ISSN 2616-5902 Vol. 4, Issue 9: 75-82, DOI: 10.25236/AJBM.2022.040911

The lifeblood of economic development-Economic Vitality

Liuchi Yan

School of Atmospheric Sciences, Nanjing University of Information Science and Technology, Nanjing, Jiangsu, 210044, China

Abstract: *In order to objectively and comprehensively evaluate the regional economic vitality and explore the reasons for this difference, we have established an economic vitality model. We proposed the factor entropy method (FEM) method to form the index parameters in the economic vitality model. We select 10 indicators from four aspects, and then integrate them into the indicator parameters by FEM and coefficiential variation method (CVM). Additionally, the definition of HL is proposed, which is divided economic vitality into three levels: strong, medium, weak. Finally, we analyzed the economic vitality of Jiangsu from the perspectives of population trends and corporate vitality, and found that the main indicators, quantity of enterprises and labor forces have a positive effect on economic vitality, and per capita savings have an inhibitory effect on economic vitality. Combining the positive and inhibitory effects of various indicators, we put forward appropriate suggestions.*

Keywords: *Economic vitality model, entropy method, vitality evaluation system*

1. Introduction

Regional economy is a long-term social and economic activity, due to historical, geographical, political, economic, and religious factors, some of the more economically related residential areas have gradually formed various economic zones with characteristics. Since the reform and opening up, the Chinese government has been committed to coordinated regional economic development and implemented various policies to support the local economy in the four major regions (Eastern, Central, Northern, and Western Regions).

In order to analyze the reasons that affect the economic vitality of a city, we are required to establish an economic vitality assessment model to determine the economic vitality of a city. By selecting appropriate and relevant indicators to establish a reasonable evaluation and scoring system, we endow target weights and combine highly relevant indicators to achieve hidden indicators. The established models were then applied to different problems. We establish an economic vitality model. Finally, we obtain the calculation of urban economic vitality.

2. Analysis of regional economic vitality

In this section, in order to analyze the impact of demographic trends and corporate vitality on the regional economic vitality of the Jiangsu province we have selected, we propose the economic vitality factor (EVF). First 10 three-level indicators are select from these two aspects, and then integrate them into the hidden factor (HF) through the factor entropy method (FEM) and the coefficient of variation method (CVM), and finally integrate the hidden factor (HF) into the economy Viability factor (EVF). In addition, we divided Jiangsu Province into southern Jiangsu, central Jiangsu, and northern Jiangsu projects to verify the accuracy of the economic vitality model we established, and finally gave action plans to improve regional economic vitality.

3. Economic vitality model

According to the classification method of the impact factors of economic vitality, we propose the factor entropy method (FEM). This classification method makes the index classification more systematic. Four hidden factors are calculated by the entropy method: economic factors, scientific and technological factors, labor factors, Policy factors. Summarize the existing statistical indicators, refer to the existing

ISSN 2616-5902 Vol. 4, Issue 9: 75-82, DOI: 10.25236/AJBM.2022.040911

research[1] on economic vitality, and combine the economic development status and future development trends[2] of Jiangsu Province to determine the index parameters in 10 economic vitality models.

3.1 Data preprocessing

Data collection was performed according to the China Statistical Yearbook. During the data collection process, there was a problem of missing some indicators and some values. Therefore, we considered the use of associative memory algorithm to restore and fill the missing values based on similarity. Similarity judgment to get correlation coefficient $V_{i,j}$, then sort the correlations, find the value with the greatest correlation, and fill in the missing data.

$$\lambda = \sigma\sqrt{2\log N} \tag{1}$$

Where N is the total number of rows per column. If $S_{i,j}^2 \le \lambda^2$, discard the padding value corresponding to the correlation coefficient and shrink the correlation factor. Since there are 8 neighboring points around the null value to be filled, let $A_i(i = 0,1,...,7)$, since the correlation coefficients have been sorted, statistics are made on these 8 points to find the average μ and standard deviation σ.

$$\mu = \frac{1}{8}\sum_{i=0}^{7} A_i \tag{2}$$

$$\sigma = \sqrt{\frac{1}{8}\sum_{i=0}^{7}(A_i - \mu)^2} \tag{3}$$

Interpolation is performed by using the relevant information of the relevant points $f(s_1, s_2)$ around the missing value as the real information of the missing value interpolation.

3.2 Indicator description

3.2.1 Economic factors

GDP per capita X_1 (100 million yuan per year). GDP of Jiangsu Province is the best economic indicator that can directly measure the economic vitality of a province, and reflects the economic strength and market size of Jiangsu Province. Therefore, we introduce GDP per capita to reflect the economic development of Jiangsu Province.

b) Public expenditure X_2 (100 million yuan per year). The amount of public expenditure reflects the government's right to control the social resources. The expenditures on investment and education and other undertakings reflect the social resource allocation activities of the province and city, which reflects the market vitality from the side, and the basic security expenditure. The population and population structure of the province. We introduce public expenditure indicators, including scientific and educational public expenditures, social security expenditures and a series of economic related public expenditures.

3.2.2 Scientific and technological factors

a) Industrial structure X_3 (percentage). During the period of economic growth, the proportion of the industrial structure and the upgrading and innovation drive of the industrial structure have an effect on the growth or attenuation of economic vitality. The rationality of the proportion of the industrial structure determines whether the economic vitality can be maintained. Therefore, we have introduced the proportion of the industrial structure.

b) Number of graduate students X_4 (institutions). In the process of economic development, technological innovation is the primary productive force. Only by technological innovation can the economy be further developed. The number of universities reflects the scientific and technological innovation talents of a province and city, and represents the strength of scientific and technological innovation. Therefore, we have introduced the number of universities.

ISSN 2616-5902 Vol. 4, Issue 9: 75-82, DOI: 10.25236/AJBM.2022.040911

c) Industrial investment X_5 (100 million yuan per year). The amount of industrial investment can reflect the current development strategy and future business plans. The amount of investment in the industry can reflect the development potential of provinces and cities and the support of government policies. It is an indispensable measurement standard in the process of marketization, so we introduce industrial investment, including government investment, domestic and foreign investment.

3.2.3 Labor factors

a) Population X_6 (10,000 people). The size of the population determines how much labor is available in the process of economic development. The labor force plays an important role in promoting economic development. The population reflects how much labor can be added to a province or city. It is an important measure of whether the current economic status quo or economic growth can be maintained. standard.

b) Number of enterprises X_7 (home). The number of enterprises is an important indicator of regional economic vitality. The number of enterprises directly affects the available job opportunities, that is, the number of enterprises determines the demand for labor, promotes resource recycling to a large extent, and determines economic benefits. Therefore, we have introduced the number of enterprises, including the number of state-owned enterprises, private enterprises and foreign enterprises.

3.2.4 Policy factors

a) Social environment X_8 . The current social environment of provinces and cities determines the overall status of economic development. Because different regions cause different social environments, different social environments play a role in promoting economic development in the development of economic vitality. Therefore, we have introduced social environmental indicators. .

b) Transportation construction X_9 (10,000 yuan per year). Transportation plays a vital role in economic development. Without the infrastructure of transportation and the development of transportation, economic vitality is difficult to maintain and may even decline. Therefore, the support of government policies in transportation construction is also a major indicator of economic vitality, so we have introduced transportation construction, including railways, highways and waterways.

c) Total imports and exports X_{10} (100 million US dollars per year). The total amount of imports and exports reflects the foreign trade of the province and city. Trade is an indispensable part of economic development. The number of imports and exports further reflects the size and internationalization of the enterprise. Therefore, we introduce import and export lump sum.

3.3 Weight of indicators

3.3.1 Entropy weight method

In this section, the entropy weight method is used. Using the model indicators defined above, we further determine the weights of these 11 indicators, there by obtaining hidden factors and further forming a combination of main indicators. We first use the entropy method (FEM) to eliminate the incommensurability of data due to inconsistent data dimensions. Based on the attribute type of the original indicator, we use the standard 0-1 transform and the given optimal interval method for non-size summing. Normalization. Therefore, it is convenient to directly judge the merits of the evaluation index from the numerical value, and promote the evaluation of multi-attribute decision-making.

These 10 indicators show the influence of different factors on regional economic vitality. In terms of labor factors, the number of population is directly proportional to regional economic vitality, while in terms of technological factors, regional economic vitality decreases as the number of primary and secondary industries increases.

$$\begin{cases} y_{ij} = \dfrac{x_{ij} - \min(x_i)}{\max(x_i) - \min(x_i)} \\ y_{ij} = \dfrac{\max(x_i) - x_{ij}}{\max(x_i) - \min(x_i)} \end{cases} \qquad j = 1, 2, ..., n \tag{4}$$

ISSN 2616-5902 Vol. 4, Issue 9: 75-82, DOI: 10.25236/AJBM.2022.040911

Where y_{ij} is the standard value of each evaluation indicator of each size, $\max(x_i)$ and $\min(x_i)$ are the maximum and minimum values of the indicator parameters.

After the data is standardized, we can use y_{ij} instead of x_{ij} to describe the regional economic vitality, and then we have

$$q_j = \frac{y_{ij}}{\sum_{j=1}^{n} y_{ij}} \tag{5}$$

According to the concepts of self-information and entropy in information theory[3], we calculate the information entropy e_i of each evaluation indicator, so that

$$e_i = -\ln(n)^{-1} \sum_{j=1}^{n} q_{ij} \ln(q_{ij}) \tag{6}$$

Based on the information entropy, we will further calculate the weight of each index previously defined before

$$w_i = \frac{1-e_i}{k-\sum_i e_i} \qquad i = 1,2,...,k \tag{7}$$

Furthermore, four comprehensive indicators including economic factors, scientific and technological factors, labor factors, and policy factors were obtained. Based on these calculated index weights, this article will be referred to as EF, ISF, LF and PF.

$$\begin{cases} EF_j = w_1 y_{1j} + w_2 y_{2j} \\ ISF_j = w_3 y_{3j} + w_4 y_{4j} + w_5 y_{5j} \\ LF_j = w_6 y_{6j} + w_7 y_{7j} \\ PF_j = w_8 y_{8j} + w_9 y_{9j} + w_{10} y_{10j} \end{cases} \tag{8}$$

Where EF_j, ISF_j, LF_j, PF_j represent the sub-indicators of comprehensive indicators. The weight of these indicators is determined by FEM, and finally the expression of these indicators is described[4].

3.3.2 Coefficient of variation method

After calculating 10 indicators and obtaining four hidden factor indicators, we need to further aggregate these four indicators into a comprehensive indicator[5], that is, economic vitality to directly reflect the status of the regional economy, and lay the foundation for reasonable and effective analysis. surroundings. The coefficient of variation method (CVM) is a method that directly uses the information contained in each indicator and calculates the indicator weight through calculation[4] Considering the difference between the units and the mean of the four comprehensive indicators, the standard deviation cannot be used to compare the degree of change, but the ratio of the standard deviation to the mean is used for comparison. The equation for each index can be expressed as:

$$CV_i = \frac{\sigma_i}{\overline{x_i}} \qquad i = 1,2,3,4 \tag{9}$$

Where CV_i is the coefficient of EF, ISF, LF, PF variation of, also known as the standard deviation. σ_i is the standard deviation of the indicator. $\overline{x_i}$ Means the average of the table. After that, we can calculate the weights of four comprehensive indicators:

$$W_i = \frac{CV_i}{\sum_i^n CV_i} \qquad i = 1,2,3,4 \tag{10}$$

Then, based on these calculated weights, we can get the economic vitality index, referred to as EV.

ISSN 2616-5902 Vol. 4, Issue 9: 75-82, DOI: 10.25236/AJBM.2022.040911

$$EV = (W_1 \times EF + W_2 \times ISF + W_3 \times LF + W_4 \times PF) \times 100 \quad (11)$$

Table 1: Weight values of the indicators

Indicators(I)	Indicators(II)	Weights	Indicators(III)	Weights
Economic vitality	Labor factors	0.283	Population	0.1293
			Number of companies	0.0937
	Policy factors	0.275	Social environment	0.0743
			Traffic construction	0.0438
			Total imports and exports	0.1038
	Economic factors	0.175	Public expenditure	0.0348
			GDP per capita	0.1189
	Industrial structure factors	0.267	Number of tertiary industries	0.1089
			Number of graduate students	0.1063
			Amount of industry investment	0.1157

Since the specific values of these indicators are given in Table 1, we can calculate the EV of the selected project. As can be seen from Table 2 below, for these four comprehensive indicators, the labor factor ranks first in our final standard, with a weight of 0.283, followed closely by policy factors, and technology ranks third, while the economy Factors are ranked lowest.

4. Decision evaluation

We first divided Jiangsu Province into three regions by default: Southern Jiangsu, Central Jiangsu, and Northern Jiangsu. Then we used our economic vitality model to evaluate the economic vitality of these three regions. Then, from the perspective of population change trends and corporate vitality, the regional economic vitality is evaluated by decision-making, and then after changing the three levels of the table, the future regional economic vitality value is predicted, and proposals for improving regional economic vitality are proposed. 4.2.1 Economic vitality assessment

We import the data of the three regions of southern Jiangsu, central Jiangsu and northern Jiangsu and calculate the value of their regional economic vitality. We propose the concept of the line of prosperity and dryness. When the economic vitality value exceeds 5, the current economic vitality is maintained, and when the economic vitality value When the economic vitality value exceeds 10, the current economy will develop. As shown in Figure1, we divided the economic vitality of the 16 years from 2000 to 2016 into weak, medium, and strong, and assigned different colors to the three levels of Honor Line(HL) to visually show the economic vitality of Jiangsu Province.

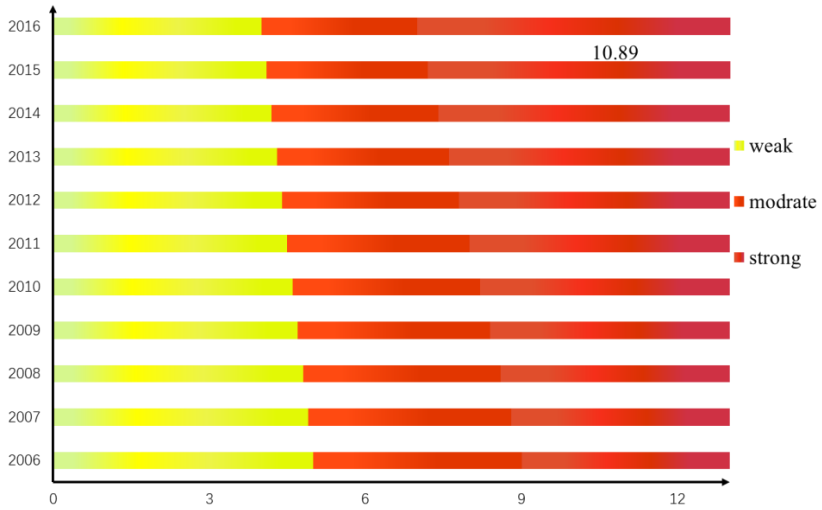

Figure 1: Regional vitality map from 2006 to 2016

ISSN 2616-5902 Vol. 4, Issue 9: 75-82, DOI: 10.25236/AJBM.2022.040911

As shown in Figure 1, In recent years, the economic vitality of Jiangsu Province has been stable and fluctuating. During the period of 2007 to 2010, through consulting data[5], the economic vitality value of the Yangtze River Delta region showed fluctuations. The economy of Jiangsu Province has developed steadily, and at the same time it has gained more preferential policies. It has further developed in the process of attracting investment. In 2013, it broke the vitality value of the Honor Line(HL), so these three regions have achieved certain development in regional economy in recent years.

4.1 Analysis of Impact from Different Angles

4.1.1 Demographic trends

As shown in Figure 2, we analyze its impact on regional economic vitality from the perspective of population change. In the past, the population of Jiangsu has been continuously increasing. By analyzing the reasons that affect the trend of population change, we can find that a series of social environment, traffic accessibility, social security and so on will cause population changes. Combined with Figure 3, Jiangsu 's Economic vitality is constantly growing, so the increase in population is positively correlated with economic vitality, but there is a difference in the strength of the interaction. When the population increases to a certain extent, the impact on regional economic vitality will flatten out. However, the degree of population change illustrates the province 's attractiveness to the population and the soundness of social security, and further illustrates the increase in the level of economic development. With the continuous development of the economy, people are more seeking job opportunities and quality of life. The increase reflects the increasing economic vitality of Jiangsu Province.

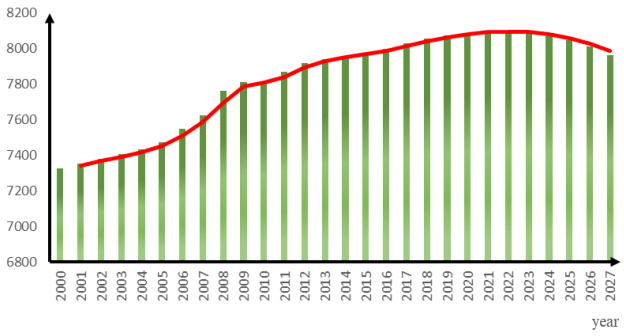

Figure 2: Population forecast trend graph

4.1.2 Enterprise vitality

Through the training of the data, we found that the industrial structure and the number of industries are the most important indicators to measure the vitality of the company. Therefore, we analyze the proportion of the industrial structure and the investment in the three major structural industries, as shown in Figure 5. Combining Figures 3 and 5, it can be analyzed that there is a positive U-shaped relationship between the advanced industrial structure and the growth of economic vitality. The rapid increase of the tertiary industry has promoted the significant growth of the regional economy and is the main driving force of current economic growth. At the same time, we can see that most of the corporate investment in Figure 3 (b) has been invested in the tertiary industry, so the number of tertiary industries has increased. At the same time, while technological innovation, corporate vitality has continued to increase, which has promoted economic vitality.

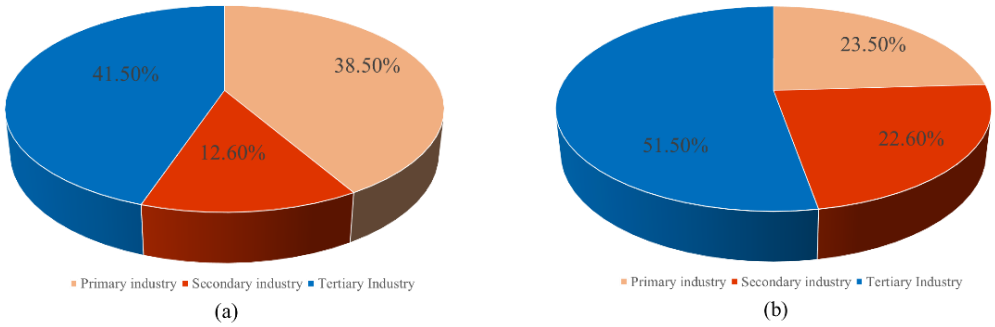

Figure 3: (a) Proportion of industrial structure (b) Proportion of investment structure

ISSN 2616-5902 Vol. 4, Issue 9: 75-82, DOI: 10.25236/AJBM.2022.040911

4.2 Making recommendations

By modifying the values of 10 parameters in the economic vitality model, the regional economic vitality is studied. After changing the population, the number of enterprises, and the proportion of the industrial structure, the values of economic vitality are respectively shown in Figure 4. By comparing the changes in economic vitality and starting from the three-level indicators, suggestions for improving regional economic vitality are proposed.

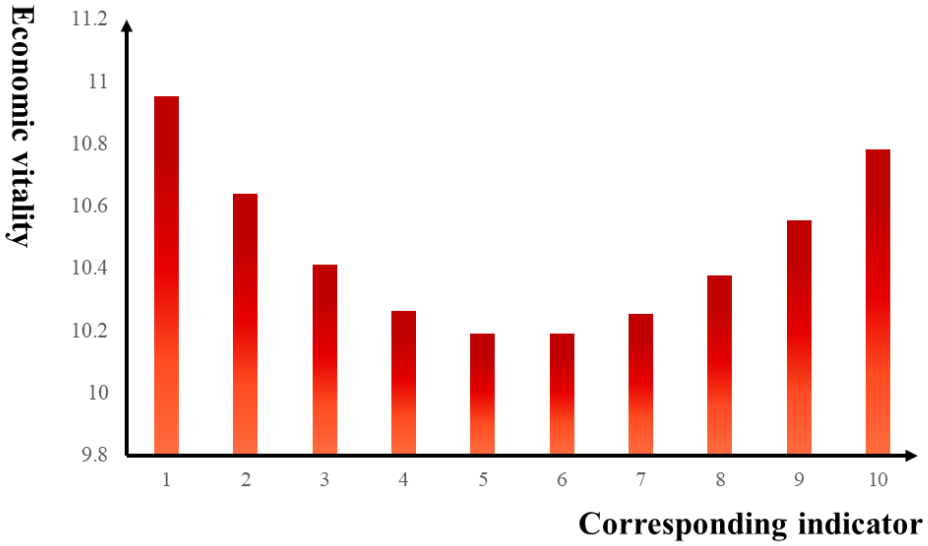

Figure 4: Fluctuating economic vitality

Table 2: Parameter—Economic vitality value correspondence table

Serial number	Indicators(III)	Corresponding indicator
1	Number of companies	10.95
2	Total imports and exports	10.63
3	Public expenditure	10.41
4	Traffic construction	10.26
5	GDP per capita	10.192
6	Social environment	10.191
7	Population	10.25
8	Number of tertiary industries	10.37
9	Number of graduate students	10.55
10	Amount of industry investment	10.78

According to the analysis in Figure 6 and Table 2, in the trained model, changing the values of different parameters, we can find that although the vitality of the company has fluctuated after 2017, it still shows an upward trend. At the same time, the regional economy is found after changing the number of enterprises and industrial structure Vitality is the highest of these ten parameters. Therefore, we propose the need to increase the number of enterprises, rationally improve the industrial structure, carry out technological innovation, and improve social security, so regional economic vitality can be improved.

5. Conclusion

To sum up, first, an economic vitality model based on the entropy method is established. In addition, we propose the concept of HL, which divides the value of economic vitality into weak, medium and strong intensity, respectively. Solving two different problems proves that our model is reliable and correct.

ISSN 2616-5902 Vol. 4, Issue 9: 75-82, DOI: 10.25236/AJBM.2022.040911

The model based on the entropy method is used. Compared to the traditional hierarchical weighting, a high-level indicator is only responsible for some low-level indicators. The high-level indicators of the system we have established will be responsible for all low-level indicators. That is, when changing the lower-level indicators, all the upper-level indicators will change accordingly. However the amount of the changes will vary depending on the weight, which reflects the interaction between the variables to a certain extent.

References

[1] Jin Yanjie. Evaluation of urban economic vitality in China [J]. Geosciences, 2007 (01): 11-18
[2] Xu Congcai. Transformation of economic development mode and development of innovative economy in Jiangsu Province: review and prospect [J]. Industrial economy research, 2012 (3): 1-8
[3] Zhu Fuyuan. Entropy and information theory [J]. Journal of nature (3), 2012:187-188
[4] Wang Wensheng. Coefficient of variation: a simple and useful statistical index to measure the degree of dispersion [J]. China Statistics, 2007 (06): 43-44
[5] Lin Lan, ye Sen, Zeng gang. Research on industrial linkage development in the Yangtze River Delta [J]. Economic geography, 2010 (01): 8-13