

Study on the Influence Factors of AHP-Grey Association Analysis on Regional GDP in Heilongjiang Province

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Abstract: Nowadays, with the comprehensive release of the epidemic in China, economic recovery has become the main tone of development. GDP, as a comprehensive statistical indicator of economic development, its influencing factors have gradually become a research topic that economists pay more and more attention to. Based on this, according to the influencing factors of GDP in Heilongjiang Province, comprehensive hierarchical analysis method and gray association analysis method can study the factors influencing the GDP of the region. The results show that the total output value of agriculture, the added value of accommodation and catering industry, the crude oil output and the total forestry output value are the main factors affecting the regional GDP of Heilongjiang Province.

Keywords: Heilongjiang Province GDP; Hierarchy Analysis; Grey Correlation Analysis

Introduction

Gross domestic product as an important indicator of a country's economic situation, the core indicators in the national economic accounting system, the international community of concern, not only is often regarded as an important reference for the balance competitiveness and evolution potential, and has great significance to the economic policy and development strategy, and GDP as a measure of economic scale in a region occupies an important position in the domestic economy. Therefore, in view of the influence factors of GDP in Heilongjiang province, from the first, second, third industry selected 12 positive indicators for influencing factors, namely the agricultural output (one hundred million yuan), forestry output (one hundred million yuan), animal husbandry output (one hundred million yuan), fishery (one hundred million yuan), construction added value (one hundred million yuan), crude oil production (ten million tons), steel production (ten thousand tons), electricity, wholesale and retail value (one hundred million yuan), transportation, warehousing and added value of postal service (one hundred million yuan), accommodation and catering value (one hundred million yuan), the added value of financial industry (one hundred million yuan), respectively. $X_i (i = 1, 2, \dots, 12)$.

1. Study on the influencing factors of GDP in Heilongjiang Province based on hierarchical analysis

First, the relevant data as shown in Figure 1.

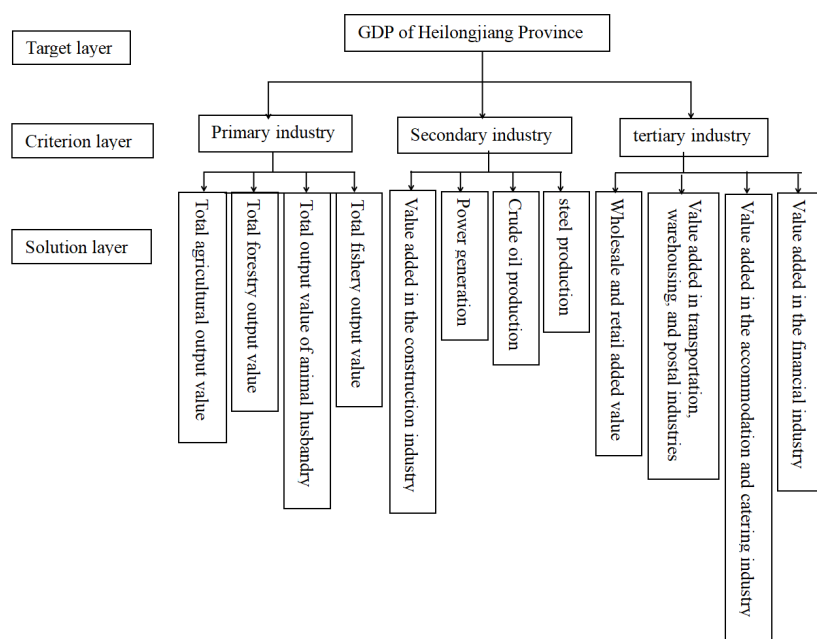


Figure 1. A hierarchy diagram

Based on this, YAAHP software can obtain the subjective weight of the consistency test of the judgment matrix at all levels as shown in Table 1.

Table 1. Subjective weights of each influencing factor

metric	weight ($W_{\text{hierarchy}-X_i}$)
X_1	0.2642
X_3	0.1970
X_1	0.1379
X_6	0.0920
X_2	0.0798
X_0	0.0746
X_4	0.0479
X_8	0.0379
X_2	0.0232
X_5	0.0205
X_9	0.0162
X_7	0.0089

According to Table 1, the influencing factors of Heilongjiang GDP derived from the hierarchical analysis method are ranked from strong to weak:

$$W_{\text{hierarchy}-X_1} > W_{\text{hierarchy}-X_3} > W_{\text{hierarchy}-X_1} > W_{\text{hierarchy}-X_6} > W_{\text{hierarchy}-X_2} > W_{\text{hierarchy}-X_0} > W_{\text{hierarchy}-X_4} > W_{\text{hierarchy}-X_8} > W_{\text{hierarchy}-X_2} > W_{\text{hierarchy}-X_5} > W_{\text{hierarchy}-X_9} > W_{\text{hierarchy}-X_7}, \quad W_{\text{hierarchy}-X_i}$$

It represents the weight of the i th index of hierarchical analysis.

2. Study on the influencing factors of GDP in Heilongjiang Province based on the grey association method

Considering the existence of subjective consciousness in the construction of the hierarchical analysis system, on the basis of the averaging of the data, the GDP of Heilongjiang Province as the reference column, gray correlation analysis and SPSSAU web pages to obtain the gray correlation degree of each factor as shown in Table 2.

Table 2 The influencing factors, correlation values

metric	Correlation degree
total value of farm output	0.802408893
Total output value of forestry	0.692398237
Total output value of animal husbandry	0.677978368
Value added of accommodation and catering industry	0.677283066
Value-added of transportation, storage and postal services	0.676997234
generating capacity	0.666749017
Crude oil production	0.661175866
The added value of financial industry	0.653459447
Construction added value	0.650643612
Wholesale and retail value added	0.647817322
Total output value of fishery	0.615681222
Steel production	0.581953602

Table 2 shows that the objective degree of the factors affecting the GDP of Heilongjiang Province is ranked as follows:

$W_{entropy - X_1} > W_{entropy - X_2} > W_{entropy - X_3} > W_{entropy - X_{11}} > W_{entropy - X_{10}} > W_{entropy - X_8} > W_{entropy - X_6}$
 $> W_{entropy - X_{12}} > W_{entropy - X_5} > W_{entropy - X_9} > W_{entropy - X_4} > W_{entropy - X_9}$

$W_{entropy - X_i}$, Which represents the weight of the i th index of the gray association method.

3. Study on the comprehensive influencing factors of GDP in Heilongjiang Province

Considering the disadvantages that the subjective empowerment of hierarchical analysis is too subjective and too objective, the following equation 3-1 is used to combine the two to realize the organic unity of subjective and objective empowerment.

$$W_{always - X_j} = \frac{W_{hierarchy - X_i} \times W_{entropy - X_i}}{\sum_{j=1, i=1}^n (W_{hierarchy - X_i} \times W_{entropy - X_i})} \quad (3-1)$$

Based on this, according to Table 1, Table 2 and equation 3-1, the comprehensive weight of the influencing factors of Heilongjiang GDP is obtained. As shown in Table 3.

Table 3. Comprehensive weights

	X_1	X_2	X_3	X_4	X_5	X_6
$W_{entropy - X_i}$	0.1002	0.0865	0.0846	0.0769	0.0812	0.0826
$W_{hierarchy - X_i}$	0.2642	0.0798	0.197	0.0479	0.0205	0.092
$W_{always - X_i}$	0.3009	0.0784	0.0418	0.0189	0.0863	0.0073

Table 3 Comprehensive weights (continued)

	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}
$W_{entropy - X_i}$	0.0727	0.0832	0.0809	0.0845	0.0846	0.0816
$W_{hierarchy-X_i}$	0.0089	0.0379	0.0162	0.0746	0.1379	0.0232
$W_{always - X_i}$	0.0126	0.0358	0.0148	0.0716	0.1325	0.0215

According to the comprehensive weights in Table 3, the degree of influence after the comprehensive subjective and objective analysis is ranked by

$$W_{always - X_1} > W_{always - X_{11}} > W_{always - X_5} > W_{always - X_2} > W_{always - X_{10}} > W_{always - X_3} > W_{always - X_8} > W_{always - X_{12}} > W_{always - X_4} > W_{always - X_9} > W_{always - X_7} > W_{always - X_6}$$

4. Conclusion

Based on the statistical data of Heilongjiang Province from 2010 to 2021, the hierarchical analysis and gray association analysis were used to study the factors affecting the GDP of Heilongjiang Province, combined with the subjective and objective analysis results, the comprehensive weight was determined and relevant conclusions were obtained. According to the results and the current situation of Heilongjiang Province, the following suggestions are put forward. (1) Ensure the basic plate of agriculture, forestry, animal husbandry and fishery. As the main influencing factor of the GDP of Heilongjiang Province, the primary industry should seize this huge potential, appropriately introduce advanced equipment, improve the technical level, promote the upgrading of original products, take the road of joint development, and realize the innovative circular industrial chain to ensure the steady progress in the original advantages. (2) Improve the level of industrial development. According to the analysis results, steel and other industries accounted for a relatively low proportion. As an old industrial base, Heilongjiang can integrate information technology, high and new technology with industry, change the traditional development mode of industrialization, take the development road of new industrialization, so as to revitalize the development and change the embarrassing situation. (3) Strengthen the development of new virtual industries. According to the results, it can be seen that the financial and other export industries have a low impact, so it can strengthen the exchange and cooperation with foreign enterprises, and increase the efforts to introduce technical talents and excellent foreign capital to Heilongjiang Province, so as to improve the capital flow, so as to promote the GDP growth of Heilongjiang Province.

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[Fund Project] 2018 Youth Cultivation Program of Provincial. Department of Education (1353MSYQN008); General Project of College Education and Teaching Reform in 2021 (SJGY20210898, SJGY20210890); General Project of College Education and Teaching Reform in 2022 (SJGY20220609)