationships (such as positive and negative feedback). The model includes policy intervention modules, such as tax incentives, technology investment, and environmental regulations, to observe the driving effect of these policy changes on economic model transformation.

Cobb-Douglas production function: this model is widely used in economics to describe the relationship between output and inputs (such as labor and capital). Its general form is:

$$Y = AK^{\alpha}L^{1-\alpha} \tag{1}$$

Among them, Y represents the total output; K is the capital stock; L is the quantity of labor force; α is the output elasticity of capital; A is the technical efficiency factor.

3.2 Economic Structure Adjustment Strategies

The economic transformation of resource-based cities not only requires policy promotion, but also specific and actionable strategies to implement. The specific impact of industrial upgrading and economic diversification strategies on the transformation of economic growth patterns is analyzed.

The implementation plan for industrial upgrading: the transformation path from traditional resource-based industries to technology intensive industries is carefully planned, including promoting clean technologies, optimizing resource utilization efficiency, and developing circular economy [11]. To achieve this goal, successful industrial upgrading cases are studied and adjusted according to local conditions. Through cooperation between the government and the private sector, the research and technological innovation are promoted, and reliance on traditional resources is reduced.

Economic diversification strategy: specific implementation plans are formulated for a diversified economic system, including the development of non resource dependent industries such as service industry, tourism industry, and high-tech industry. The strategy includes specific measures such as financial support, talent training, and market development for these emerging industries, as well as establishing a sound enterprise incubation and innovation support system to promote the improvement of the industrial chain and the localization of technology.

Solow growth model: this model is a classic model for studying long-term economic growth, emphasizing the impact of capital accumulation, population growth, and technological progress on economic growth. The core equation is:

$$\Delta k = sf(k) - (\delta + n)k \tag{2}$$

Among them, Δk is the rate of change of per capita capital; s is the savings rate; $f(k)$ is the marginal output of capital; δ is the depreciation rate; n is the population growth rate.

3.3 Application of Sustainable Development Evaluation System

A comprehensive evaluation system is needed to evaluate the sustainability of the transformation of the economic growth model in resource-based cities. A sustainability evaluation index system is developed that includes three dimensions: economic, social, and environmental.

Economic sustainability assessment: it mainly considers indicators such as the stability of economic growth, the improvement of employment rate, and the growth of household income. By establishing an economic forecasting model, the impact of different economic policies and market changes on economic stability is evaluated.

Social sustainability assessment: by evaluating from the aspects of education, health, social justice, and the quality of life of residents, how social policies during economic transformation can help improve living conditions and enhance social welfare for residents is analyzed.

Environmental sustainability assessment: it focuses on evaluating resource consumption efficiency, environmental pollution control, and ecosystem protection. By using an environmental impact assessment model, the impact of economic activities on natural resources and the ecological environment is monitored, and the implementation effectiveness of environmental protection policies is evaluated.

Through the above methods, this study not only provides transformation strategies for the economic growth model of resource-based cities, but also establishes a scientific evaluation system to monitor and guide this transformation process, ensuring that sustainable development goals for society and the environment are achieved while economic development.

Environmental Kuznets Curve Model: this model describes the nonlinear relationship between environmental pollution level and economic development level, usually manifested as an inverted U-shaped curve. Mathematically, this can be represented by a quadratic equation:

$$E = aI^2 + bI + c \tag{3}$$

Among them, E is the level of environmental pollution; I is per capita income; a, b and c are parameters, where $a < 0$ to ensure that the curve is inverted U-shaped.

Resource depletion model: for the sustainability research of resource-based cities, it is necessary to consider the impact of resource depletion on the economy. A simplified model can be represented as:

$$\frac{dR}{dt} = -\gamma R(t) \tag{4}$$

This is a fundamental differential equation for resource depletion. Among them, $R(t)$ is the

amount of resources at time t, and γ is the rate of resource depletion.

4. Results and Discussion

4.1 Experimental Setup

(1) Experimental environment settings

The experimental environment is mainly based on several typical resource-based cities in Northeast and Northwest China. These cities have a rich history of natural resources and a background of ongoing economic restructuring. Each experiment is conducted in actual economic, social, and environmental contexts to ensure the practicality and relevance of the results.

(2) Experimental parameter settings

The experimental parameters include:

Economic growth rate: measuring the overall growth of economic activity.

Employment rate changes: reflecting the impact of economic transformation on the job market.

Resource consumption rate: examining whether resource efficiency has been improved.

Changes in environmental indicators: including air quality and water quality, evaluate changes in environmental conditions.

Resident quality of life: measured by changes in resident income, education, and health status.

Policy acceptance: conducting a survey to understand the acceptance and satisfaction of local residents and enterprises with the transformation policy.

4.2 Experimental Results

(1) Industrial upgrading effect

The effect of industrial upgrading is shown in Table 1.

Table 1: Effect of industrial upgrading

Year	Economic growth rate (%)	Change in employment rate (percentage points)
2020	5.0	0.2
2021	5.5	0.5
2022	6.0	0.8
2023	6.5	1.0
2024	7.0	1.2
2025	7.5	1.5
2026	8.0	1.8
2027	8.5	2.0
2028	9.0	2.2
2029	9.5	2.5

From the perspective of economic growth rate, it has steadily increased from 5.0% in 2020 to 9.5% in 2029, which clearly reflects the effectiveness of policy guidance in transferring funds and technology to high-tech industries. The high-tech industry has the characteristics of high added value and innovation driven, which can bring faster economic growth and gradually replace reliance on traditional resource industries.

At the same time, the change in employment rate also shows a steady upward trend. From 0.2 percentage points in 2020 to 2.5 percentage points in 2029, this indicates that with the advancement of industrial upgrading, emerging industries continue to emerge, providing more employment opportunities for society. This growth in employment rate has a positive significance in improving

the living standards of residents and promoting social stability.

To sum up, this industrial upgrading strategy has achieved remarkable results in a resource-based city in China by guiding the transfer of capital and technology to high-tech industries and reducing dependence on traditional resource industries. The promotion of economic growth rate and the increase of employment rate have fully proved the importance of industrial upgrading for urban economic development. This trend is of great significance for promoting the sustainable development of urban economy.

(2) Implementation of environmental protection policies

The implementation results of environmental protection policies are shown in Table 2.

Table 2: Implementation Results of environmental protection policy

Year	The proportion of decrease in resource consumption rate (%)	Annual decrease in PM2.5 concentration (micrograms/cubic meter)	Improvement in water quality index (percentage points)
2020	2.0	5.0	1.0
2021	3.5	8.0	1.5
2022	5.0	10.0	2.0
2023	6.5	12.0	2.5
2024	8.0	15.0	3.0
2025	9.5	18.0	3.5
2026	11.0	20.0	4.0
2027	12.5	22.0	4.5
2028	14.0	25.0	5.0
2029	15.5	28.0	5.5

First of all, from the perspective of the decline ratio of resource consumption rate, it increases from 2.0% in 2020 to 15.5% in 2029 year by year, which shows that the environmental protection policy effectively limits the excessive consumption of resources and urges enterprises and all sectors of society to pay more attention to the conservation and rational utilization of resources.

Secondly, the average annual concentration of PM2.5 (particulate matter2.5) has also shown an increasing trend year by year, from 5.0 μ g/m3 in 2020 to 28.0 μ g/m3 in 2029, which directly reflects the significant improvement of air quality. This improvement is not only beneficial to the health of residents, but also improves the overall environmental quality of the city.

Finally, the data on the improvement of water quality index also shows the same trend, increasing from 1.0 percentage points in 2020 to 5.5 percentage points in 2029, which means that water quality has been effectively improved and the water environment has been improved.

Overall, these positive changes fully demonstrate the effectiveness of environmental policies in resource-based cities. By implementing strict environmental policies, resource consumption can be effectively reduced; air quality and water quality can be improved; better conditions can be created for the sustainable development of cities. This trend is of great significance for improving the quality of life of residents and promoting green development of urban economy.

(3) Social policy impact

The results of exploring the impact of social policies are shown in Table 3.

From the perspective of the resident quality of life index, the score has increased year by year from 70 in 2020 to 97 in 2029, indicating that with the improvement of public service quality, residents have made significant improvements in daily life, education, healthcare, and other aspects, and their quality of life has been significantly improved.

At the same time, the policy acceptance (satisfaction percentage) has also shown a steady

upward trend, increasing from 65% in 2020 to 99% in 2029, indicating that residents have a positive attitude towards the government's policies to improve the quality of public services and believe that these policies have effectively improved their lives.

Table 3: Results of exploring the impact of social policies

Year	Resident quality of life index (out of 100)	Policy acceptance (percentage of satisfaction)
2020	70	65
2021	73	70
2022	76	75
2023	79	80
2024	82	85
2025	85	90
2026	88	93
2027	91	95
2028	94	97
2029	97	99

The emergence of this trend indicates that by improving the quality of public services, the government not only effectively enhances the quality of life of residents, but also enhances their sense of identification and satisfaction with policies. This virtuous cycle helps to enhance social cohesion and stability, laying a solid foundation for the sustainable development of cities.

In summary, social policies aimed at improving the quality of public services can effectively enhance the quality of life and policy acceptance of residents, which is of great significance for the economic growth and social stability of resource-based cities.

(4) Comprehensive economic diversification

The results of the comprehensive economic diversification test are shown in Figure 1.

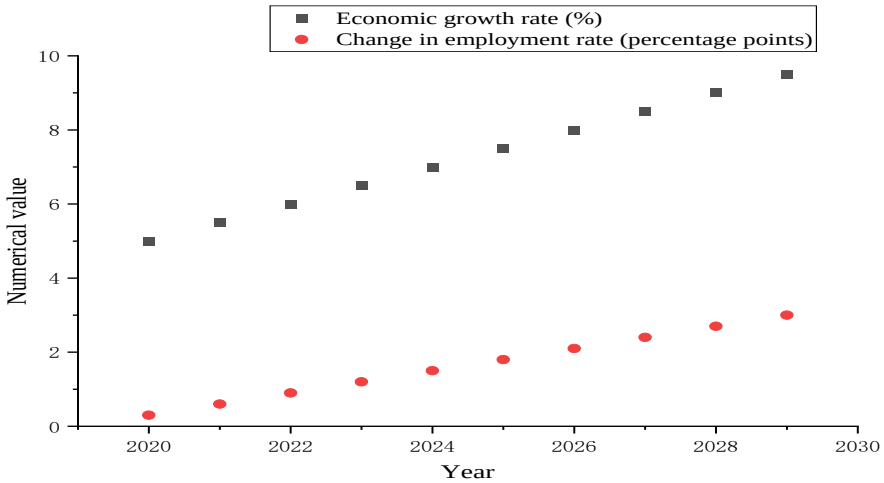

Figure 1: Comprehensive economic diversification test results

From the perspective of economic growth rate, it has steadily increased from 5.0% in 2020 to 9.5% in 2029, indicating a strong trend in the city's economic development. The implementation of comprehensive economic diversification has led to the development of multiple non resource dependent industries, injecting new vitality into the urban economy and promoting rapid growth of the overall economy.

At the same time, the change in employment rate also shows a steady upward trend. The growth

from 0.3 percentage points in 2020 to 3.0 percentage points in 2029 demonstrates the significant effect of comprehensive economic diversification strategies in promoting employment. With the rise of non resource dependent industries, these industries not only create a large number of employment opportunities, but also attract more talent inflows, further promoting the prosperity of urban economy.

In summary, the comprehensive economic diversification strategy has achieved significant results in this resource-based city. By simultaneously promoting the development of multiple non resource dependent industries, the city has not only achieved rapid economic growth but also effectively promoted an increase in employment rates. This development approach is of great significance for enhancing urban competitiveness, promoting social stability and sustainable development.

(5) Technological innovation promotion

The results of technological innovation promotion are shown in Figure 2.

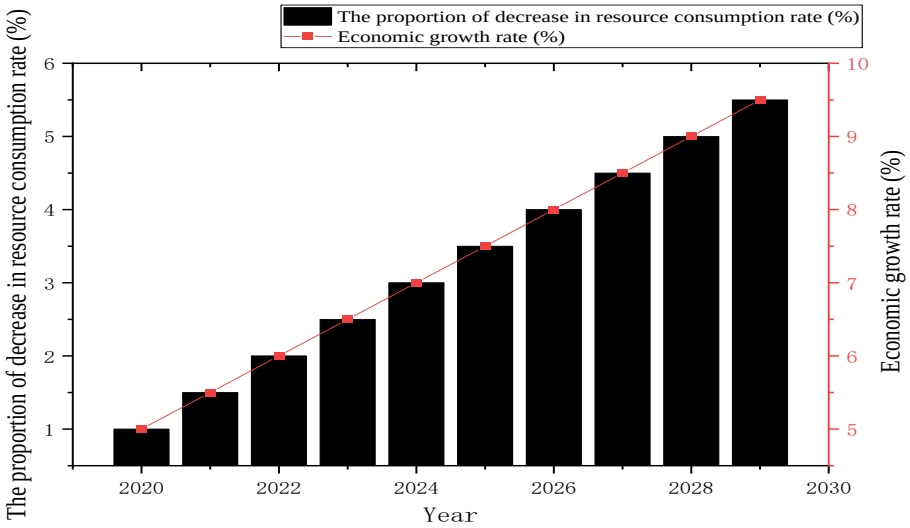

Figure 2: Results of technological innovation promotion

Judging from the decreasing proportion of resource consumption rate, it increases from 1.0% in 2020 to 5.5% in 2029, which shows that technological innovation has been effectively promoted and applied in this city. The adoption of new technology not only improves the efficiency of resource utilization and reduces waste, but also promotes the transformation and upgrading of production mode, so that the resource consumption rate can be significantly reduced.

At the same time, the improvement of economic growth rate also verifies the effectiveness of the promotion strategy of technological innovation. From 5.0% in 2020 to 9.5% in 2029, this growth trend shows that technological innovation has a strong driving force for economic growth. Through technological innovation, enterprises can develop more competitive products and services, expand markets and increase output value, thus promoting the rapid growth of the overall economy.

By investing heavily in research and development and promoting technological innovation and application, the city not only achieves a decline in resource consumption rate, but also promotes rapid economic growth. This mode of development is of great significance for enhancing the competitiveness of cities and realizing sustainable development.

(6) Residents' participation and feedback

The results of residents' participation and feedback are shown in Figure 3.

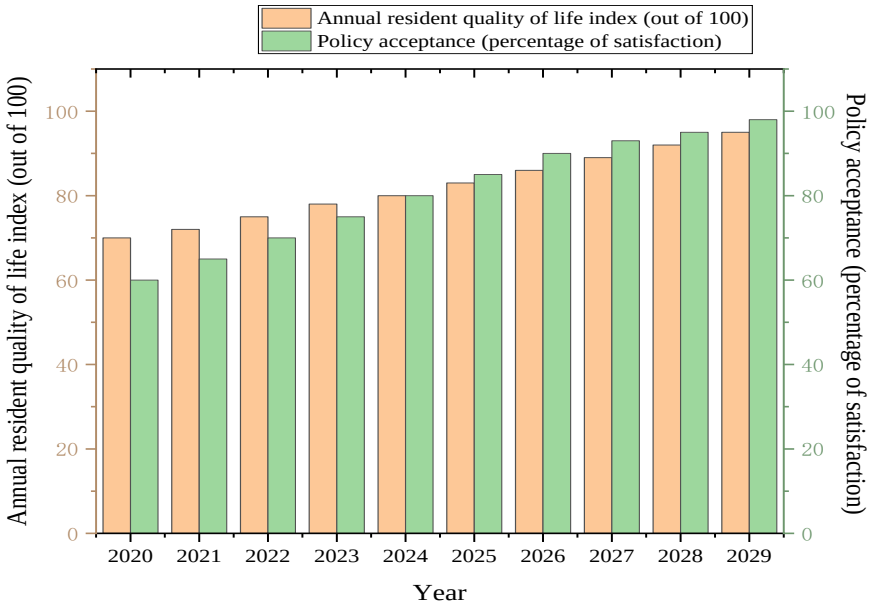

Figure 3: Residents' participation and feedback results

In terms of residents' quality of life index, from 70 points in 2020 to 95 points in 2029, it shows that residents' quality of life has improved significantly. This may be because residents' extensive participation and feedback have enabled the government to grasp residents' needs and concerns more accurately, and then formulate policies that are more conducive to residents' rights and interests.

The improvement of policy acceptance further proves that the participation and feedback behavior of community residents is effective. The degree of public satisfaction has increased from 60% in 2020 to 98% in 2029, reflecting the public's recognition and support for the government. A high degree of public recognition of the policy not only enables the policy to be implemented smoothly, but also enhances people's trust in the government and promote social harmony and stability.

Overall, the residents' participation and feedback in this resource-based city is very effective. By widely listening to the opinions of residents, the government can better understand the needs and expectations of residents, and then formulate favorable policies for them. On this basis, a new community governance model is proposed.

5. Conclusions

China's resource-based cities are facing the dual pressures of world economy and environment, and the transformation of their development mode and sustainable development. On this basis, combined with multi-scenario simulation, this article evaluated the sustainable development strategy of resource-based cities in China from three aspects: industrial upgrading, environmental protection and social policy, with a view to providing experience support and policy suggestions for the sustainable development of resource-based cities in China. This article held that the core element of resource-based cities to achieve sustainable development is the optimization of industrial structure. Empirical research showed that using high-tech means to improve the efficiency of resource use can greatly improve the quality and efficiency of economic activities. At the same time, the implementation of strict environmental protection policies also plays a significant role in improving the ecological environment and reducing pollutant emissions. Improving social policies such as education and health can also improve people's quality of life and overall welfare.

The limitations of this study mainly lie in data collection and the applicability of the model. Incomplete data acquisition in some regions may affect the accuracy and generalization ability of the model. In addition, although system dynamics models can simulate policy effects, the parameter settings and initial condition selection of the model may have an impact on the results, which needs to be further refined and validated in future research. Future research should expand the sources of data, including more detailed economic, social, and environmental data of resource-based cities, in order to improve the breadth and depth of research. At the same time, research should further explore customized transformation strategies that adapt to different regional characteristics, especially in terms of technological application and policy innovation. In addition, considering the impact of global climate change and economic integration, future research should also focus on the impact of external environmental changes on the transformation of resource-based cities, as well as how to implement effective localization strategies in a broader international context.

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