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Measurement and Analysis of Economic High-quality Development

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Abstract:

China's economic development has shifted from high-speed growth to high-quality growth. The measurement and analysis of the high-quality economic development of prefecture-level cities in the province is conducive to the coordinated economic development of cities in the province and the improvement of the overall quality of economic development. This paper takes 11 prefecture-level cities of Shanxi Province, a resource-based province from 2010 to 2018, as the research object, and constructs an evaluation system of economic high-quality development indicators from the aspects of economic growth, economic structure, and economic benefits. At the same time, the high-quality economic development level and influencing factors of prefecture-level cities are selected for specific measurement and in-depth analysis. The research results show that: First of all, during the sample period, the high-quality economic development level of Shanxi Province showed a slow upward trend. Secondly, the high-quality economic development of provincial and municipal-level cities is uneven. Finally, the core driving force is economic benefits for high-quality economic development. All of the above are significant factors that cause differences in the quality of economic development of provincial and municipal cities. According to the analysis result, the paper last gives some policy suggestions.

Keywords*: High-quality economic development, Economic efficiency, Entropy method.*

I. INTRODUCTION

Since the reform and opening up, China's economy has grown rapidly. The total GDP has

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grown from 367.87 billion yuan in 1978 to 99,086.51 billion yuan in 2019.In addition, GDP per capital increased from 385 yuan to 70,892 yuan per capital in 2019. While the total economic volume is growing rapidly, a series of problems affecting the quality of economic growth have arisen, such as environmental pollution, low efficiency, and insufficient innovation.The report of the 19th National Congress of the Communist Party of China put forward an important statement that "China's economy has shifted from a stage of rapid growth to a stage of high-quality development, with supply-side structural reforms as the main line to promote quality changes in economic development",which triggered a heated discussion about high-quality economic development in the academic world. Under the requirements of the new development concept, it is no longer appropriate to measure the effectiveness of economic development only from the total economic growth and growth rate. It is necessary to construct a measurement system for evaluating high-quality economic development.

There are two main methods to measure and evaluate the quality of economic growth. One is to define the quality of economic growth from a narrow perspective, use economic growth efficiency to measure economic growth quality, and use total factor productivity or input-output ratio to measure economic growth quality:Liu Wenge (2014) and others used the data envelopment analysis method (DEA method) to measure the productivity indexes of China’s provinces and regions. These indexes are used as important indicators to measure the total factor productivity growth index of all provinces and regions in China to further measure China Quality level of economic growth[1].In addition, Xu Hengzhou et al. (2014) adopted the Solow residual method and used the least square method to estimate total factor productivity to measure the quality of my country's economic growth [2].The Cobb-Douglas production function was used by Xiao Huanming (2014), who included natural resources and the environment as input factors in the production function to measure and analyze the quality of my country’s economic growth[3].Gao Yanhong et al. (2015) used a random boundary heterogeneous panel production model to explore the relationship between the renewable resource industry and the quality of economic growth[4].The Cobb-Douglas production function was adopted by Yan Erwang et al. (2019) to analyze and study the economic growth factors of Shanxi Province and measure the quality of economic growth in various cities in Shanxi Province[5].

Another method is to define the quality of economic growth from a broad perspective. It is believed that the quality of economic growth is rich in connotations. It is not simply to use a single indicator to define the quality of economic growth, but to measure the quality of economic growth by constructing a comprehensive indicator system.Factors such as environmental conditions, income, political system, life expectancy, and fertility were adopted

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by Barro (2002) to discuss the quality of economic growth[6].Chao Xiaojing and Ren Baoping (2011) studied the quality of our country's economic growth from the perspectives of income distribution, ecological environmental costs, economic growth structure and stability) [7].So far, there are mainly five kinds of analysis methods: relative index method, analytic hierarchy process, entropy method, factor analysis method and principal component, all of which are used to measure and analyze the comprehensive evaluation index of our country's economic growth quality.For example, Zhao Yingcai (2006), etc.and Li Junlin (2007)utilized the relative index method to comprehensively evaluate the quality of China's economic growth[8-9].Liu Youzhang (2011) et al. and Wei Jie (2011) et al.took advantage of analytic hierarchy process to analyze the quality of European economic growth[10-11] .Ma Yiqun (2012) et al. and Liu Xiaoyu (2012) et al.used entropy method to evaluate the quality of China's economic growth, and discussed the relationship between economic growth and the quantity of growth[12-13].Liu Haiying (2006) et al.and Zhang Bing (2018) et al. made use of factor analysis method to analyze the quality of China's economic growth [14-15].Principal component analysis is used by Yao Min (2016)and Li Qiang (2018) to analyze and measure the quality of economic growth in various regions of China [16-17].

The existing research,which has relatively few high-quality measurement analysis of prefecture-level cities in specific provinces and insufficient analysis of economic development quality at the city level, mainly takes the whole country or provinces as the object of the research to gauge the level of economic quality development. What is of great significance to promote high-quality economic development and solve the problem of rapid development of local economy is how to measure the high-quality economic development level of each prefecture-level city at the micro- level, and find out the gaps between regions in the high-quality economic development.The resource-based province of Shanxi is regarded as the research object of this article, and factors such as economic aggregate, economic structure, and economic benefits are included in the comprehensive index system. On the basis of constructing the model, this paper comprehensively measures the economic high-quality development of 11 prefecture-level cities in Shanxi Province. At the end, effective suggestions and countermeasures are put forward through research.

II. MODEL, METHODOLOGY AND DATA

2.1Index System for High-quality Economic Development

High-quality economic development is a considerable goal of China's economic transformation at this stage. The connotation of economic development cannot be limited to the

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increase in economic aggregates. It is that multiple aspects such as structural adjustment,efficiency improvement, and quality of life improvement need to be included in the measurement system.Based on the research of scholars such as Zhan Xinyu (2017)[18], Ma Ru (2019)[19], Su Yongwei (2019)[20], Ren Baoping[21-24] and Mlachila[25], referring to the basis of relevant materials, this paper constructs a multi-dimensional indicator system to measure the high-quality economic development of Shanxi Province, which systematically reflects the specific level of high-quality economic development in Shanxi Province. In addition,the index system is shown in TABLE I.

It can be seen from TABLE I that the evaluation system revolves around the target layer of high-quality economic development, and is further broken down into three dimensions at the criterion layer: total, structure, and benefit. Moreover,there are 7 specific indicators in the program layer.In the analysis and measurement of the aggregate level, GDP is selected to reflect the level of output, and the total labor compensation of non-private units is used to reflect the level of income.On the structural level, the impact of economic structure on the quality of regional economic development is explained separately from the perspectives of population structure and industrial structure.The proportion of the tertiary industry is chosen to reflect the industrial structure,and the urbanization rate is used to reflect the population structure, showing the process and degree of population gathering in the city.With the increase in the urbanization rate, technological progress will be made. At the same time, urbanization will promote the strong development of the service industry, which will drive changes and adjustments in the economic structure.The improvement of economic efficiency is one of the major indicators to measure high-quality economic development.This paper analyzes and measures the benefits from the input of production factors-human, capital, and land. It selects GDP per square kilometer, which is the ratio of GDP to the total area, to show the output per unit area and reflect it Land output efficiency.This paper analyzes and measures the benefits from the input of production factors-human, capital and land. The output GDP per square kilometer is selected, that is, the ratio of GDP to the total area, which shows the output per unit area and reflects the land Output efficiency.The disposable income of residents is used to reflect the efficiency of human production in the region. The input-output ratio, that is, the ratio of GDP to the completed fixed investment of one hundred yuan, reflects how many units of capital can be produced by investing 1 unit of capital in the project. The larger the input-output ratio, the better the economic effect, and thus the efficiency of capital output in a region.

TABLE I. Index system of high quality economic development

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Target level	Criterion level	Scheme level	
		Sub-index level	Way of measurement
High-quality economic development	Economic aggregate	Output	GDP
		Income	Total labor compensation of non-private entities
	Economic structure	Industrial structure	The proportion of tertiary industry
		Population structure	Urbanization rate
	Economic benefit	Production efficiency of labor	Per capita disposable income of urban residents
		Production efficiency of land	GDP per square kilometer
		Production efficiency of capital	GDP per unit of fixed investment

2.2 Data Sources

The proportion of tertiary industry is calculated based on the ratio of tertiary industry to total GDP.And the urbanization rate is calculated as the ratio of the non-agricultural population to the total urban population.The GDP per square kilometer can be calculated by the ratio of GDP to city area.In addition, the output GDP per unit of fixed investment is calculated by the ratio of GDP to the completed fixed investment of 100 yuan.Data such as total GDP, total labor remuneration of non-private units, tertiary industry output, per capital disposable income of urban residents, non-agricultural population, total population, urban area, and fixed investment completion data are all from the Shanxi Provincial Statistical Yearbook and the National Bureau of Statistics Official website.

III. DATAANALYSIS

Regarding index evaluation methods, there are currently two main categories: subjective weighting evaluation methods and objective weighting evaluation methods. In order to

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minimize the subjective factors in the weight setting, the information entropy model is used in this paper to determine the weight of each evaluation index, and the entropy method is used to measure the high-quality economic development level of 11 prefecture-level cities in Shanxi Province. The calculation structure is shown in TABLE II, and the main calculation steps are as follows:

(1) The initial data is standardized. Since the selected 7 indicators are all positive indicators, the natural logarithm must be taken when calculating the entropy value, and the indicator value must be a positive number, so the following formula (1) is used:

$$y_{ij}=\frac{x_{ij}-\min\limits_{1\le i\le n}(x_{ij})}{\max\limits_{1\le i\le n}(x_{ij})-\min\limits_{1\le i\le n}(x_{ij})}+1(i=1,2,\cdots,n;\ j=1,2,\cdots,m)\quad(1)$$

In formula (1), n represents the number of cities, and m represents the number of indicators.

(2) Calculate the proportion of each variable of the positive consistency evaluation matrix y_{ij}:

$$R_{ij}=\frac{y_{ij}}{\sum_{i=1}^{n}y_{ij}}\ (i=1,2,\cdots,n;\ j=1,2,\cdots,m)$$

(3) Calculate the entropy value of each variable in R_{ij} to obtain E_j:

$$Ej=\frac{\sum_{i=1}^{n}R_{ij}\times\ln R_{ij}}{\ln n}\ (j=1,2,\cdots,m)$$

(4) Calculate the coefficient of difference of each variable in R_{ij}:

$$d_j=1-E_j\ (j=1,2,\cdots,m)$$

(5) d_j is normalized so that the total weight of each inspection index is 1, and then the final evaluation weight of each index is obtained:

$$w_j=\frac{d_j}{\sum_{j=1}^{m}d_j}\ (j=1,2,\cdots,m)$$

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(6) Calculate the economic high-quality development score of the city:

$$Z_i = \sum_{j=1}^{m} W_j \times R_{ij} \left(i = 1,2,\cdots,n;\ j = 1,2,\cdots,m\right)$$

TABLE II. Comprehensive scores of high-quality economic development of 11 prefecture-level cities in Shanxi Province from 2010 to 2018

Years / Area	2010	2011	2012	2013	2014	2015	2016	2017	2018	Mean	Rank
Taiyuan	0.1289	0.1307	0.1317	0.1333	0.1362	0.1383	0.1252	0.1347	0.1331	0.1325	1
Datong	0.0889	0.0906	0.0906	0.0885	0.0899	0.0912	0.0873	0.0898	0.0896	0.0896	6
Yangquan	0.0955	0.0958	0.0938	0.0954	0.0957	0.0935	0.0874	0.0927	0.0945	0.0938	3
Changzhi	0.0914	0.0932	0.0914	0.0901	0.0901	0.0884	0.0837	0.0884	0.0867	0.0892	7
Jincheng	0.0885	0.0942	0.0930	0.0938	0.0929	0.0911	0.0849	0.0906	0.0904	0.0910	4
Shuozhou	0.0965	0.0919	0.0934	0.0935	0.0932	0.0901	0.0957	0.0980	0.0962	0.0942	2
Jinzhong	0.092	0.090	0.089	0.090	0.091	0.089	0.091	0.087	0.086	0.089	5

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	9	8	4	4	1	5	7	3	0	9	
Yuncheng	0.0786	0.0774	0.0782	0.0801	0.0801	0.0850	0.0929	0.0813	0.0834	0.0819	9
Xinzhou	0.0723	0.0696	0.0708	0.0710	0.0715	0.0737	0.0823	0.0744	0.0742	0.0733	11
Linfen	0.0861	0.0856	0.0854	0.0842	0.0834	0.0840	0.0878	0.0841	0.0885	0.0854	8
Lvliang	0.0803	0.0801	0.0823	0.0796	0.0759	0.0752	0.0812	0.0788	0.0776	0.0790	10

It can be seen from TABLE II that the scores of the economic high-quality development measurement of 11 prefecture-level cities in Shanxi Province have been increasing year by year, which shows that the quality of economic development in various cities is constantly improving, and the economic development model is constantly transforming and upgrading from extensive resource mining.However, there are still significant differences in the level of high-quality economic development, and the economic development of various cities is not balanced.Xinzhou City has the lowest score, with a value of only 0.0733, while Taiyuan City has the highest score for high-quality economic development, with an average value of 0.1325. The difference between the scores of the two cities has nearly doubled.Therefore, the disparity is very significant. Differences in economy, environment, and resource endowments will lead to even bigger gap in the level of urban high-quality development.Furthermore,the high-quality development scores of other prefecture-level cities are between 0.07-0.09.

TABLE III. Classification and ranking of the high-quality economic development of Shanxi Province in 2010

	Economic aggregate	**Economic structure**	**Economic benefit**	**Economic high quality**

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	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Taiyuan City	0.0367	1	0.0384	1	0.0561	1	0.1312	1
Datong City	0.0239	3	0.0292	2	0.0376	9	0.0906	6
Yangquan	0.0202	9	0.0287	3	0.0454	5	0.0943	2
Changzhi City	0.0243	2	0.0215	10	0.0460	3	0.0918	5
Jincheng	0.0225	6	0.0245	5	0.0417	6	0.0887	7
Shuozhou	0.0200	10	0.0246	4	0.0489	2	0.0935	3
Jinzhong	0.0224	7	0.0238	7	0.0459	4	0.0921	4
Yuncheng	0.0217	8	0.0227	8	0.0343	10	0.0787	10
Xinzhou	0.0184	11	0.0241	6	0.0299	11	0.0724	11
Linfen City	0.0227	4	0.0223	9	0.0407	7	0.0858	8
Lvliang	0.0226	5	0.0193	11	0.0390	8	0.0810	9

Note:Due to limited space, only the scores and rankings of prefecture-level cities in Shanxi Province in 2010 are listed in the paper

Based on the measurement results of high-quality economic development (TABLE II, TABLE III), in this paper, the 11 prefecture-level cities in Shanxi Province are divided into 4 levels, as shown in TABLE IV.

TABLE IV. Regional division of economic development in 11 prefecture-level cities

Category	Area
Rapid and high-quality development	Taiyuan
Medium high quality development	Yangquan, Jincheng, Shuozhou

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Slow high-quality development	Jinzhong, Datong, Linfen, Yuncheng, Changzhi
Stagnant high-quality development	Xinzhou City, Lvliang

Above all, the high-quality and rapid economic development area is the first level,which the average high-quality development comprehensive score is greater than 0.1, and Taiyuan is included in this area.As the capital city of Shanxi Province, Taiyuan has a geographical advantage, a good foundation for urban development, and its economic structure, economic aggregate, economic efficiency and other indicators are ranked first in the province.In the future, such regions should continue to leverage their first-mover advantages as a political center to further promote urbanization and industrialization, and steadily improve the efficiency of economic development.Secondly, the second tier is the medium-sized areas with high-quality economic development, with a high-quality development index between 0.09-0.1, including Yangquan, Jincheng, and Shuozhou. In the third place,the third level is areas with slow high-quality development, including five prefecture-level cities, namely Jinzhong, Datong, Linfen, Yuncheng and Changzhi, with a high-quality development index between 0.08-0.09.Among them, Xinzhou's economic aggregate score ranks last in the province, its economic structure score ranks 7th among 11 prefecture-level cities, and its economic benefit score ranks 11th.And Lvliang's economic aggregate score ranks in the upper middle and upper reaches, ranking fourth, but the economic structure ranks the bottom 1 with the average economic benefit score of 0.0356, and the province ranks the bottom 2.Through analysis, it is concluded that the industrial structure of such areas is not reasonable enough, the process of urbanization is slow, and the economic efficiency is low, all of which have led to the lagging of high-quality development. Therefore, there is still a lot of room for improvement in the future. It is necessary to accelerate the cultivation of emerging industries, adjust and optimize the industrial structure, and promote the rapid progress of the urbanization process through the upgrading of the industrial structure.In the meantime, attention must be paid to the efficiency of input of production factors to improve economic development efficiency during the process of economic development.

IV. CONCLUSION AND SUGGESTION

A multi-dimensional index system is constructed, and the entropy method is used to measure the economic development quality of 11 prefecture-level cities in Shanxi Province from 2010 to 2018. The conclusions are as follows:

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During the period, the quality of economic development in Shanxi Province is slowly improving. The high-quality economic development level of 11 prefecture-level cities fluctuates, while the quality of economic development of prefecture-level cities is obviously unbalanced. The difference in the number of cities with the highest and lowest scores of economic development quality is nearly doubled.In the measurement and analysis of high-quality economic development, economic benefits are the core driving force and an important factor that causes the imbalance in the quality of economic development of prefecture-level cities. According to the analysis results, the following suggestions are given:

First of all, it is not a simple requirement that all regions reach the same level of economic development, but a path of rational division of labor and optimized development based on the staple conditions and resource endowments of each region.Moreover,attention should be paid to structural adjustment and promote coordinated industrial development. Each prefecture-level city should look for characteristic industries in the region according to its own development characteristics.It is also necessary to optimize the industrial structure of the region, adjust the industrial layout, correctly handle the relationship between the primary, secondary, and tertiary industries, and achieve a reasonable adjustment of the economic structure.Secondly, we must attach importance to the efficiency improvement in the process of economic development, and promote economic recycling, low-carbon and green development, so that economic growth must be coordinated with population, resources, and the environment.

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