The Empirical Analysis of China's Industrial Structure Optimization Based on Resources and Environment Constraints

Ning Guoyu
School of Economics and Management ,
Northwest University,229 Taibai N. Rd.Xi'an,
Shaanxi,China710069

Zhao Jingfeng
School of Economics and Management ,
Northwest University,229 Taibai N. Rd.Xi'an,
Shaanxi,China710069

Abstract—Chinese industrial structure optimization is currently facing increasingly severe resource and environmental constraints, especially in the face of economic volume is increasing, their consumption of resources and energy surge, coupled with the international resources market environment faced by influences such as political, economic and other factors and the international community for sustainable development, promote energy conservation and environmental protection, and promote the development of low-carbon economy has become increasingly intense Coupled with the world's renewable energy reserves dwindling interaction of multiple factors, so that the pressure resource consumption and ecological environment with the Japanese surge, economic development potential is clearly insufficient. Therefore, this article covered by building economic growth, resource conservation, pollution control planning model of the three objective function to energy conservation as a constraint on Chinese 2013-2015 data for analysis, especially in the gray forecasting method to 2015 emissions integrated forecasting, an attempt to optimize the industrial structure to achieve a breakthrough resource and environmental constraints to provide a reference to boost the development of the national economy to achieve stable and healthy development.

Keywords-Environment Constraints; Industrial Optimization; Model Design, Grey Prediction*;*Objective functions*；*Model

I. INTRODUCTION

Industrial structure is linked economic activities and ecological environment an important link, is closely related to the industrial structure and economic growth, resource use and environmental pollution. Therefore, the relationship between industrial structure optimization of the quality of economic growth and sustainability. In the process of economic growth, the limited nature of the growing demand and supply of natural resources, as well as contradictory limited carrying capacity and environmental pollutant emissions between growing increasingly acute. For example, China's current industrial structure contradiction, high energy-consuming industries energy is too large, fast comprehensive energy consumption of above-scale industrial growth, low energy efficiency, backward production capacity exit mechanism is not perfect, resulting in unsustainable consumption of energy resources[1]-[3]. Especially in the current domestic and international environmental constraints facing multiple pressures from abroad, the international resource market environment faced by influences such as political, economic and other factors, as well as the international community for sustainable development, promote energy conservation and environmental protection, promote low-carbon economy increasingly strong voice for development[4]; from the domestic point of view, especially in the lack of resources, energy shortages, environmental pollution and constraints under multiple pressures, such as China, the world's largest developing country, is both energy-producing countries, but also a big energy consuming country , energy supply and demand increasingly prominent, energy saving enormous pressure.[5] Twelfth Five-Year Plan "proposed energy required gross domestic product million, down 16% compared with 2010, down 32% compared with 2005, chemical oxygen demand and sulfur dioxide decreased by 8% over 2010, total ammonia and nitrogen oxide emissions compared with 2010 decreased by 10%. Therefore, the face of increasingly severe environmental and resource pressures, making the exploration of resources, industrial structure optimization environment under the Dual Restriction more urgent and important, so, this is research in resources, environment Dual Restrictions on Chinese industrial structure optimization provides the title good good opportunity for development, but also for achieving sustainable development of China's industry has great theoretical and practical significance.

II. MODEL DESIGN OF INDUSTRIAL STRUCTURE OPTIMIZATION UNDER RESOURCE AND ENVIRONMENT CONSTRAINTS

A. *Building objective functions*

Facing exceptional circumstances, the Chinese economy has maintained an average annual growth of 7%, but the total resource consumption is large, coal, oil and natural gas and other resource consumption ranked in the world, the larger the total amount of emissions, is facing more serious resources environmental bottleneck constraints, so this paper research needs, mainly from the economic growth, resource depletion, pollution control three aspects of the design of the objective function. Among them, the ultimate goal is to achieve optimization of the industrial structure of GDP growth, so we are one of the main objectives in order to optimize the use of GDP[6]; in resource and environmental constraints, industrial water, industrial energy consumption yuan GDP water efficiency is to investigate the industry, the main indicators of energy efficiency and, therefore, the minimum total water consumption, energy consumption and high efficiency is another major objective optimization; discharge of industrial waste water, waste, gas and other "waste" products is a key measure of industrial sector emissions of pollutants Therefore, this paper reduction by controlling the amount of waste emissions, which come from the source to reduce the pressure on the ecological environment of great significance[7].

The objective functions of the model are built as follows:

1) Economic growth objective

$$\max F(x_t)=\sum a_i*x_i(t)$$

It regards achieving the economic growth maximum as the objective. a_i is the value-added rate of the industry, and $x_i(t)$ is the total output value of the i industry at t phase.

2) Resource consumption control objective

$$\min G(x_t)=\sum c_i(t)*x_i(t);\ \min H(x_t)=\sum d_i(t)*x_i(t)$$

It regards the resource consumption minimum as the objective, to achieve the minimum industrial energy consumption per ten thousand yuan of GDP and minimum industrial water consumption. $c_i(t)$ is the gross output energy consumption coefficient of each establishment at t phase. $d_i(t)$ is the gross output water consumption coefficient of each establishment at t phase.

3) Pollution control objective

$$\min K(x_t)=\sum e_i(t)*x_i(t)+\sum f_i(t)*x_i(t)$$

It regards the pollution minimum as the objective, to represent by the minimum chemical oxygen demand and sulfur dioxide emission in reference to the relevant literatures. In the formula, $e_i(t)$ is the chemical oxygen demand emission coefficient of the i industry in t year. $f_i(t)$ is the sulfur dioxide emission coefficient of the i industry in t year.

B. Determination of constraint conditions

1) Constraint of industrial scale

According to China's "second five" national strategic emerging industry development plan ", China's industrial development and regional distribution of domestic industrial structure adjustment and optimization of the three programs, and the national guard to fulfill its international climate summit - Copenhagen climate summit binding emission reduction and other content for measure the size of the industry carried out[8]-[9].

Constraint of energy sources

$$\sum c_i(t)*x_i(t)<=R_1(t)$$

$R_1(t)$ is the constraint of the maximum energy consumption of each industry in t year.

Constraint of water resources

$$\sum d_i(t)*x_i(t)<=R_2(t)$$

$R_2(t)$ is the constraint of the maximum water consumption of each industry in t year.

2) Constraint of pollution control

① Constraint of chemical oxygen demand

$$\sum f_i(t)*x_i(t) <=R_3(t)$$

$R_3(t)$ is the constraint of total chemical oxygen demand emission of waste water discharge represented by each industry in t year.

② Constraint of sulfur dioxide emission

$$\sum e_i(t)*x_i(t)<=R_4(t)$$

$R_4(t)$ is the constraint of total sulfur dioxide emission of waste water discharge represented by each industry in t year.

C. Determination of output department

According to this study needs, we needed data model, mainly based on "China Statistical Yearbook" (2012-2013), "China Environment Statistical Bulletin" relevant basic data (2012-2013) are, respectively, three times to collect and calculate industrial value added rate, three industrial output, industry yuan GDP energy consumption, industry unit energy consumption coefficients of total output, industrial chemical oxygen demand and sulfur dioxide emissions, the largest industrial water consumption and COD discharge wastewater discharge total, total emissions of sulfur dioxide and other emissions data. Industrial structure optimization model based on our previous article establish conserve resources and protect the environment as the goal, combined with more relevant data to focus on China in 2014-2015 years of industrial energy consumption, water consumption, sewage and industrial structure proportion relations, in order to make results of this study add to China's industrial development has a certain reference. However, due to different data as well as the difficulty of collecting statistical data, we achieve the optimal goal of China to finalize the three industries in resource-constrained conditions. At the same time solving the process model, since the determination of the initial data and parameter estimation results for an important role, which is largely a direct impact on the quality of the estimates, and have a fundamental impact on the results of the follow-up study Therefore, we first need to determine these parameters[10].

D. Determination of parameters

1) Determination of parameters in plan summary. The production value structure change evaluation of China is mainly in accordance with *The Twelfth Five-year Plan Summary of National Economic and Social Development*. During the period of “the Twelfth Five-year Plan”, the average annual increase of the gross domestic product is more than 7%. The industrial structure tends to become more reasonable, and the development quality and level of three industries are improved significantly. The average annual increase of the added value of the service industry is more than 4%. According to the decomposition indicators of the energy saving and emission reduction in *Comprehensive Work Program of Energy Saving and Emission Reduction in The Twelfth Five-year Plan* by the State Council, By 2015, the National yuan GDP energy consumption fell to 0.869 tons of standard coal (at 2005 prices), down 16 percent from the 1.034 tons of standard coal in 2010, compared with 1.276 tons of standard coal in 2005 down 32%; "twelve Five" period, 670 million tons of standard coal in energy savings, and the total amount of chemical oxygen demand and sulfur dioxide emissions were controlled at 23.476 million tons, 20.864 million tons, compared with 25,517,000 tons in 2010 , 22.678 million

tons were down 8 percent and other content to determine the energy constraint dynamic control objectives.The specific parameters are shown in Table 1.

TABLE I. DETERMINATION OF OPTIMIZATION MODEL R VALUE

Determination of R Value	2013	Remarks
Energy consumption per ten thousand yuan of GDP (ton standard coal)	[0, 1.926]	The energy consumption per ten thousand yuan of GDP is reduced by 10% in "the Twelfth Five-year Plan".
The water consumption of the primary industry (100 million cubic meters)	[0, 495.95]	The total water consumption ratio of the primary industry is reduced by 4% in "the Twelfth Five-year Plan".
The water consumption of the secondary industry (100 million cubic meters)	[13.6, 14.14]	The water saving of the primary industry is fully used for determining the maximum limit of the secondary industry.
The water consumption of the tertiary industry (100 million cubic meters)	[1.14, 1.19]	The water saving of the primary industry is fully used for determining the maximum limit of the tertiary industry.
Chemical oxygen demand emission (10 thousand tons)	[0, 56.9]	The emission of "the Twelfth Five-year Plan" is controlled within the scope of "the Eleventh Five-year Plan".
Sulfur dioxide emission (10 thousand tons)	[0, 63.1]	The emission of "the Twelfth Five-year Plan" is controlled within the scope of "the Eleventh Five-year Plan".

2)Grey prediction. Grey prediction is made of a system of scientific theory scholar Professor Deng Julong pioneered in the 1980s, it is the gray system theory is an important component of a system containing uncertainties method to predict. Existing literature mainly from the initial value, the background value, ash derivative, discrete model parameters and morbid, cushioning operator theory, increase the angle of modeling data sequence smoothness, gray model and neural networks, function transform angle of gray prediction model research, it is also a very active area of research[11]-[13]. Gray predicted by the degree of dissimilarity between trends factor authentication system, namely, correlation analysis, and the raw data generating process to find the law of the system changes, generate a strong regular data series, and then establish the appropriate differential equations model to predict future trends of the situation of things. Series with an equal number of their time away from the observed response prediction target characteristic value structure gray prediction model, to predict the future of the feature quantity at a time, or up to a certain amount of time feature. It is generally a "five-step model (system qualitative analysis, factor analysis, preliminary quantification, dynamic quantization, optimization)" method, the establishment of a fraction theory even GM (1,1) model and the theory of continued fractions vector MGM (1, n) model, thus effectively improving the simulation and prediction accuracy of gray combined forecasting model. This method is used to predict parameters coefficients[14].

III. ANALYSIS ON ENERGY SAVING AND EMISSION REDUCTION PROGRAM OF INDUSTRIAL STRUCTURE OPTIMIZATION IN CHINA BASED ON ENERGY SAVING AND EMISSION REDUCTION

The industrial structure optimization of China under the resource and environment constraint should achieve the economic growth maximum and also achieve multiple objectives such as the improvement of the resource consumption efficiency and the controlling of the pollution discharge[15]. Moreover, the energy saving and emission reduction program is the optimization program with the energy saving, less environmental pollution, ecological environmental protection, and improvement of self-healing capacity of the environment as the primary objective, giving consideration to the economic growth. Therefore, this paper make the optimization analysis on the industrial structure through designing the single objective of the energy saving and emission reduction. According to the requirements and the constraint conditions of the energy saving and emission reduction in China, in consideration to the threshold value of the industrial energy consumption per ten thousand yuan of GDP and pollution discharge, it utilizes the calculation method set out above. According to the dynamic adjustment of the planning year, the optimization results of three industries are obtained, as shown in Table 2.

In the energy conservation program, our carbon reduction targets are to ensure economic growth as a precondition, but rapid economic growth will be constrained the efforts and effects of carbon emissions, which is not conducive to China's realization of sustainable carbon reduction row, also delayed the transformation of economic growth mode of our time. Therefore, we must adhere to the principle of "energy-based, optimize the industrial structure and the development of clean energy supplement" by adjusting and optimizing the structure can achieve a low-carbon economic growth, thereby improving the quality of economic growth. Should guide the industry to less energy consumption structure, the service in the manufacturing sector but lags behind the manufacturing industry, the tertiary industry development of producer services and other knowledge-intensive, reducing the economic and social costs, thereby reducing the carbon intensity. For example, energy savings, and the total emissions of chemical oxygen demand and sulfur dioxide reduction requirements, domestic petroleum processing, coking, chemical, steel, electricity consumption of more industry should strengthen technological innovation, and strive to improve energy efficiency. The total output value in this program can not reach the increase level of total output value in the economic growth program. In the program, total quantity of GDP in 2015 will be RMB 57,740.9 billion, which is lower than the total output value level achieved under the scheme of the economic growth. In addition, from the production value structure, the proportion of the primary industry is relatively small, and the contribution of the secondary industry to the economic growth is declined slightly, which shows that the secondary industry of China plays a larger role in the economic growth. The contribution of the tertiary industry to the economic growth has relatively large ascending range, indicating that the energetic development of the tertiary industry is beneficial to the pollution control. At the same time, only upon considering the increase of the ecological environment cost, the quality of the economic growth can be achieved finally.

TABLE II. INDUSTRIAL STRUCTURE OPTIMIZATION RESULT OF ENERGY SAVING AND EMISSION REDUCTION

	2014	2015
Energy consumption (10 thousand ton standard coal)	37.9	38.1
Energy saving and water consumption (100 million cubic meters)	121	119
Chemical oxygen demand emission for emission reduction (10 thousand tons)	2326	2238
Sulfur oxide emission (10 thousand tons)	2007	1999
The proportion of the primary industry (%)	9.8	9.7
The proportion of the secondary industry (%)	44.1	44.0
The proportion of the tertiary industry (%)	46.1	46.3
Total output value (100 million yuan)	573111	577409

IV.CONCLUSIONS

In the 21st century, the pace for the economic globalization and regional economic integration is quickening, and various countries in the world begin to a new round of the industrial structure upgrading and adjustment, and the industrial structure is faced with the tasks of upgrading and seniorization. namely the industrial structure, "softening" in the industry's development process the role of other tangible goods and factors of production resources increasingly reduced, while the role of knowledge, technology, services and information soft factors of production increasing, investment in various industries increases rapidly. Since China's economic development, industrial structure is not rational, low energy efficiency of resource use, ecological environment is fragile, adjust and optimize the industrial structure, the path of sustainable development is to achieve economic development mode shift, breaking resources and the environment, "bottlenecks" in the only way. Therefore, the need to implement sustainable development strategies, on the one hand to promote industrial development, saving resources and protecting the environment should seek a balance between control incremental, accelerate the elimination of backward production capacity, improve policies and measures to promote industrial restructuring, and actively promote energy structure adjustment, adhere to the new road to industrialization, promote the upgrading of traditional industries, increase the proportion of high-tech industries in the industry; the other hand by the continuous improvement of the social security system, reduce infrastructure energy costs, through a certain system design for the industry to achieve economic social development and population, resources and environment in harmony, in order to continue to create favorable conditions for sustained, rapid and stable development.

REFERENCES

[1] DAI Yue.Research on Industrial Structure Optimization under Resource and Environment Constraint [J]. Academic Exchange, 2014, (2): 126-129

[2] CHEN Qing.Research on Multi-objective Optimization of Industrial Structure Adjustment in Wuhan City under Environment and Resource Constraint [D]. Wuhan:Huazhong University of Science and Technology, 2011:23-26.

[3] LI Fang. Multi-objective Model Building and Empirical Research of Industrial Structure Optimization in Xinjiang under Resource and Environment Constraint [J]. Xinjiang Farms Economy, 2013, (7): 39-43

[4] MEN Chang g. Review of Industrial Structure Research Progress – Orientation of Regional Industrial Structure Research under Resource and Environment Constraint [J]. Modern Finance and Economics, 2012, (1): 97-104

[5] HE Hui-shuang.Environmental quality, environmental regulation and industry structure optimization-Empirical Analysis Based on China's east, central and western Panel Data [J].Areal Research and Development,2015, (1): 105-110.

[6] B hringer,C,U Moslener, U.Oberndorfer, A.Ziegler.Clean and Productive?Empirical Evidence from the German Manufacturing Industry[J]. Research Policy, 2011,(2)442-451.

[7] YE Xiang-song,PENG Liang-yan.Regulatory efficiency of environ -mental regulation and total factor productivity under study:.1999-2008[J]. Finance and Trade Economics. 2011 ,(2): 102-109 + 137

[8] WU Ming-e, ZENG Guo-ping, Cao Yue. Group resource and environmental constraints increase under study [J].Based on total factor productivity of capital and services China Population, Resources and Environment, 2015, (5): 83-91.

[9] YUAN Yi-jun, LIU Liu.Environmental Regulation and Economic Growth:A Research Based on Different Kinds of Economic Regulation[J]. Economic Review.2013,(1):27-33.

[10] GONG Qing-hua,YANG Lei, HUANG Guang-qing.Optimization Model Based on resource constraints of the industrial structure of linear programming theory[J].Science and Technology Management Research 2011 (12): 26-28 + 39 .

[11] QIU Xin-guo,TAN Jing-lei.Industrial Structure Adjustment Impact on energy conservation-Empirical Analysis Based on China and more than 247 prefecture-level city data[J].Science and Technology Management Research 2015M (10): 239-243 + 254.

[12] LI Shao-lin.The next resource and environmental constraints of industrial structure changes, optimize growth and TFP [D]. Dalian:Dongbei University of Finance and Economics, 2013:122-125.

[13] LIU Si-feng, CAI Hua,YANG Ying-jie etal.Progress on Gray Correlation Analysis Model [J]. Systems Engineering Theory and Practice ,2013 (8): 2041-2046.

[14] LIU Yu.Resources, Environment double constraint optimization of the industrial structure in Liaoning Province[D].Shenyang: Liaoning University, 2012:96-102.

[15] YUAN Yi-jun, XIE Rong-hui.Study the effect of environmental regulation adjustment of industrial structure-the empirical test based on Chinese Provincial Panel Data [J].China Industrial Economy. 2014, (8): 57-49.