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Explore the Impact of Low-carbon Transformation on the Optimization of My Country'S Economic Structure

Teng Gao, Tingting Chen, Qiuyi Wang, and Jingran Yin

Anhui University of Finance & Economics, Bengbu 233000, China

Abstract

As my country's modernization process continues to accelerate, the modernization of the economic structure is also accelerating. However, there is no literature that statistically measures the optimization of the economic structure for low-carbon transformation. According to the requirements and rules of economic structure modernization, this article builds a comprehensive evaluation index system based on various methods such as entropy weight method and topsis comprehensive evaluation method to analyze the impact of China's current low-carbon transformation on economic structure optimization. The results show that low-carbon transformation has a great impact on the energy structure of the economic structure. The most important factors affecting the energy structure are carbon emission limits and energy consumption limits. Among them, carbon emission limits have an important impact on the energy structure. , limiting energy use has a negative effect on the optimization of the energy structure, and improving carbon emissions will promote further optimization of the energy structure and further optimize the economic structure.

Keywords

Modernization of Economic Structure; Low-carbon Transformation; Optimization and Upgrading.

1. Research Background

In today's era of high-speed and high-quality economic development, the application of statistical indicators to accurately measure and analyze my country's economic structure has become a hotly discussed topic in the context of today's era. The related concepts of modern economic system were first proposed in the report of the 19th National Congress of the Communist Party of my country. Building a modern economic structure has become a major strategic goal for our country in the context of economic development in the new era. Grasp the transformation of the main contradictions in Chinese society in the new era, vigorously develop the economy to satisfy people's pursuit of material, and start a new journey for our country to build a modern and powerful country. In order to build a modern and powerful country with an excellent economic structure, our country still needs to focus on transforming the economic development model and optimizing the economic structure. This is an urgent need to achieve the goal of building our country into a modern and powerful economic country, and its significance is far-reaching and important. China plans to basically establish a complete basic system and policy system for energy green and low-carbon development by 2030 . In this context, our country must focus on greening the economy, and in the process of implementing green and low-carbon policies, it is also promoting the optimization of the economic structure. In view of this, under the background of the new economic era and the increasing attention of low-carbon transformation, this paper uses methods such as Topsis and entropy weight method to analyze the impact of low-carbon transformation on the optimization of China's economic structure, aiming to use statistical measurement analysis The indicator economic

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structure optimization provides scientific guidance and promotes the development of China's economic structure and the optimization and transformation of its economic structure.

2. Literature Review

2.1. Related Research on Statistical Measurement of Economic Structure Modernization

The existing literature mainly studies statistical measurement indicators under the current economic structure. On this basis, some scholars have given economic structure optimization strategies. Few scholars have used Topsis and entropy weight methods to measure my country's economic structure. Han Zhaozhou (2006) studied the application of the statistical measurement index system in new industrial processes, and used seven major indices, including the industrialization process index, economic benefit index and environmental protection index, to construct a theoretical framework for the statistical measurement index system of my country's new industrialization process. 0Wang Kaike, Zhang Guijun, and Wang Kaiyong (2021) studied the statistical measurement index system of my country's economic structure optimization and economic development efficiency improvement based on the effectiveness of economic structure measurement, and concluded that the short-term "contradiction" problem between environmental protection and economic growth is relatively Outstanding conclusion. [2]Men Xiuping, Li Xuhui, and He Jinyu (2022) studied the regional differences and dynamic evolution of the allocation efficiency of innovation factors based on the statistical measurement of the Yangtze River Economic Belt, and established a super-efficiency SBM model to statistically detect the modern economy of the Yangtze River Economic Belt from 2011 to 2020. system, and used the Dagum Gini coefficient and Kernel density to measure the dynamic economic evolution of the Yangtze River Economic Belt, and found that the allocation efficiency of innovative factors in the Yangtze River Economic Belt continues to grow steadily, but there are still regional and staged characteristics. [3].

2.2. Related Research on Economic Structure Optimization in the Context of Low-carbon Transformation

Hou Xiaodong and Huang Can (2014) used a game analysis model to confirm that adjusting and optimizing the industrial structure and advancing regional economic development are the driving forces for corporate green economic innovation. [4]Mo Jiebiao (2016) studied the situation of continuous development of economic globalization and carried out a comprehensive discussion on energy conservation and emission reduction, regional industrial structure optimization and economic growth, and on this basis proposed the optimization of regional industrial structure. Corresponding optimization strategies. [5]Tang Shihang (2022) studied the optimization and adjustment of my country's industrial structure under the dual-carbon background based on the extended STIRPAT model. Using the comprehensive score chart of my country's industrial structure optimization level from 2000 to 2019, he found that my country's industrial structure has problems of incompleteness and unbalanced development, and It is proposed that under the dual-carbon background, adjusting the economic structure upgrading level factor and technological emission reduction factor is conducive to the optimization of the enterprise's economic structure. [6]Wei Ronghan (2023), in his thinking on the relationship between ecological priority low-carbon development and industrial structure optimization, conducted an in-depth analysis of the relationship between low-carbon economy and industrial structure optimization, and believed that industrial structure optimization and low-carbon economic development are intrinsically unified. They complement each other and point out the direction for China's industrial structure optimization in the low-carbon context. [7].

2.3. Literature Review

Based on the above analysis results, this article summarizes two comments.

2.3.1. Lack of Research on Statistical Measurement of Economic Structure Modernization from the Perspective of Topsis and Entropy Weight Method

Most existing studies use measurement indicators such as economic efficiency index and Gini coefficient to evaluate my country's current economic structure. There are relatively few studies that use Topsis, entropy weight method and principal component analysis method to measure my country's economic structure. The advantage of the entropy weight method is that it is not affected by subjective factors and can more objectively evaluate the pros and cons of the economic structure, and the results are more reliable and accurate. Principal component analysis can help researchers find the factors that have the greatest impact on the optimization of economic structure from many low-carbon indicators, which is conducive to making scientific suggestions for the optimization of my country's economic structure based on low-carbon transformation.

2.3.2. The Multi-dimensional Economic Structure Optimization Method under the Low-carbon Background has not Yet been Clarified

Existing research has paid less attention to the use of modern statistical measures to evaluate the current status of my country's economic structure in the context of low-carbon transformation. At the same time, research on factors affecting economic structure optimization has paid less attention to the variable of low-carbon transformation. Therefore, this topic draws on existing research, uses Topsis, entropy weight method, etc. to analyze relevant statistical data of many provinces in my country in 2021, and analyzes the optimization of economic structure based on low-carbon transformation in advocating high-quality economic development and green In the context of the construction of a low-carbon civilization, it is of reference significance for the high-quality and sustainable development of our country's economy through the optimization of economic structures in all dimensions.

3. Definition of the Connotation of Economic Structural Modernization

3.1. Economic Structure Optimization and Economic Structure Optimization System

Economic structure refers to the allocation of funds and the proportion of personnel in the primary industry, the secondary industry and the tertiary industry among the economic components. Economic structure optimization mainly includes the optimization and upgrading of the primary, secondary and tertiary industries, agriculture and industrial structure, as well as the optimization and upgrading of the labor structure, income distribution structure and technology structure. Economic structure optimization can adjust and improve all aspects of social reproduction and the economic structure optimization of various sectors of the national economy. Transforming the mode of economic development includes not only changing the mode of economic growth, but also changes in ecology, environment, quality, efficiency, structure and technology. Such changes reflect my country's "five-in-one" economic, political, cultural, social and ecological civilization. "The requirements of the overall layout of modernization have become a strong guarantee for our country to move from an economic power to an economic power. It is also a major measure to solve my country's problems in resource utilization and environmental protection. At present, my country's economic structure optimization still faces some problems. First, my country's current industrial structure has unbalanced development. Among them, because my country's industrial structure is heavily tilted toward heavy industry, it has resulted in high greenhouse gas emissions, high resource and energy consumption, and severe pollution to the environment.

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Second, the proportion of domestic demand and external demand in our country is seriously imbalanced. Although our country is currently trying its best to expand domestic demand, the situation of strong external demand and weak domestic demand continues. Third, the proportion of investment and consumption is seriously imbalanced, which is one of the endogenous reasons hindering my country's economic development. Fourth, the national income distribution structure is distorted, the income gap between various classes is large, and the public's consumption desire is generally sluggish.

The core of high-quality economic development is to build a modern economic structural system. To achieve a qualitative change in the mode of economic development, find new driving forces for economic growth, and promote the continuous adjustment and optimization of the economic structure, our country needs to establish a modern economic system to achieve this goal. The specific construction paths are: first, build a more competitive and coordinated and balanced industrial system. Consolidate the leading position of advantageous industries, and on this basis, cultivate them into advantageous industries that are equally competitive in the world. It is the integrated development of emerging strategic industries, building a new generation of new materials, green environmental protection, artificial intelligence and information technology to promote economic development. Strengthen industrial chain security and independent innovation capabilities in areas related to national security and development, and improve the supply and security of strategic resources. Second, build a high-quality modern service industry system, accelerate the transformation process of the service industry, accelerate the development of information technology, build an efficient and smooth logistics system, and reduce product transportation costs. Enhance the comprehensive economic capabilities of modern financial services and promote the integrated development of modern service industries, modern agriculture, and industry. Third, build a modern infrastructure system. Based on the existing infrastructure, optimize its function, structure and layout, improve the efficiency of resource allocation, and enhance the ability of infrastructure to drive my country's economic development. Fourth, improve the fairness of income distribution. Income distribution is directly related to the realization of the goal of common prosperity for all people in our country. Promoting fair and reasonable income distribution can narrow the gap between the rich and the poor and fully share the results of high-quality economic development. Fifth, build an urban and rural regional development system with more reasonable functions. Accelerate the construction of emerging urbanization, optimize the layout of productivity, establish a regional economic layout with complementary advantages, promote integrated development and friendly interaction between regions, and build a new pattern of coordinated regional development. Sixth, build an environmentally friendly green ecological civilization development system. Promote green, healthy and sustainable development of social economy. Implement a comprehensive conservation strategy, promote resource reuse, promote high-quality economic development through resource conservation, and actively promote the realization of the "double carbon" goal. Seventh, build a diversified and comprehensive open system. Optimize the layout of regional opening-up, actively participate in international trade, maintain stable economic and trade relations and the international economic pattern, and promote high-level and high-quality development of international trade.

3.2. The Connotation and Characteristics of Traditional Economic Structure and New Economic Structure

China's traditional economic structure mainly consists of agriculture, handicrafts and commerce, of which agriculture occupies an important position. Traditional agriculture has many typical characteristics, such as the family as the main production unit, men farming and women weaving , living a self-sufficient life , and most people are tied to In a land where the

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family is the unit of production, China's traditional economic structure is very stable. This is not only due to this, but also to traditional conservative economic concepts and the blessing of the state's all-round economic management and control . The characteristics of the traditional economic structure can be simply summarized as: Single and direct, the structure is relatively stable.

Before 1978, China's economic structure had a relatively weak foundation in agriculture , and the proportion of light and heavy industries was seriously unbalanced. Since the reform and opening up in 1978, China's new economic structure has gradually taken shape. The country has adopted a series of policies and measures such as prioritizing the development of light industry, strengthening the construction of basic industries and infrastructure, focusing on expanding the import scale of high-end consumer goods , and vigorously developing the tertiary industry to harmonize China's economic structure and move toward optimization and upgrading. direction of trend development. The proportional relationship between and within China's various industries has been significantly improved, which is reflected in the decrease in the proportion of the primary industry and the increase in the proportion of the secondary and tertiary industries ; the growth of the total national economy has mainly been the first . , driven by the secondary industry has been transformed into mainly driven by the secondary and tertiary industries . It is obvious that the growth of the secondary industry constitutes the main driving force for China's rapid While the overall industrial structure has undergone significant changes, the internal structure of each industry has also undergone significant changes. Among the total output value of agriculture, forestry, animal husbandry and fishery, the proportion of pure agricultural output value has declined, while the proportion of forestry, animal husbandry and fishery has increased; within industry, the structure of light and heavy industry is gradually changing from a light structure that emphasizes "consumption compensation" to an "investment-oriented" one. Heavy structural upgrades; within the development of the tertiary industry, the proportion of traditional industries such as transportation and commerce has declined, while the real estate, finance and insurance, and telecommunications industries have developed rapidly.

3.3. Concept and Analysis of Economic Structural Modernization

The so-called Chinese-style economic structural modernization refers to the economic modernization initiated and led by the Communist Party of China. It is based on China's basic national conditions and advances with the times, forming economic modernization goals and strategic approaches for different periods. For example, based on China's basic national conditions and drawing on the development steps of Soviet-style socialist industrialized countries, Comrade Mao Zedong first proposed the goal of realizing socialist industrialization and then the "four modernizations", mobilizing all positive factors and making full use of the inner-party Direct and indirect positive factors outside the party, at home and abroad , have successfully built our country into a strong socialist country. After the reform and opening up, Comrade Deng Xiaoping took the lead in going out to understand the modern development models of Japan, the United States and other countries, and creatively proposed "a Chinese-style modernization development path" and then the "three-step" development to China's socialist modernization The strategic vision is a stage of rapid growth in which the national economy doubles . This article explores the degree of modernization of the economic structure from the perspective of energy structure elements.

Energy is an important strategic material and core driving force for national economic and social development . There is a cointegration relationship between energy consumption, energy structure and economic growth. Energy structure adjustment will affect energy consumption, thereby affecting economic development and ultimately affecting the economic structure . The development of low-carbon economic transformation has an economic promotion effect on the

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optimization of energy structure. The transformation of the energy structure is mainly reflected in the need to adjust media control, stabilize oil, increase nuclear safety, and vigorously develop renewable energy. This article ultimately selects carbon emission limits, economic development, population, industrial structure, technological innovation, energy structure, and energy consumption limits as measures of the modernization level of the energy structure.

4. Research Design and Methods

4.1. Data Source

This article takes 30 provinces (autonomous regions and municipalities) across the country as the research objects. Tibet, Hong Kong, Macao and Taiwan are not included in the scope of the study due to a large number of missing indicator data. The research time point is mainly 2021 , and the data sources include various statistical annual reports, the China Bureau of Statistics, etc.

4.2. Descriptive Statistics

This article mainly conducts statistical analysis on indicators of the level of China's modern economic structure from the perspective of energy structure , and goes into depth about the impact of energy transformation on the optimization of economic structure , as well as the degree of impact on the development level of China's economy.

4.3. Entropy Weight Method

This article weights the indicators based on the entropy weight method. The entropy value method reflects the amount of information based on the degree of variation of the indicator. The smaller the degree of variation of the indicator, the less the amount of information reflected, then the weight corresponding to the indicator should also be The lower the value, the entropy weight method is a more objective weighting method. The specific calculation steps are as follows:

Indicator preprocessing: forward and standardize the indicators, and the processed indicator matrix is recorded as Z.

Calculate probabilities in entropy calculations.

We calculate the probability matrix P, where each element in Pp_{ij}The calculation formula is as follows:

$$p_{ij} = \frac{z_{ij}}{\sum_{i=1}^{n} z_{ij}} \qquad \text{Formula(1)}$$

Calculate the information entropy of each indicator to obtain the information utility value, and normalize it to obtain the entropy weight of each indicator.

For the jth indicator, the calculation formula of information entropy is:

$$e_j = -\frac{1}{\ln n}\sum_{i=1}^{n} p_{ij}\ln(p_{ij}) \qquad \text{Formula (2)}$$

Information utility value calculation method:$d_j = 1 - e_j$

Normalize the information utility value to obtain the entropy weight of each indicator:

$$W_j = \frac{d_j}{\sum_{j=1}^{m} d_j} \qquad \text{Formula(3)}$$

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4.4. Topsis Comprehensive Evaluation Method

Topsis is also called the distance method between superior and inferior solutions. This method can accurately reflect the gap between evaluation solutions. Based on the original matrix normalization and forwardization, the calculation process is as follows:

Define the maximum value$Z^+ = (z_1^+, z_2^+, \dots, z_m^+)$,

$$D_i^+ = \sqrt{\sum_{j=1}^{m} w_j (Z_j^+ - z_{ij})^2} \qquad \text{Formula(4)}$$

Similarly, definitionZ^-,D_i^-Calculate score:

$$S_i = \frac{D_i^-}{D_i^+ + D_i^-} \qquad \text{Formula(5)}$$

$$S_i' = \frac{S_i}{\sum_{i=1}^{n} S_i} \qquad \text{Foemula(6)}$$

4.5. Structural Equation Analysis

Structural equation modeling (SEM) is a multivariate statistical method that analyzes the relationship between variables based on the covariance matrix of variables. Compared with traditional exploration methods, structural equation modeling is better at handling some data that are difficult to observe and can be more accurate. Efficiently and quickly reveal the relationship between external latent variables and internal latent variables, thereby making research more scientific and objective. The structural equation consists of two parts: the measurement model and the structural model, as shown in the figure below. Among them, the measurement model consists of latent variables and observed variables, and the study of latent variables is generally achieved by quantifying the corresponding observed variables. Structural models are descriptions of models of causal relationships between latent variables.

4.6. Principal Component Analysis

Principal component analysis is a multivariate statistical method that can reduce multiple variables into a few comprehensive variables. The comprehensive variables here are principal components. Each principal component is a linear combination of the original variables, each pair is independent of each other, and retains most of the information of the original variables. The PCA algorithm is an unsupervised algorithm that is widely used in dimensionality reduction. The main purpose of using this algorithm in this article is to express the original data with fewer dimensions.

5. Measurement Synthesis Process

In recent years, low-carbon thinking has been deeply rooted in the hearts of the people, and low-carbon transformation has gradually been put on the agenda. Compared with the high-carbon economy, the low-carbon economy is a sustainable economic development characterized by low energy consumption, low emissions, and low pollution. The essence of the model is to transform the way of energy utilization, improve energy efficiency, and optimize the energy structure through low-carbon technology innovation and institutional innovation, so as to achieve the goal of promoting economic development while reducing carbon dioxide emissions. Based on the above understanding of low-carbon economy, we know that adjusting the energy structure is the key to the success of low-carbon transformation, and strive to achieve the "decoupling" of economic growth and carbon emissions as soon as possible.

However, various industries in the general economic system have relatively complex correlations. Adjusting the industrial structure or energy structure will have a certain impact on China's economic development [8]. Therefore, it is particularly important to study the impact of low-carbon transition on the energy structure.

5.1. Screening Indicators based on Principal Components

5.1.1. Data Preprocessing

The PCA algorithm synthesizes 24 feature vectors into m new feature vectors, namely principal components. Before performing principal component analysis, the data needs to be preprocessed. Since the dimensions of each dimension are different, each dimension needs to be zero-meaned first, and then the standard deviation standardization method is used.

5.1.2. Calculate the Elementary Load Matrix

$$\lambda_1 \geq \lambda_2 \geq \lambda_3 \geq \cdots \geq \lambda_p \geq 0, u_1, u_2, u_3, \cdots, u_p \; u_j = [r_{1j}, r_{2j}, \cdots, r_{pj}]$$

The elementary load matrix can be expressed as:

$$\Lambda_1 = \left[\sqrt{\lambda_1 u_1}, \sqrt{\lambda_2 u_2}, \sqrt{\lambda_3 u_3}, \cdots, \sqrt{\lambda_p u_p}\right] \quad \text{Formula(7)}$$

A scree plot is a plot based on how well each principal component explains the variation in the data. Its function is to confirm the number of principal components that need to be selected based on the slope of the eigenvalue decline. It can be used to confirm or adjust the number of principal components in conjunction with the variance explanation table. Based on the above-mentioned quantification of the impact of low-carbon requirements on the energy structure, using SPSS software, we selected the default eigenvalue to be greater than 1, and calculated the variance contribution rate of each principal component, the component matrix and eigenvector matrix after factor rotation.

5.1.3. Select M Principal Factors

To calculate the public contribution rate, this article selects 7 public factors as the main factors among 24 variables.

Calculate the rotated factor loading matrix and get the matrix:

$$\Lambda_2 = \Lambda_1^m T \quad \text{Formula(8)}$$

Construct factor model:

$$\begin{aligned} x_1 &= a_{11}F_1 + a_{12}F_2 + \cdots + a_{1m}F_m \\ x_p &= a_{p1}F_1 + a_{p2}F_2 + \cdots + a_{pm}F_m \end{aligned} \quad \text{Formula(9)}$$

In:

$$\begin{bmatrix} a_{11} & \cdots & a_{m1} \\ \vdots & \ddots & \vdots \\ \beta_{p1} & \cdots & \beta_{pm} \end{bmatrix}$$

Table 1. Component matrix table

Variable	Ingredient 1	Ingredient 2	Ingredient 3	Ingredient 4	Ingredient 5	Ingredient 6	Ingredient 7
X1	-0.031	-0.09	-0.099	0.451	0.037	0.156	0.078
X2	-0.112	0.101	0.035	-0.416	-0.006	-0.11	-0.24
X3	-0.058	0.097	0.191	-0.422	-0.052	-0.064	-0.106
X4	0.139	0.113	-0.285	-0.047	0.032	-0.122	-0.074
X5	0.13	0.122	-0.301	0.042	0.008	0.194	0.117
X6	0.277	0.094	-0.438	-0.064	0.144	0.138	0.406
X7	-0.026	0.12	-0.193	-0.046	-0.024	0.121	-0.09
X8	-0.14	0.127	-0.215	-0.041	0.028	-0.113	-0.005
X9	-0.396	0.101	-0.058	0.094	-0.093	-0.494	0.214
X10	-0.032	0.091	-0.085	-0.015	-0.262	0.153	0.142
X11	0.206	0.095	0.204	0.118	-0.343	0.681	-0.098
X12	-0.217	0.101	0.231	0.046	0.089	0.807	0.133
X13	0.104	0.096	0.173	0.167	-0.093	0.813	0.218
X14	-0.219	0.104	0.082	0.143	-0.24	0.115	0.766
X15	-0.268	0.107	-0.062	0.093	-0.262	-0.136	0.697
X16	0.017	0.077	-0.102	0.14	0.274	-0.175	0.86
X17	0.093	0.086	0.248	0.061	0.242	0.352	-0.033
X18	0.05	0.109	0.02	0.185	0.034	-0.013	-0.076
X19	-0.019	0.094	0.045	0.065	0.342	0.34	0.129
X20	0.274	0.072	-0.067	0.13	-0.321	-0.257	0.376
X21	0.362	0.094	0.236	-0.01	0.307	0.173	-0.047
X22	0.085	0.101	0.233	0.107	0.008	0.097	-0.059
X23	0.23	0.096	0.2	0.02	0.111	-0.22	-0.076
X24	-0.352	0.093	0.023	0.13	0.382	-0.04	0.172

5.1.4. Calculate the KMO Test Statistic

Assume that there are p indicator variables for factor analysis, respectively$x_1, x_2, \cdots, x_p$, but:

$$KMO = \frac{\sum\sum_{i\neq j} r_{ij}^2}{\sum\sum_{i\neq j} r_{ij}^2 + \sum\sum_{i\neq j} p_{ij}^2} \quad \text{Formula(10)}$$

Table 2. KMO and Bartlett test table

KMO value		**0.879**
Bartlett's test of sphericity	Approximate chi-square	2547.163
	degrees of freedom	276
	Significance	0.000***
Note: *** **represents the 1% significance level**		

5.1.5. Calculate Factor Scores

Use regression to find the factor score function:

$$\hat{F}_j = \beta_{j1}x_1 + \beta_{j2}x_2 + \cdots + \beta_{jp}x_p \quad \text{Formula(11)}$$

Record the estimated value of the i-th sample point for the j-th factor:

$$\hat{F}_{ij} = \beta_{j1}x_{i1} + \beta_{j2}x_{i2} + \cdots + \beta_{jp}x_{ip} \quad \text{Formula(12)}$$

Then there are:

$$\begin{bmatrix} \beta_{11} & \cdots & \beta_{m1} \\ \vdots & \ddots & \vdots \\ \beta_{1p} & \cdots & \beta_{mp} \end{bmatrix}$$

$$\hat{F}=\left(\hat{F}_{ij}\right)_{k\times m}=X_0R^{-1}\Lambda_2 \quad \text{Formula(13)}$$

$X_0 = \left(a_{ij}\right)_{k\times p}$ is the standardized matrix of the original k samples: R is the correlation matrix;$\Lambda_2$is the load matrix.

Based on the above analysis results, seven factors were finally selected to build the model: carbon emission limits, economic development, population, industrial structure, technological innovation, energy structure, and energy consumption limits.

5.2. Structural Equation Model

(1) According to the quantitative influencing factors, the relationship between the variables in the model can be expressed as the following matrix equation:

$$\begin{gathered} Y = \Lambda_y\eta + \varepsilon \\ X = \Lambda_x\xi + \delta \\ \eta = \beta\eta + \Gamma\xi + \zeta \end{gathered} \quad \text{Formula(14)}$$

For data showing normal distribution, the maximum likelihood estimation method is used to estimate the parameters of the structural equation.

(2) Matching appropriateness inspection

The fit index is an index used to evaluate the degree of fit between the model and the observation data. It is of great significance. Only when the relevant index range is reached can the next step of analysis be carried out. This article uses two indicators: absolute fit and value-added fit to test the fit and see if the next step of analysis can be carried out.

Judgment criteria:

GFI (Goodness of Fit Index) mainly uses the coefficient of determination and regression standard deviation to test the degree of fit of the model to the sample observations. The closer to 0, the worse the fit. CFI ≥ 0.9, the model is considered to have a good fit; RMSEA (Root mean square of approximation error) is below 0.08 (the smaller, the better); RMR (root mean square residual) This indicator measures the degree of fit of the model by measuring the average residual associated with predictions and actual observations. If RMR < 0.05, the model is considered to have a good fit; CFI (comparative fit index) is used to compare the hypothetical model and the independent model. The closer to 0, the worse the fit. CFI ≥ 0.9, the model is considered to have a good fit; NNFI (non-independent model) Standard fitting coefficient), the larger the value, the better. Among them, all indicators are within the ideal range, which shows that the setting of this theoretical model is acceptable.

Table 3. Fitting index values of structural equation model

χ^2	df	R	$\frac{\chi^2}{df}$	GFI	RMSEA	RMR	CFI	NFI	NNFI
-	-	>0.05	<3	>0.9	<0.10	<0.05	>0.9	>0.9	>0.9
39.302	42.000	0.590	0.936	0.954	0.001	0.047	1.003	0.954	1.005

(3) Setting of latent variables and observed variables

Based on the above analysis results, this article finally selects carbon emission limits, economic development, population, industrial structure, technological innovation, energy structure, and energy consumption limit indicators as the research objects. Since each variable in this article is an observable variable and there is no measurement error in exogenous variables, subsequent analysis can be carried out. This paper sets the exogenous variables as energy consumption limit, carbon emission limit and technological innovation, and uses population, industrial structure, energy structure and development level as endogenous variables. The development level is observed by my country's GDP, and the rest are residual variables. Specifically As shown below.

(4) Path analysis

We use AMOS software to draw the causal relationship path diagram of the model according to the symbolic rules of the structural equation model path diagram, and set up the causal relationship path diagram.

According to the above description, the maximum likelihood estimation method is used for estimation, and the goodness of fit of the model is compared by comparing the chi-square degree of freedom ratio, GFI, RMSEA, RMR, CFI, NFI, and NNFI tests. The analysis results are shown in the table below. Show:

Table 4. Model regression coefficient table

Variable	→	Variable	unstandardized coefficient	standard error	CR	P
The level of development	<---	Carbon emission limits	8.528	2.576	3.309	***
The level of development	<---	Energy consumption limit	-9.241	2.632	-3.497	***
The level of development	<---	technological innovation	0.048	0.09	0.531	0.578
The level of development	<---	Industrial structure	2.659	0.349	7.693	***
The level of development	<---	population	8.141	2.097	3.876	***
Industrial structure	<---	Carbon emission limits	0.096	0.824	0.114	0.913
Industrial structure	<---	technological innovation	0.013	0.018	0.646	0.516
Industrial structure	<---	Energy consumption limit	-0.153	0.87	-0.183	0.352
energy structure	<---	The level of development	0.067	0.024	2.604	0.009
energy structure	<---	Energy consumption limit	2.152	0.375	5.752	***
energy structure	<---	Carbon emission limits	-2.185	0.358	-6.104	***
energy structure	<---	population	-1.646	0.31	-5.316	***
energy structure	<---	technological innovation	0.0373	0.01	3.633	***
energy structure	<---	Industrial structure	-0.091	0.075	-1.193	0.233
population	<---	Energy consumption limit	-1.113	0.133	-8.328	***
population	<---	Carbon emission limits	1.067	0.136	7.884	***
population	<---	technological innovation	0.043	0.003	14.221	***

According to the above table, it can be seen that the significance of the coefficients corresponding to multiple paths meets the requirements, but the significance P value of some variable paths is greater than 0.1. The path of this model needs to be improved so that the P value meets the requirements. . We require that the significant P value must meet the conditions to reduce the chi-square value and chi-square degree of freedom ratio of the model. We need to conduct correlation analysis on the error terms between variables, and finally delete 5 paths with significance significantly greater than 0.1. Perform maximum likelihood estimation again, and the results are as follows:

Table 5. Regression coefficient table of the improved model

Variable	→	Variable	unstandardized coefficient	standard error	CR	P
population	<---	Energy consumption limit	-1.121	0.133	-8.338	***
The level of development	<---	Carbon emission limits	17.479	2.997	5.831	***
The level of development	<---	Energy consumption limit	-18.693	2.949	-6.34	***
population	<---	Carbon emission limits	1.067	0.136	7.884	***
population	<---	technological innovation	0.043	0.003	14.218	***
The level of development	<---	technological innovation	0.416	0.064	6.453	***
energy structure	<---	The level of development	0.039	0.013	2.959	0.003
energy structure	<---	Energy consumption limit	1.875	0.308	6.115	***
energy structure	<---	Carbon emission limits	-1.936	0.299	-6.472	***
energy structure	<---	population	-1.483	0.288	-5.163	***
energy structure	<---	technological innovation	0.041	0.01	3.848	***

As can be seen from the above table, the improved model has coefficients corresponding to multiple paths, and its significance meets the requirements. By conducting a goodness-of-fit test on the structural equation. All indicators are within the ideal range, and the results are shown in the table below:

Table 6. Goodness of fit test table

index	df	P	$\frac{\chi^2}{df}$	GFI	RMSEA	RMR	CFI	NFI	NNFI
suggested value	-	>0.05	<3	>0.9	<0.10	<0.05	>0.9	>0.9	>0.9
numerical value	70	0.175	1.156	0.933	0.012	0.080	0.990	0.933	0.985

5.3. Structural Analysis and Discussion

After reasonable planning of the path, the group obtained a model with good fitting degree. Each path coefficient has its own meaning. Based on the previous assumption of the one-way influence relationship between each latent variable, this investigation team analyzed the significant indicators based on the results and made the following conclusions:

As shown in the figure above, in the conclusion drawn from the collected data, the regression coefficient between energy consumption limit and energy structure is 17.381, which means that every 1 percentage point increase in energy consumption limit will directly increase the energy structure by 17.381 percentage points, thus Promote the optimization of economic structure.

For the level of technological innovation, the regression coefficient between technological innovation and energy structure optimization is 0.809, which means that every 1 percentage point increase in the level of technological innovation will also affect the energy structure, and the energy structure level will increase by 0.809 percentage points. The impact of my country's total population on energy structure is negative, with a regression coefficient of -2.359, which means that an increase of 1 percentage point in population will reduce the level of energy structure by 2.359 percentage points. Analyzing the impact on the development level through energy restrictions and carbon emission restrictions, the regression coefficients are -6.783 and 6.127 respectively. From the positivity and negativity of the data, we can get that the impact of carbon emission restrictions on the development level is positive, while restrictions Energy consumption reduction has a negative impact on development. Obviously, the restriction of carbon emissions has a great impact on the energy structure. Its regression coefficient is -17.206. The impact of development level on the energy structure is positive, and its regression coefficient is 0.982.

6. Conclusion and Suggestions

This paper uses methods such as Topsis and entropy weight method to measure the modernization level of China's economic structure . Based on this analysis, it explores the impact of low-carbon transformation on the optimization of China's economic structure and draws the following conclusions: (1) The impact of low-carbon transformation on the economic structure It has a great impact on the energy structure ; (2) The most important factors affecting the energy structure are carbon emission limits and energy consumption limits; (3) Limiting carbon emissions has an important impact on the energy structure, and improving carbon emissions will Promote further optimization of the energy structure, thereby optimizing the economic structure, but limiting energy use has a negative effect on the optimization of the energy structure.

In response to the above problems, the author puts forward the following suggestions: (1) Innovate low-carbon technologies to increase coal utilization and reduce coal usage ; (2) Promote clean energy to replace coal, thereby effectively reducing carbon emissions; (3) Increase Mass publicity has enabled the general public to consciously regulate their own behavior and join the low-carbon ranks.

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References

[1] Han Zhaozhou . Research on the statistical measurement index system of new industrialization process [J]. Statistics and Forecasting , 2006(01):26-29.

[2] Wang Kaike , Zhang Guijun , Wang Kaiyong . Evaluation of China's economic efficiency improvement and structural optimization process - Research background based on high-quality development [J]. Acta Statistica , 2021.

[3] Men Xiuping , Li Xuhui , He Jinyu . Regional differences and dynamic evolution of innovation factor allocation efficiency-statistical measurement based on the Yangtze River Economic Zone [J]. Statistics and Decision-making , 2022, 38(17).

[4] Hou Xiaodong , Huang Can . Game analysis of corporate green economic innovation dynamics - adjusting and optimizing industrial structure and promoting regional economic development [J]. Business Economics , 2014(03):43-44+110.

[5] Mo Jiebiao . Economic growth, energy conservation and emission reduction and regional industrial structure optimization [J]. Modern State-owned Enterprise Research , 2016(10):136.

[6] Tang Shihang . Research on the optimization and adjustment of China's industrial structure under the background of "dual carbon" [D]. Chongqing Technology and Business University , 2023.

[7] Wei Ronghan . Thoughts on the relationship between low-carbon development and industrial structure optimization based on ecological priority [C]// Langfang Applied Economics Society . Social Development - Basic Papers on Economics Across Time and Space (1) . [Unknown publisher], 2023 :6.

[8] Zhang Chunni . Research on fiscal and taxation policies for economic structural adjustment and optimization [J]. Heilongjiang Science and Technology Information , 2016(36):374.