Research on Sustainable Economic Development of Hebei Province

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Abstract This paper first constructed the regional economic impact of sustainable development including economic, social, population, resources and environmental aspects of the comprehensive index system, then, according to AHP calculate the various factors on the sustainable economic development impact of weight, finally, based on the data of 11 cities 2007, using the method of principal components to calculate the score of 11 cities sustainable economic development.

Key words Regional, Economic, Sustainable development

1 Introduction

At present, economic development is the most important task in our country. China's economy is also developing rapidly in recent years, GDP growth has been steady at around 10 percent. At the same time, the problem of sustainable economic development is also prominent, and economic development cannot be unrestrained energy-consuming, not to damage the ecological environment as the prerequisite.

In order to more comprehensive understanding of sustainable economic development in Hebei Province, the paper used AHP and principal component analysis 11 cities of Hebei Province.

2 Composite Index System Construction

In order to reflect the actual situation more fully, the comprehensive index system should be constructed, we first explain all the indicators on economic, social, population, resources and the environment.

2.1 Economic indicators

The direct economic indicators to reflect the level of economic development.
(1) Per capita GDP. It reflects a single man-made economic development the contribution made by, but also reflects the changes in per capita income and resources change.
(2) per capita investment in fixed assets. Investment in fixed assets is an enterprise or government for the purchase of life expectancy for more than a year of goods (such as cars, land, equipment) or construction of infrastructure (such as bridges, houses, roads) the cost, it reflects the degree of economic prosperity.
(3) all-personnel labor productivity. It is able to reflect the economic prosperity of other factors.
(4) The second and tertiary industries in the GDP proportion of the output. It reflects the GDP in the second and tertiary industries in the contribution of the situation.
(5) R & D expenditures percent of GDP. It direct impact on the scientific and technological progress, thereby affecting economic development.
(6) GDP growth. The economic indicator in the assessment of sustainable development occupies a very important position.
(7) Per capita retail sales of consumer goods, It reflects the economic prosperity.

2.2 social indicators

Social development is sustainable economic development of external support.
(1) Urbanization rate. This indicator can also be said to be Chengzhenhualv. Urbanization is the progress of civilization of human society and the inevitable result of economic development.
Urbanization rate = non-agricultural population / total population
(2) Gini coefficient.
Gini coefficient = A / (A + B)  \hspace{1cm} (1)
A-actual person or persons to the distribution curve and the distribution of absolute equality between the area
B-real people at the lower right corner of the area of distribution curve
(3) doctors Per million people. It reflects the region's medical standards.
(4) Per capita housing area. It reflects the living conditions of residents, on the other hand reflect the change in real estate development, According to statistics, a real estate investment activities, the corresponding more than 100 will lead to the development of the industry.
(5) Education expenses. It reflects the importance of the development of education. Increase investment in education can provide the necessary human resources.
(6) Unemployment rate. It reflects the people's poverty. The unemployment rate=the unemployed population/number of employees* 100%
(7) Social security coverage.
Old-age insurance enrollment rate = participation in the pension insurance /the number of total labour force*100%
(8) Road network density. It reflects the region's traffic and transport situation.

2.3 demographic indicators
The impact of demographic is one of the key to sustainable economic development.
(1) Population density. It reflects the region's population intensive.
(2) The natural population growth. It belongs to pressure indicators.
(3) Practitioners burden coefficient. It reflects the structural conditions of employees in the entire society. Practitioners burden coefficient = total population of the whole society / the economically active population
(4) Enrolment rate of school-age children. It reflects the level of education for all regions.
(5) Proportion of the population over the secondary. It reflects the higher education of the population.

2.4 resource indicators
In recent years, due to rapid economic growth in Hebei Province, which faces the problem of resource constraints.
(1) Per capita possession of natural resources.
D used to indicate the per capita possession of natural resources,
\[ D = \sqrt{d_1d_2d_3d_4d_5} \]  \hspace{1cm} (2)
d_1, d_2, d_3, d_4, d_5 on behalf of the volume index of the per capita water resources, land resources, forest resources, mineral resources and energy.
\[ d_i = \frac{r_i}{r_0} \]  \hspace{1cm} (3)
\( r_i \) -- Region's per capita possession of resources
\( r_0 \) -- The country's per capita possession of resources
(2) Reclamation rate. It reflects the regional reserve of arable land resources. calculated as follows:
Reclamation rate = \[ \frac{ns}{gs} \]  \hspace{1cm} (4)
\( ns \) -- Sown area of crops
\( gs \) -- Area of arable land
(3) Effective irrigation area. It reflects the region's water resources and agricultural production coordination.
2.5 Environmental indicators
(1) Rate of groundwater pollution. It reflects the production of water pollution.
(2) Coordinating economic environment factor. Pollutant emissions by an average annual growth rate of economic growth and the ratio of the average annual growth rate.
(3) The economic losses caused by pollution proportion. It reflects the impact of economic development.
(4) Investment in the GDP proportion of pollution control. It reflects the efforts of restore the state of the environment.
(5) Sound pollution

3 Sustainable development of the regional economic impact of the weights of the factors identified of Hebei Province

AHP is the decision-making and the elements are broken down into goals, guidelines, programmes and other levels, based on qualitative and quantitative analysis of the decision-making methods.

<table>
<thead>
<tr>
<th>Economic indicators</th>
<th>A1</th>
<th>Per capita GDP, per capita investment in fixed assets, all-personnel labor productivity, The second and tertiary industries in the GDP proportion of the output, R &amp; D expenditures percent of GDP, GDP growth, Per capita retail sales of consumer goods</th>
</tr>
</thead>
<tbody>
<tr>
<td>social indicators</td>
<td>A2</td>
<td>Urbanization rate, Gini coefficient, doctors per million people, Per capita housing area, Education expenses, Unemployment rate, Social security coverage, Road network density</td>
</tr>
<tr>
<td>Demographic indicators</td>
<td>A3</td>
<td>Population density, The natural population growth, Practitioners burden coefficient, Enrolment rate of school-age children, Proportion of the population over the secondary</td>
</tr>
<tr>
<td>Resource indicators</td>
<td>A4</td>
<td>Per capita possession of natural resources, Reclamation rate, Effective irrigation area, Consumption of renewable resources</td>
</tr>
<tr>
<td>Environmental indicators</td>
<td>A5</td>
<td>rate of groundwater pollution, Coordinating economic environment factor, The economic losses caused by pollution proportion, Investment in the GDP proportion of pollution control, Sound pollution</td>
</tr>
</tbody>
</table>

First step towards the establishment of judgement matrix, here we use a scale compared to September compared matrix structure in pairs.

### Figure 2 The norm and connotation of judge matrix

<table>
<thead>
<tr>
<th>Scaling</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equally important</td>
</tr>
<tr>
<td>3</td>
<td>The former than the latter slightly important</td>
</tr>
<tr>
<td>5</td>
<td>The former than the latter obviously important</td>
</tr>
<tr>
<td>7</td>
<td>The former than the latter strongly important</td>
</tr>
<tr>
<td>9</td>
<td>The former than the latter extremely important</td>
</tr>
<tr>
<td>2, 4, 6, 8</td>
<td>The two neighboring judging the value of intermedia</td>
</tr>
</tbody>
</table>

Countdown: If the element i and j elements of the importance of the ratio above a certain value for aij, elements j and an important element of i, aij = 1/aij
A matrix of the elements of judgement. A layer to the various elements of February 2, according to the investment environment in the evaluation of the importance of the establishment of O-A judgement matrix.

### Figure 3  Judgment shower

<table>
<thead>
<tr>
<th></th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
<th>A5</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>A2</td>
<td>1/2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>A3</td>
<td>1/3</td>
<td>1/2</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>A4</td>
<td>1/4</td>
<td>1/5</td>
<td>1/2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>A5</td>
<td>1/5</td>
<td>1/4</td>
<td>1/3</td>
<td>1/2</td>
<td>1</td>
</tr>
</tbody>
</table>

The second step "sum" seek the judgement of the features of vector and matrix characteristics of the largest root, and do consistency test.

\[
A = \begin{bmatrix}
1 & 2 & 3 & 4 & 5 \\
1/2 & 1 & 2 & 3 & 4 \\
1/3 & 1/2 & 1 & 2 & 3 \\
1/4 & 1/5 & 1/2 & 1 & 2 \\
1/5 & 1/4 & 1/3 & 1/2 & 1 \\
\end{bmatrix}
\]  

(5)

Eigenvector of \(A\) \(\bar{W} = \begin{bmatrix} W_1 \\
\cdots \\
W_n \end{bmatrix}\)  

(6)

the characteristic root \(\lambda_{\text{max}}\)

1. \(A = (a_{ij})_{5 \times 5}\) In the series:

\[
A(\bar{W}_i)_{5 \times 5} = \begin{bmatrix} 0.438 & 0.506 & 0.439 & 0.258 & 0.333 \\
0.219 & 0.253 & 0.293 & 0.194 & 0.267 \\
0.146 & 0.127 & 0.146 & 0.129 & 0.2 \\
0.109 & 0.051 & 0.073 & 0.065 & 0.133 \\
0.088 & 0.063 & 0.049 & 0.032 & 0.067 \end{bmatrix}
\]  

(7)

2. \(A(\bar{W}_j)_{5 \times 5}\) According row to Sum: \(\bar{W}_i = \sum_{j=1}^{5} \bar{W}_j\)

\[
A(\bar{W}_i) = \begin{bmatrix} 1.974 \\
1.226 \\
0.748 \\
0.431 \\
0.299 \end{bmatrix}
\]  

(9)
(3) the characteristic root \( \bar{W} = \frac{\sum_{i=1}^{n} \bar{W}_i}{n} = \frac{1}{5} \begin{pmatrix} 1.974 \\ 1.226 \\ 0.748 \\ 0.431 \\ 0.299 \end{pmatrix} = \begin{pmatrix} 0.395 \\ 0.245 \\ 0.15 \\ 0.086 \\ 0.06 \end{pmatrix} \) \( (10) \)

(4) Calculate the most characteristic root

\[
A\bar{W} = \begin{pmatrix} 1.979 \\ 1.241 \\ 0.756 \\ 0.429 \\ 0.298 \end{pmatrix} = \begin{pmatrix} 1.979 \\ 1.241 \\ 0.756 \\ 0.429 \\ 0.298 \end{pmatrix} \frac{1}{n} \sum_{i=1}^{n} \begin{pmatrix} 1.979 \\ 1.241 \\ 0.756 \\ 0.429 \\ 0.298 \end{pmatrix} \frac{1}{n-1} = 5.014 \]

\( (11) \)

\[
\lambda_{\max} = \frac{1}{n} \sum_{i=1}^{n} \frac{(A\bar{W})_i}{W_i} = \frac{1}{5} \begin{pmatrix} 1.979 \\ 1.241 \\ 0.756 \\ 0.429 \\ 0.298 \end{pmatrix} = \begin{pmatrix} 0.395 \\ 0.245 \\ 0.15 \\ 0.086 \\ 0.06 \end{pmatrix} \]

\( (12) \)

(5) Consistency test indicators:

\[
CI = \frac{\lambda_{\max} - n}{n-1} = \frac{5.014 - 5}{5 - 1} = 0.0034
\]

\( (13) \)

\[
RI = 1.12 \quad CR = \frac{CI}{RI} = \frac{0.0034}{1.12} = 0.0031 < 0.1 \quad \text{Pass the test.}
\]

Therefore, economic, social, population, resources and environment of the subsystems of sustainable economic development impact of the weights were: 0.395, 0.245, 0.15, 0.086 and 0.06.

4 According to principal component calculated integrated scores

Use the method of principal components analysis, first of all, the original sample data standardization, to eliminate inconsistencies among indicators dimensional and magnitude of the differences, in light of the above be sustainable economic development factors to calculate the weight of 11 in Hebei Province Level of sustainable economic development in a comprehensive, scoring system and ranking, as shown in table 4:

<table>
<thead>
<tr>
<th>City</th>
<th>Economic A1</th>
<th>Social A2</th>
<th>Demographic A3</th>
<th>Resource A4</th>
<th>Environmental A5</th>
<th>Composite A</th>
<th>order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shijiazhuang</td>
<td>7.601880</td>
<td>9.026988</td>
<td>4.510470</td>
<td>2.817075</td>
<td>5.963499</td>
<td>6.491004</td>
<td>1</td>
</tr>
<tr>
<td>Tangshan</td>
<td>-1.620584</td>
<td>-0.495270</td>
<td>-1.462897</td>
<td>-1.401001</td>
<td>1.130948</td>
<td>-1.033536</td>
<td>7</td>
</tr>
<tr>
<td>Handan</td>
<td>-2.451161</td>
<td>-3.049947</td>
<td>2.812109</td>
<td>0.755593</td>
<td>1.212443</td>
<td>-1.155902</td>
<td>8</td>
</tr>
<tr>
<td>Xingtai</td>
<td>-6.355851</td>
<td>-6.651293</td>
<td>3.419363</td>
<td>0.795074</td>
<td>2.708585</td>
<td>-3.396332</td>
<td>10</td>
</tr>
<tr>
<td>Baoding</td>
<td>4.131227</td>
<td>3.431652</td>
<td>-0.132946</td>
<td>2.444867</td>
<td>4.716611</td>
<td>2.945903</td>
<td>2</td>
</tr>
<tr>
<td>Zhangjiakou</td>
<td>0.295770</td>
<td>-0.847472</td>
<td>-3.784922</td>
<td>0.240691</td>
<td>-0.971931</td>
<td>-0.696156</td>
<td>6</td>
</tr>
<tr>
<td>Chengde</td>
<td>-6.149377</td>
<td>-5.768852</td>
<td>-0.940827</td>
<td>-2.478707</td>
<td>0.127501</td>
<td>-4.189015</td>
<td>11</td>
</tr>
<tr>
<td>Changzhou</td>
<td>-1.817350</td>
<td>-3.403305</td>
<td>-2.558046</td>
<td>1.114357</td>
<td>-3.847357</td>
<td>-2.070377</td>
<td>9</td>
</tr>
<tr>
<td>Liangfang</td>
<td>-0.441986</td>
<td>-0.577900</td>
<td>3.130379</td>
<td>0.967445</td>
<td>-5.284066</td>
<td>0.459710</td>
<td>4</td>
</tr>
<tr>
<td>Hengshui</td>
<td>-1.780225</td>
<td>-2.419492</td>
<td>4.883403</td>
<td>1.125238</td>
<td>-2.300710</td>
<td>-0.604726</td>
<td>5</td>
</tr>
</tbody>
</table>
5 Conclusion

From the economic sustainable development of an integrated scoring, we can see that in 2007 in Hebei Province in the 11 cities above the average level of sustainable development has four (Shijiazhuang, Baoding, Qinhuangdao, Langfang), but there are lower than the average level of 7 (Hengshui, Zhangjiakou and Tangshan, Handan, Cangzhou, Xingtai, Chengde). Is the highest in Shijiazhuang City, sustainable economic development of an integrated scoring about 6.491004 points, the lowest scoring only Chengde -4.189015 points.

From the assessment results can be seen, Hebei Province, the level of sustainable economic development of larger regional differences in space on three levels to clearly show the region: ① Shijiazhuang, Baoding, Qinhuangdao, Langfang 4 Cities sustainable economic development in the average water 0 Above, as the high development area; ② Hengshui, Zhangjiakou, Tangshan, Handan City, four integrated sustainable economic development in scoring at about -1.0 to 0 points between, as in the development area;③ Cangzhou, Xingtai, in Chengde City, the three economic Comprehensive sustainable development scores are far lower than -1.0 points for low-developed areas. Score from the comprehensive look at the various levels in the mainland is not much difference between the scores, which show that the hierarchy within the sustainable level of development throughout the city closer. However, levels of sustainable economic development throughout the city level there is still a certain gap.

References