

# Research on Measuring High-Quality Economic Development in Beijing

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## Abstract

*This paper constructs a three-level evaluation index system for the high-quality development of Beijing's economy from six dimensions and measures the level of high-quality development of the economy from 2000 to 2019 by using entropy weight TOPSIS. The main conclusions are as follows: from the perspective of the comprehensive measurement level, the level of high-quality development of Beijing's economy is constantly improving, but there is still a certain gap from the optimal value; from 2000 to 2004, the growth rate of high-quality development of the economy was slower, with an average annual increase of less than 1%; from the perspective of the measurement level of the first-level indexes, the coordinated development is maintained at 0.17, the open development has seen a small decline, and the remaining four dimensions have an obvious upward trend in the remaining four dimensions.*

## Keywords

*high-quality development, Entropy TOPSIS, measurement level, data envelopment analysis.*

## 1. Introduction

Since the reform and opening up in 1978, China's economy has grown rapidly, with GDP continuing to grow from 0.36 trillion yuan in 1978 to 98 trillion yuan in 2019, and the people's living standards have improved, even achieving full poverty eradication in 2020. Beijing, as the capital of China, has experienced even faster economic growth, with annual GDP growth rates consistently above 10% except in 1981, and more than 15% for 20 years. However, along with the rapid economic growth, problems such as irrational industrial structure, serious environmental pollution, and low economic efficiency have become increasingly prominent.

In December 2017, the Central Economic Work Conference proposed that "socialism with Chinese characteristics has entered a new era, and so has China's economic development, the basic feature of which is that China's economy has shifted from a stage of high-speed growth to a stage of high-quality development". In March 2018, the State Council government work report proposed: "By the requirements of high-quality development, the overall Promote the "five-in-one" overall layout and coordinate the "four comprehensive" strategic layout, adhere to the supply-side structural reform as the main line, and coordinate the work of stabilizing growth, promoting reform, adjusting the structure, benefiting people's livelihood and preventing risks".

As the center of national politics, culture, and international exchange, Beijing's high-quality development is particularly important. In 2009, Beijing proposed the development direction

of "Three Beijing"; in 2015, it proposed the goal of "achieving the peak of carbon emissions around 2020". Since the 18th Party Congress, Beijing has given full play to its advantages in science and technology and talent resources, adhered to the priority of efficiency, vigorously promoted quality change, efficiency change, and power change of economic development, and accelerated the capital's high-quality development. 2017, Beijing Vice Mayor Cheng Hong pointed out when attending the CPPCC meeting that "the high-end economy is the urgent need to implement the capital's functional positioning, and Beijing should do industry cabbage heart, do not do cabbage help." "In the 13th Five-Year Plan period, Beijing's industrial structure has been deeply adjusted, focusing on "high precision" and concentrating on "cabbage heart", and the digitalization and high-end characteristics of the industry have been highlighted.

This paper starts by sorting out the current status of research on high-quality development at home and abroad, combining with Beijing's capital function positioning, constructing an evaluation index system for high-quality development of Beijing's economy, and measuring high-quality development of Beijing's economy, to provide theoretical support for deepening high-quality development of Beijing's economy.

## 2. Literature Review

High-quality development is a shared development that meets people's needs for a better life. Based on a thorough study of the central government's spirit, academics interpret the connotation of high-quality development from two perspectives: "five development concepts" and "efficient and effective production methods", and use them to The corresponding evaluation index system constructed.

High-quality economic development, as a concrete embodiment of the five development concepts of "innovation, coordination, greenness, openness and sharing", is also clearly explained by the central government: "Development in which innovation becomes the first driving force, coordination an endogenous feature, greenness a universal pattern, openness an indispensable path, and sharing a fundamental purpose". According to the central government's explanation, Yang Xinhong constructed a socioeconomic development evaluation index system containing five parts innovation, coordination, green, openness, and sharing with a total of 37 indicators from the five development concepts(Yang Xinhong,2017). Scholars such as Zhao Ruyu Chang Zhongli and Zhou Ji divided high-quality economic development into six dimensions: economic development, innovation development, coordination development, green development, open development, and shared development from the actual economic development of China at present and the guiding concept of China's high-quality economic development under the new normal(Zhao Ruyu et al.,2020; Zhou Ji et al.,2019). Some scholars have selected some representative characteristics from the five development concepts to construct an evaluation index system. Li Jinchang et al, Yang Yang et al, Zhang Man and Xu Qifa, Yang Renfa and Yang Chao constructed an evaluation index system for high-quality economic development in different regions from five dimensions: economic development, innovation development, green development, people's life, and social harmony(Li Jinchang et al.,2019; Yang Yang et al.,2021; Xu Qifa et al.,2021; Yang Renfa et al.,2019). Zhao Yu et al and Fang Ruonan et al constructed the index system of economic high-quality development from four dimensions: economic development, scientific and

technological innovation, ecological and environmental protection, and coordination and sharing(Zhao Yu et al.,2020; Fang Ruonan et al.,2021). Guanghua Wan and Jiaying Lu take people's happiness as the target orientation and construct the index system of economic development quality from three dimensions of people's lives, economic development and social development(Guanghua Wan et al.,2021). Shi Bo and Han Xueying evaluated the high-quality development of China's real economy from the fundamental side of economic development and the social and ecological outcome side(Shi Bo et al.,2020). Some scholars have expanded the indicators based on the five development concepts. Liu Fei and Gong Ting constructed a comprehensive evaluation index system of high-quality development in Hubei Province from six guideline layers of innovation, coordination, green, openness, sharing, and development(Liu Fei et al.,2021). Ling Lianxin and Yang Guoliang evaluated the high-quality economic development of the Guangdong-Hong Kong-Macao Greater Bay Area from six dimensions of innovation, coordination, green, openness, sharing, and security(Ling Lianxin et al.,2021). Zhang Zhen constructed the indicator system from seven dimensions: economic development dynamics, new industrial structure, transportation and information infrastructure, openness of economic development, coordination of economic development, green development, and sharing of economic development(Zhang Zhen et al.,2019).

Since there are different academic elaborations on the definition of high-quality development, the evaluation index system has its characteristics, and the measurement results of the level of high-quality development vary greatly, constructing a scientific and reasonable evaluation index system for high-quality economic development is a key and difficult issue for research. Based on the study of the connotation of high-quality development, this paper constructs the evaluation index system of high-quality development of Beijing's economy with full consideration of Beijing's capital function positioning and measures it to enrich the theory and application of high-quality development of the economy.

### **3. Measurement of the level of quality economic development**

#### **3.1. Construction of the evaluation index system for high-quality economic development**

Due to the vast size of China and practical issues such as geographical location, resource endowment, and policy differences, the situation of high-quality economic development varies among different provinces and regions. At present, studies on the measurement of high-quality economic development in China mainly focus on two levels: provincial and regional. In this paper, by sorting out the connotation of high-quality economic development, it is considered that high-quality economic development in the new era is an economic development model of comprehensive and efficient economic development guided by the five major development concepts of "innovation, coordination, green, openness, and sharing", concerning Zhao Ruyu and Chang Zhongli, Li Jinchang et al, Ma Ru et al, and Wei Min and Li Shuhao. , Wei Min and Li Shuhao and other scholars' research results, combined with the actual situation of Beijing's economic development and fully considered Beijing's capital function, the evaluation index system of Beijing's high-quality economic development, which contains 15 secondary indicators and 33 tertiary indicators, is constructed from six primary indicators of economic development, innovation development, coordinated development, green development, open development, and shared development, as shown in Table 1.

**Table 1:** Evaluation index system of high-quality economic development in Beijing

Level 1 Indicators	Secondary indicators	Tertiary indicators	Efficacy
Economic Development (A1) (0.21)	Economic Development (B1) (0.06)	Economic growth rate (C1) (0.04)	+
		Share of economic development in the country (C2) (0.02)	+
	Income level (B2) (0.07)	GDP per capita (C3) (0.03)	+
		Disposable income per capita (C4) (0.04)	+
	Consumption level (B3) (0.08)	Total retail sales of social consumer goods (C5) (0.04)	+
		Consumer Price Index (C6) (0.04)	-
Innovative Development (A2) (0.14)	Innovation Inputs (B4) (0.06)	R&D investment intensity (C7) (0.03)	+
		R&D personnel investment efforts (C8) (0.03)	+
	Innovation Output (B5) (0.08)	Number of patents granted (C9) (0.04)	+
		Technology Market Turnover Share (C10) (0.04)	+
Coordinated Development (A3) (0.12)	Industry Coordination (B6) (0.06)	Contribution rate of primary industry (C11) (0.01)	+
		Contribution rate of secondary industry (C12) (0.02)	-
		Contribution of tertiary industry (C13) (0.03)	+
	Urban-rural coordination (B7) (0.06)	Disposable income ratio of urban and rural residents (C14) (0.02)	-
		Urbanization level (C15) (0.04)	+
Green Development (A4) (0.20)	Greening and environmental protection (B8) (0.07)	Urban greening coverage rate (C16) (0.03)	+
		Green space per capita (C17) (0.04)	+
	Energy saving and emission reduction (B9) (0.13)	Sewage treatment rate (C18) (0.03)	+
		Harmless disposal rate of domestic waste (C19) (0.01)	+
		Sulfur dioxide emissions per unit of GDP (C20) (0.03)	-
		Solid waste emissions per unit of GDP (C21) (0.02)	-
		Wastewater emissions per unit of GDP (C22) (0.04)	-

Open Development (A5) (0.10)	Foreign Investment (B10) (0.03)	The degree of foreign capital utilization (C23) (0.03)	+
	International Trade (B11) (0.07)	Degree of foreign trade dependence (C24) (0.03)	+
		Foreign trade quality (C25) (0.04)	+
Shared Development (A6) (0.23)	Cultural and educational level (B12) (0.06)	Number of students enrolled in undergraduate programs and above (C26) (0.02)	+
		Total number of books in the library (C27) (0.04)	+
	Medical and health care level (B13) (0.07)	Number of beds in medical and health institutions (C28) (0.04)	+
		Population mortality rate (C29) (0.03)	-
	Employment level (B14) (0.04)	Non-farm employment level (C30) (0.03)	+
		Urban registered unemployment rate (C31) (0.02)	-
	Infrastructure Development Level (B15) (0.05)	Urban road area (C32) (0.02)	+
		Public toilets per 10,000 people (C33) (0.03)	+

Note: "+ (-)" in the "Efficacy" column indicates that the measure is a positive (negative) indicator under the set measurement method.

### 3.2. Measurement of economic quality development level

The measurement methods of economic quality development level mainly focus on entropy method, entropy TOPSIS, principal component analysis, cluster analysis, factor analysis, subjective and objective assignment method, etc.

This paper selects data from Beijing from 2000-2019 and measures the level of high economic high-quality development using the entropy-weighted TOPSIS method, with data from the China Statistical Yearbook and the Beijing Statistical Yearbook.

Since there are more indicators of high-quality economic development, different levels of measurement among the indicators, and large differences in the order of magnitude of the indicators, the indicators are first dimensionless processed. In this paper, we choose the extreme value method to dimensionlessly process the economic quality development indicators.

For positive indicators treated according to equation (1).

$$x'_{ij} = \frac{x_{ij} - m_j}{M_j - m_j} \quad (1)$$

For negative indicators treated according to equation (2).

$$x'_{ij} = \frac{M_j - x_{ij}}{M_j - m_j} \quad (2)$$

where  $i = 1, \dots, m$  denotes the time,  $j = 1, \dots, n$  denotes the indicator,  $x_{ij}$  denotes the original value of the economic quality development indicator,  $x'_{ij}$  denotes the data after dimensionless processing,  $M_j$  denotes the maximum value of  $x_{ij}$ , and  $m_j$  denotes the minimum value of  $x_{ij}$ .

The extreme value method is to transform all the values of the indicators into the interval [0, 1]. To meet the requirements of the operation, it is necessary to shift all the indicators to the right by one unit after dimensionless processing, see Equation (3), where  $y_{ij}$  denotes the data after shifting by one unit.

$$y_{ij} = 1 + x'_{ij} \quad (3)$$

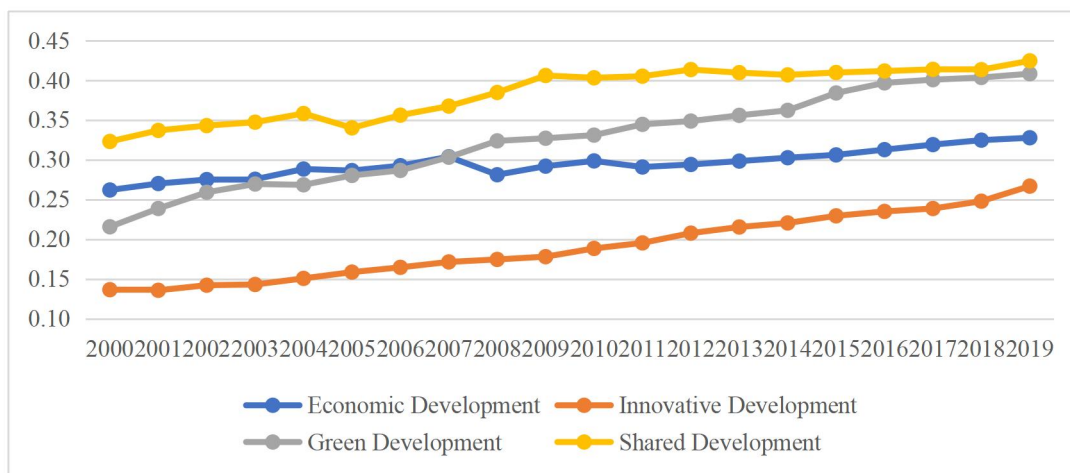
For the panned data, its information entropy is calculated according to Equation (4).

$$H_j = -\frac{1}{\ln(n)} \cdot \sum_{i=1}^m \left( \frac{y_{ij}}{\sum_{i=1}^m y_{ij}} \cdot \ln\left(\frac{y_{ij}}{\sum_{i=1}^m y_{ij}}\right) \right) \quad (4)$$

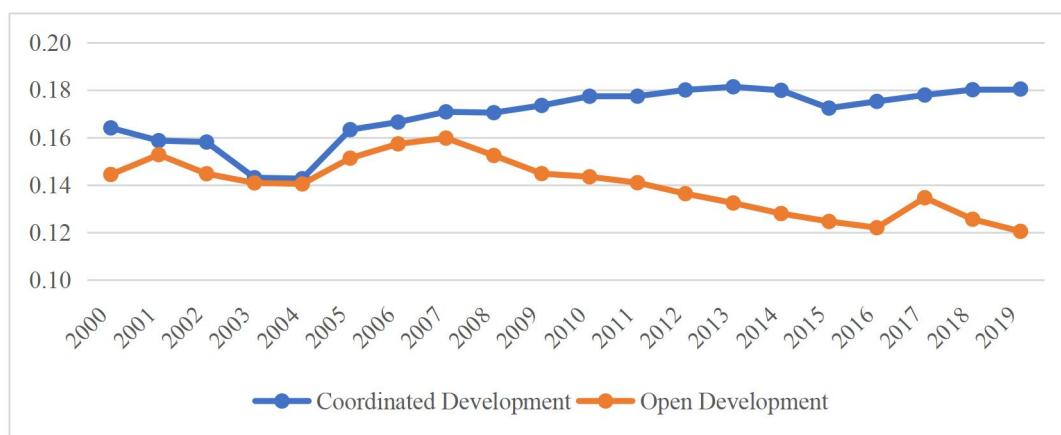
The entropy weighting method is to determine the weights according to the size of information reflected by the degree of difference of the values of each evaluation index. The greater the degree of difference of the data, the greater the amount of information, the smaller the information entropy will be, and thus the greater the weight of the index should be in the comprehensive evaluation. The degree of difference of each evaluation index is shown in formula (5), the weight of each evaluation index is shown in formula (6), and the weight of each evaluation index of the high-quality economic development of Beijing is shown in Table 1.

$$G_j = 1 - H_j \quad (5)$$

$$W_j = \frac{G_j}{\sum_{j=1}^n G_j} \quad (6)$$



**Figure 1:** Graph of changes in the first-level indicator measure of Beijing's high-quality economic development (1)

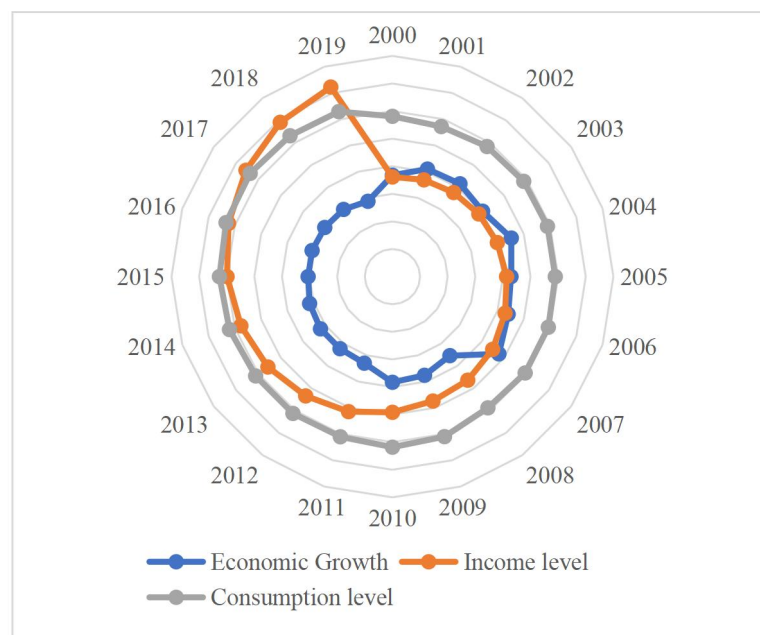


**Figure 2:** Changes in the first-level indicators of Beijing's high-quality economic development (2)

Based on the weights of the indicators at all levels of economic quality development in Table 1, the development levels of six primary indicators of economic quality development in Beijing from 2000 to 2019 are measured. As shown in Figure 1 and Figure 2, there are obvious upward trends in the level of economic development, innovation development, green development, and shared development from 2000 to 2019, and the level of coordinated development has always maintained a small fluctuation around 0.17, while the level of open development has seen a small decline.

The primary indicator of economic development is composed of three secondary indicators: economic growth, income level, and consumption level. Under the economic growth indicator system, the economic growth rate declined from 12% to 6.1%, showing a downward trend overall; the proportion of economic development in the country remained stable, with a slight decrease, so the overall level of economic growth measurement is in a declining state. Under the income level index system, GDP per capita and disposable income per capita have an obvious upward trend, and the measurement of income level is in an upward state overall. Under the indicator system of consumption level, the total retail sales of consumer goods increased significantly, and the consumer price index increased slightly, and the measure of consumption level also had an upward trend, see Figure 3. In 2008 and 2009, the economic crisis led to a decrease in the economic development measure, while in other years, the

economic development measure increased steadily, but the increase was not significant, with an average annual increase of 1.3%.



**Figure 3:** Economic development level measurement chart 2000-2019

The measure of innovation development level increased from 0.14 to 0.27, which shows that innovation development varies very obviously among different years. 2000-2004 the measure of innovation development level was relatively low, maintained at 0.14 basically, and after 2004, with the determination of the development direction of science and technology in Beijing, innovation input and innovation output both showed a significant increase, making innovation development level in After 2004, with the development direction of science and technology Beijing, innovation input and innovation output both increased significantly, making the level of innovation development the fastest among all indicators, with an increase of over 93%. This is consistent with the development direction of "Science and Technology Beijing", and is also necessary for high-quality development.

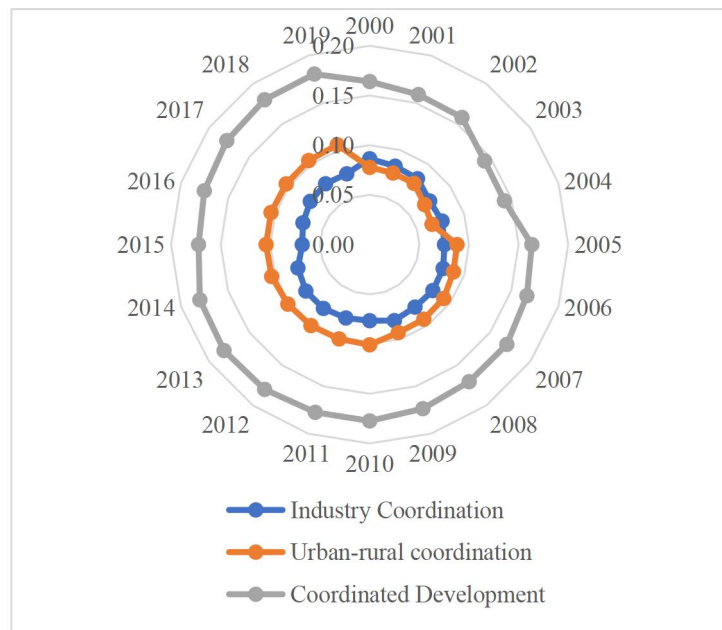
The green development level measure increased from 0.22 to 0.41, an increase of more than 86%, which is slightly lower than the growth rate of the innovation development level. Under the green development index system, except for the small increase in wastewater emissions per unit of GDP, all the other tertiary indicators increased by more than 5%, which is consistent with the development direction of Green Beijing.

The shared development level measure increased from 0.32 to 0.42, an increase of about 32%. Although the increase is stable, the level of shared development measure is the highest among the six indicator systems. This indicates that Beijing has achieved better results in the level of culture and education, health care, employment, and infrastructure development.

The contribution rate of the primary industry remains unchanged under the set of coordinated development indicators; the contribution rates of the secondary and tertiary industries show a complementary change curve of decline and rise; the level of urbanization in Beijing is relatively high, showing a small rise from 2000 to 2019; the disposable ratio of urban and rural residents first increases and then decreases, but the change is small, from 2.34 value-added 2.77 and then decreases to 2.55. In the indicator set Under the common

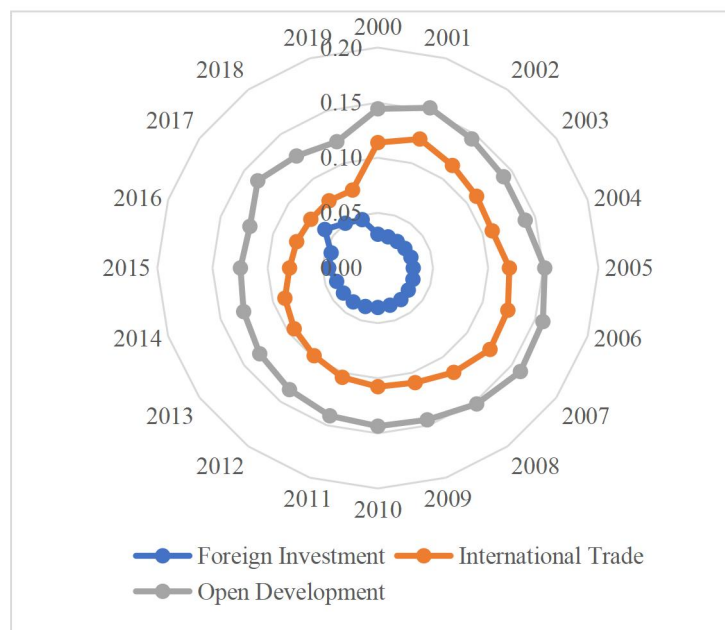


effect of the indicator set, the coordinated development level measure maintains fluctuating around 0.17, see Figure 4.



**Figure 4:** 2000-2019 Coordinated Development Level Measurement Chart

The level of open development is the only one with a decreasing trend among the six indicator systems. Under the index set of open development level, the total utilization of real foreign investment shows an increase, and the proportion of total import and export to GDP remains unchanged, but the proportion of high-tech products in the total import and export of goods shows a certain degree of decrease, resulting in the decrease of open development measure level from 0.14 to 0.12, see Figure 5.



**Figure 5:** 2000-2019 open development level measurement chart

After measuring the weights among indicators at all levels using the entropy weighting method, the TOPSIS method was used to measure the comprehensive level of high-quality

development from 2000 to 2019.

First, the optimal solution  $Y^+$  and the worst solution  $Y^-$  for the high-quality economic development of Beijing from 2000 to 2019 are determined according to Equation (7) and Equation (8).

$$Y^+ = \left( \max_{1 \leq i \leq m} y_{i1}, \max_{1 \leq i \leq m} y_{i2}, \dots, \max_{1 \leq i \leq m} y_{in} \right) \quad (7)$$

$$Y^- = \left( \min_{1 \leq i \leq m} y_{i1}, \min_{1 \leq i \leq m} y_{i2}, \dots, \min_{1 \leq i \leq m} y_{in} \right) \quad (8)$$

Based on the weights of the indicators at each level of economic quality development in Table 1, the weighted Euclidean distances  $d^+$  and  $d^-$  of the economic development level from the optimal and worst solutions of quality development in 2000-2019 are measured according to Equation (9) and Equation (10).

$$d_i^+ = \sqrt{\sum_{j=1}^n W_j (y_{ij} - Y^+)^2} \quad (9)$$

$$d_i^- = \sqrt{\sum_{j=1}^n W_j (y_{ij} - Y^-)^2} \quad (10)$$

The smaller the  $d^+$  indicates the closer to the optimal solution of economic quality development, and the larger the  $d^-$  indicates the farther from the worst solution. To combine the two distances, "proximity"  $C_i$  is used to describe the level of high-quality economic development, which is shown in Equation (11).

$$C_i = \frac{d_i^-}{d_i^+ + d_i^-} \quad (11)$$

**Table 2:** Comprehensive measure of the level of high-quality economic development in Beijing, 2000-2019

Year	High Quality Development Measure (Entropy Power TOPSIS)	Year	High Quality Development Measure (Entropy Power TOPSIS)
2000	0.22	2010	0.57
2001	0.25	2011	0.59
2002	0.27	2012	0.63
2003	0.25	2013	0.65
2004	0.29	2014	0.65
2005	0.32	2015	0.68
2006	0.39	2016	0.72

2007	0.46	2017	0.73
2008	0.48	2018	0.73
2009	0.54	2019	0.75

The range of the closeness of the economic quality development level is within the interval [0, 1], and the closer the closeness to 0, the lower the level of economic quality development; conversely, the closer the closeness to 1, the higher the level of economic quality development. 2000-2019 Beijing's comprehensive measure of economic quality development level is shown in Table 2.

From the comprehensive measure of Beijing's high quality economic development level, the lowest measured level was only 0.22 in 2002. The highest measured level was 0.75 in 2019, with an average score of 0.51, standard deviation of 0.19, and an average annual increase of 2.8%, which indicates that from 2000 to 2019. However, the level of Beijing's high-quality economic development has been improving, it is still far from the optimal value. There is a certain gap, and there are obvious differences in the level of high-quality economic development between different years.

During 2000-2004, the growth rate of high-quality economic development was slow, with an average annual increase of less than 1%. It is mainly caused by the slow growth of the innovation development level measure in 2000-2004. 2005-2013, the economic high-quality development grew faster, with an average annual increase of more than 4%. during this period, with the introduction of the 3 Beijing development strategies, innovation development and green development rose rapidly. Economic development, coordinated development and shared development also increased to different degrees, making the high-quality development. From 2014 to 2019, the level of economic high-quality development increased from 0.65 to 0.75. The growth rate slowed down, mainly because after the high-quality development reached a certain level, the increase of economic development, innovation development, and green development slowed down. Coordinated development, open development and shared development were maintained at a certain high level without significant changes during this period.

#### 4. Conclusion

A scientific and reasonable index system is the key to statistical analysis. In this paper, based on an in-depth analysis of the connotation and characteristics of high-quality economic development, we construct an evaluation index system for high-quality economic development in Beijing from six dimensions: economic development, innovation development, coordinated development, green development, open development and shared development, and use entropy-weighted TOPSIS and data envelopment analysis model with non-expected output to measure the level of high-quality economic development as well as efficiency in Beijing from 2000 to 2019, with the following main conclusions.

(1) From the measurement levels of the primary indicators, the level of economic development, the level of innovation development, the level of green development, and the level of shared development all have an obvious upward trend from 2000 to 2019, the level of coordinated development maintains little fluctuation above and below 0.17, while the level of open development shows a small decline.

(2) From the comprehensive measurement level, the lowest measurement level was only 0.22 in 2002. The highest measurement level was 0.75 in 2019, with an average score of 0.51, standard deviation of 0.19, and an average annual increase of 2.8%, indicating that although the level of high-quality economic development in Beijing from 2000 to 2019 has been improving, there is still a certain gap from the optimal value. There is a significant difference between different years. There are obvious differences in the level of high-quality economic development.

To actively promote the high-quality development of Beijing's economy, the following policy recommendations are made based on the findings of the above study.

(1) Pay attention to high-quality economic development. General Secretary Xi Jinping clearly pointed out in the report of the 19th Party Congress that "Socialism with Chinese characteristics has entered a new era, and the main contradiction of our society has transformed into the contradiction between people's growing need for a better life and unbalanced and insufficient development." Although the level of high-quality development of Beijing's economy is progressing, there is still a certain gap. We should take into account the local conditions, fully consider the positioning of Beijing's capital function, change our mindset, change the focus of economic development from speed to quality, and accelerate the realization of high-quality economic development in Beijing.

(2) Pay attention to the all-around high-quality economic development. High-quality economic development is a five-in-one development. Although the measurement level of high-quality economic development is progressing, the measurement level of some indicators remains the same or even tends to decline, so we should give full play to Beijing's advantages in science and technology and talents, increase the development of innovation, improve the level of modern service industry, expand high-tech foreign trade, and let more residents enjoy the green development and shared development brought by good life.

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