

# A Measure of China's High-quality Economic Development

-- Research based on Factor Analysis

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**Abstract:** During the "14th Five-Year Plan" period, continuous promotion of high-quality economic development is the core driving force of economic and social development. Taking the five major development concepts as the core, this paper studies the five dimensions of innovation, coordination, green, openness and sharing in 30 provinces in China in 2020, sets up 14 standard layer measurement standards, 21 specific measurement indicators, and comprehensively evaluates the level of high-quality economic development based on the two-stage factor analysis method, and finds that the overall level of high-quality economic development in 30 provinces in China is low, and the comprehensive score of 60% of the provinces is negative. At the same time, the level of high-quality development of China's economy also faces the problem of unbalanced regional development in space, and the development pattern of "high in the east, low in the west, high in the coastal area and low in the inland" in the region. In addition, the development perspectives of each province in China also have different emphases, uneven development, and relevant policy recommendations are drawn for the analysis conclusions.

**Keywords:** High-quality Economic Development; Factor Analysis; Five Development Concepts.

## 1. Introduction

To study the situation of high-quality economic development in our country by constructing a comprehensive evaluation index system to measure the level of high-quality economic development in our provinces, and to find the problems existing in the process of high-quality economic development is of great significance to better promote the process of economic development in our country and finally achieve high-quality development.

## 2. Literature Review

Influenced by economic models in studies of Solow [1], Jorgenson and Griliches [2], scholars usually use economic total factor productivity to simply measure the quality of economic growth [3, 4], most of the existing literatures focusing on high-quality economic development only focus on several aspects of the five new development concepts, such as the shared aspects of environmental regulation on social and economic development, such as residents' welfare. And the coordination level such as the coordination of urban and rural development and other aspects of the impact of the general attention is insufficient, there are still few studies on the construction of high-quality economic development index system. Based on the existing research, the marginal contribution of this paper may be to scientifically and objectively evaluate the level of high-quality economic development in various regions of China, and to build a high-quality economic development index system by studying the five development concepts of innovation, coordination, green, open and sharing in 30 provinces of China. Based on the quadratic weighted factor analysis method, the high quality development level of China's economy is comprehensively evaluated.

## 3. Research Design

### 3.1. Index Selection and System Construction

This paper selects the 2020 data of 30 provinces excluding Tibet Autonomous Region for relevant analysis, all of which are from the National Bureau of Statistics.

#### 3.1.1. Construction of High-Quality Economic Development Index System:

With five new development concepts as the core, this paper constructs a statistical index system from five dimensions to measure the high-quality economic development of various provinces. A total of 14 first-level indicators and 21 second-level indicators are selected, all of which are positive. The construction logic of indicators in each dimension is as follows, and the indicator system is shown in Table 1:

#### 3.1.2. Description of Factor Analysis Method:

The basic idea of factor analysis is to group variables according to the magnitude of the correlation, so that the correlation of variables in the same group is high, while the correlation of variables in different groups is low. Each set of variables represents a basic structure, which is called a common factor. The mathematical model is as follows.

$$\begin{cases} x_1 = a_{11}F_1 + a_{12}F_2 + \cdots + a_{1m}F_m \\ x_2 = a_{21}F_1 + a_{22}F_2 + \cdots + a_{2m}F_m \\ \vdots \\ x_p = a_{p1}F_1 + a_{p2}F_2 + \cdots + a_{pm}F_m \end{cases} \quad (1)$$

In formula (1),  $x_1, x_2, \dots, x_p$  is a standardized variable with mean 0 and standard deviation 1;  $F_1, F_2, \dots, F_m$  is  $m$  factor variables, where  $m < p$ .

Firstly, KMO test and Bartlett's sphericity test are carried out on each index data to determine whether it is suitable for factor analysis. Secondly, the principal component analysis method is used to extract the common factors and the

maximum variance method is used to rotate the initial load matrix. Finally, the regression was performed to get the factor score, and the corresponding variance contribution rate was

weighted for each factor. Finally, the comprehensive score was calculated. In order to eliminate contradictions and incommensurability, all indicators are standardized.

**Table 1.** Index system of China's high-quality economic development

Dimension	First-level indicator	Second-level indicator	attribute
Innovate	Innovation efficiency	Per mu GDP	+
		Energy intensity (GDP-base)	-
coordinate	Innovation output Innovation impetus Social coordination	Share of technology market turnover	+
		S&T personnel ratio	+
		Unemployment rate	-
		Social security and employment expenditure	+
		Urban-rural income balance	-
green	Urban-rural coordination	Urban-rural consumption balance	-
		Forestation rate	+
		Gov't eco support	+
		Waste treatment efficiency	+
		Public transit vehicles/10k people	+
open	Trade opening Investment opening	Urban wastewater capacity	+
		Trade dependency index	-
		Foreign enterprise appeal	+
		Foreign investment share	-
		Health professionals/10k people	+
share	Medical treatment Transportation development Income benefit Consumption welfare Education welfare	Urban road space per capita	+
		Resident income per capita	+
		Resident consumption per capita	+
		Higher education enrollment rate	+
			+

#### 4. Factor Analysis

In this paper, the five sub-systems were processed by factor analysis method, and the comprehensive scores of the sub-systems of high-quality economic development level in 30 provinces were obtained, as shown in Table 2. As can be seen from Table 2, there are large differences in the scores of 30 provinces in different subsystems, indicating that China's

economic development is facing the problem of unbalanced regional development. Provinces with political and economic centers score much higher than other provinces in a number of sub-systems. But there are also some provinces in a number of subsystems score negative, far below the average. Secondly, the problem of unbalanced development Angle, some provinces in a certain index score is high, outstanding performance, but in other indicators score ranking low, there is a "partial" situation.

**Table 2.** Comprehensive scores of 30 provincial subsystems

District	innovation	coordination	green	opening	sharing
Peking	-2.4081	0.6474	0.9846	1.1931	-2.6255
Tianjin	-1.0331	-1.1034	-0.2649	0.6301	-1.4371
Hebei	0.2160	-0.3987	-0.5646	-0.4267	1.4471
Shanxi	0.3019	0.3744	-1.2035	-0.6195	0.1209
Inner Mongolia	1.6078	-0.3497	-0.5851	-0.6814	-0.2602
Liaoning	0.1286	-1.2525	0.5599	0.0028	0.7508
Ji Lin	0.0793	-1.0317	-0.6197	-0.5614	-0.1299
Amur River	1.4360	-2.0700	-0.0787	-0.5128	1.2885
Shanghai	-1.2758	0.1758	-0.3795	2.7025	-1.0245
Jiangsu	-0.5787	-0.2297	1.7318	1.1234	-1.2176
Zhejiang	-0.6668	-0.6050	1.3709	1.0605	0.4058
Anhui	-0.1514	-0.7551	0.3511	-0.4073	0.3200
Fujian	-0.4979	-0.0108	0.4646	0.3853	-0.9890
Jiangxi	0.2266	-0.5187	-0.6410	-0.3972	0.4003
Shandong	-0.1776	0.6033	1.2873	0.3927	0.0400
Henan	0.1585	-0.7429	0.1962	-0.4226	-0.2489
Hubei	-0.2929	-1.0429	0.2104	-0.4490	-1.0489
Hunan	-0.1338	0.1186	1.2353	-0.4320	0.3548
Kwangtung	-0.6095	0.9542	1.8360	3.3095	0.3223
Guangxi	0.3344	-0.2332	0.1407	-0.2447	1.2988
Hainan	0.1011	-0.0323	-0.2221	-0.5525	0.5661
Chongqing	-0.2927	-0.6461	-3.1251	-0.1419	-1.0076
Sichuan	-1.8437	-0.7448	0.3299	-0.2694	0.2864
Guizhou	-0.2626	1.2549	-1.0972	-0.7587	0.3342
Yunnan	0.1441	1.4632	0.1715	-0.5203	0.0176
Shaanxi	-0.5667	0.7347	0.1267	-0.4315	-1.5142
Gansu	0.8906	2.7338	-0.2884	-0.7385	1.9625
Qinghai	1.4873	1.2143	-0.8764	-0.8523	0.7763
Ningxia	1.4692	0.2663	-0.7908	-0.7923	0.4301
Xinjiang	2.2099	1.2266	-0.2600	-0.5879	0.3811

Factor analysis method is used to calculate the comprehensive score of the above 5 sub-systems, and the comprehensive score of the high quality economic development level of 30 provinces is obtained. The result of KMO test shows that the value of KMO is 0.641; meanwhile, the result of Bartlett sphericity test shows 394.006, and the significance P value is 0.000\*\*\*, showing significance at the level and correlation among variables. The above data is suitable for factor analysis. After that, principal component analysis was carried out to extract the main factors. The total variance interpretation was obtained,

The number of common factors was determined according

to factor eigenvalue >1, and 5 common factors  $F_1, F_2, F_3, F_4$  and  $F_5$  were finally obtained. The factor rotation was carried out using the maximum variance method, and the factor load matrix after rotation was shown in Table 3. According to the load size of the common factor on each index, the name of the common factor was determined, and  $F_1$  was named as the open and sustainable development factor,  $F_2$  as the knowledge and technology level factor,  $F_3$  as the green life and coordinated development factor,  $F_4$  as the economic welfare level factor, and  $F_5$  as the social development level factor.

**Table 3.** Factor load coefficient after rotation

index	Factor load coefficient after rotation					communality
	divisor1	divisor2	divisor3	divisor4	divisor5	
Per mu GDP	-0.580	-0.158	-0.033	0.402	0.154	0.548
Energy consumption per 10,000 yuan GDP	-0.504	-0.339	0.580	0.110	0.172	0.746
Share of technology market turnover	0.182	0.907	0.015	-0.133	0.182	0.907
Proportion of scientific and technological personnel	0.440	0.097	-0.066	-0.124	-0.098	0.232
Unemployment rate	-0.081	0.088	-0.024	-0.059	-0.831	0.710
Social security and employment expenditure	-0.402	0.335	-0.253	0.395	-0.381	0.639
The level of urban and rural income coordination	-0.109	-0.146	0.816	0.032	-0.064	0.705
Level of coordination between urban and rural consumption	0.098	0.169	0.841	0.173	-0.022	0.777
Forest coverage rate	0.265	-0.054	-0.484	0.079	-0.126	0.330
Government support for environmental protection	-0.243	0.085	0.021	0.201	0.006	0.107
Harmless treatment rate of household garbage	0.031	0.074	-0.181	0.176	0.667	0.515
Public transport vehicles per 10,000 people	-0.066	0.274	0.111	-0.174	0.641	0.533
Daily treatment capacity of municipal sewage	0.751	-0.101	-0.210	-0.058	0.245	0.682
Foreign trade dependence	0.796	0.415	-0.105	-0.126	0.076	0.839
Attractiveness of foreign-funded enterprises	0.903	-0.020	0.005	-0.001	0.181	0.848
Foreign investment rate	0.007	-0.064	-0.234	0.128	0.142	0.096
Number of health technicians per 10,000 people	-0.023	0.830	0.219	-0.178	0.237	0.825
Per capita urban road area	-0.478	-0.644	0.048	-0.213	0.257	0.757
Per capita disposable income	-0.142	-0.073	-0.048	0.931	0.074	0.900
Per capita consumption expenditure	-0.226	-0.234	0.143	0.887	0.014	0.913
Gross enrollment rate of higher education	-0.138	0.574	-0.417	-0.122	-0.400	0.697

The comprehensive score is obtained by weighted calculation with the corresponding variance contribution rate of each factor. The specific formula is as follows:

$$F = (0.165/0.634) \times F_1 + (0.139/0.634) \times F_2 + (0.115/0.634) \times F_3 + (0.109/0.634) \times F_4 + (0.105/0.634) \times F_5 \quad (2)$$

**Table 4.** Comprehensive scores of 30 provinces in China

District	Composite score	Rank	District	Composite score	Rank
Peking	1.274592	1	Hainan	-0.07424	16
Kwangtung	0.72084	2	Tianjin	-0.08474	17
Gansu	0.588414	3	Ji Lin	-0.09936	18
Shanghai	0.523837	4	Liaoning	-0.10263	19
Qinghai	0.409937	5	Sichuan	-0.13433	20
Zhejiang	0.306995	6	Guangxi	-0.18582	21
Shandong	0.29899	7	Ningxia	-0.2221	22
Hunan	0.150546	8	Henan	-0.24897	23
Shaanxi	0.105197	9	Anhui	-0.3188	24
Xinjiang	0.050013	10	Guizhou	-0.32899	25
Hebei	0.049068	11	Inner Mongolia	-0.34361	26
Yunnan	0.013877	12	Fujian	-0.39054	27
Jiangsu	-0.00364	13	Hubei	-0.47446	28
Amur River	-0.00502	14	Jiangxi	-0.49794	29
Shanxi	-0.04082	15	Chongqing	-0.93629	30

The comprehensive scores of the provinces are shown in Table 4. It can be seen that the high-quality economic development of the 30 provinces shows a development pattern of "high in the east, low in the west, high in the coast and low in the inland". Beijing's level of high-quality economic development exceeded that of other provinces, with only 12 provinces scoring more than 0.

## 5. Conclusion and Recommendations

### 5.1. Research Conclusion

Based on the connotation of high-quality economic development, this study constructs a four-level comprehensive evaluation index system, and uses the two-stage factor analysis method to comprehensively measure the level of high-quality economic development of 30 provinces in China in 2020. It is found that the overall level of high-quality economic development of 30 provinces in China is low, and 60% of the provinces' comprehensive score is negative. At the same time, China's high-quality economic development level also faces the problem of unbalanced regional development in space, showing a regional development pattern of "high in the east, low in the west, high in the coast and low in the interior". In addition, the development Angle of China's provinces is also different, the development is uneven, and a few provinces have a "partial" situation.

### 5.2. Policy Suggestions

Based on the above research conclusions, in order to comprehensively and systematically improve the level of high-quality development of China's economy, this paper puts forward the following policy suggestions.

1) To change the economic development model, we should abandon the backward development model of "only GDP theory", and promote the concept of economic development from the pursuit of quantity to the pursuit of quality. We will increase the share of knowledge-intensive and technologically innovative service industries, and promote the upgrading of the economic form and the optimization of the division of labor.

2) Explore a path of high-quality economic development tailored to local conditions. We should take full account of regional differences in resource endowments, harness the strength with the weakness, and jointly improve the level of high-quality economic development in different regions. We will give full play to the leading role of special economic zones and open coastal cities in opening up to the mainland, and actively introduce new energy, new technologies, and related advanced equipment and management models.

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