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Problem Chosen :	B

2019APMCM summary sheet

Discussion and Research on Improving the Vitality of Local Economy

Summary

Nowadays, as an important component of regional comprehensive competitiveness, economic vitality has been paid more and more attention by local governments. How to improve economic vitality more effectively and more quickly has become a problem for policy makers in various regions.

For the part I, we collected the data of economic indicators of Jiangsu Province from 2012 to 2017. Through analysis, we select **11 key influencing factors** from a variety of influencing factors. We established a **comprehensive evaluation model** of economic vitality and analyzed the short-term and long-term effects of economic policies transformation on the economic vitality of Jiangsu Province, and studied the action plan to improve regional economic vitality.

For the part II, we optimized **the comprehensive evaluation model based on time series**. We use the derivative of economic vitality function to describe the long-term and short-term development of regional economy, and obtain the comprehensive evaluation value of regional economic sustainable development through vitality function. We also analyzed the short-term and long-term effects of economic policy transformation on economic vitality of Jiangsu Province.

For the part III, due to the limited collection time and the confidentiality of relevant data, we **simplify the model** and select a representative index in each subsystem to replace the subsystem. So, we calculated the economic vitality of each city and ranked them in descending order.

For the part IV, we put forward a **development proposal** for sustainable development of Jiangsu Province. From the perspective of decision-makers, we believe that we need to attach great importance to the resources and environment, vigorously developing the environmental protection industry, and carrying out in-depth environmental publicity and education.

Keywords: comprehensive evaluation model; Optimized model; simplified the model; benign sustainable development; development proposal

Contents

1 Introduction

If you are the leader of a region where the economic vitality is always depressed, in the face of various factors, do you feel panic because you have no way to start? This problem is often caused by the failure to grasp the core influencing factors of economic vitality. Only when we find out the main influencing factors, analyze the specific influencing degree and implement the corresponding measures, can we effectively improve the regional economic vitality.

1.1 Restatement of the problem

Nowadays, in order to improve the comprehensive competitiveness of each region, many policies have been put forward to stimulate the local economic vitality. However, due to different resource endowments, these policies have different effects in different regions. It is very important to choose the key factors. In order to study how to improve the regional economic vitality more effectively, we mainly concern the four questions below:

- Build the suitable relational model of influencing factors of economic vitality, and study the program of action to improve the economic vitality in Jiangsu Province.
- Analyze the short-term and long-term impact of economic policy transformation on the economic vitality of Jiangsu Province according to our survey data.
- Establish a mathematical model to analyze and measure the regional economic vitality, and rank economic vitality of the cities.
- To provide suggestions for the development of Jiangsu Province, so that the economic vitality of Jiangsu Province presents a benign sustainable development.

1.2 Previous research

There are a lot of literature that have researched the economic vitality，entropy weight method and time series analysis.

CAO Yanling [2] have pointed out six factors that can affect the talent vitality. Then the content of the regional talent vitality and regional economic vitality and the dialectical relationship between the two have been analyzed and explained. The regional talent vitality can contribute to enhance the regional economic vitality. It is the basis for us to choose the indexes that affect the regional economic vitality.

Chaoping Ma [3] have analyzed the gray correlation entropy with the annual GDP as the order parameter, establishes the evolutionary discriminant model based on the correlation entropy theory, analyzes the development model of the regional economy, the economic development situation of the current year can be judged, so the economic development of the

past decade can be judged in this way. It can help us to establish the evaluation model of regional economic vitality.

The basic idea of entropy weight method [5] is to determine the objective weight according to the variation of index. It is directly calculated by sample data, not affected by human subjective factors, and more in line with data analysis. It can determine the weight of each index for us.

Junhui Wang and Honglin Wang [6] have used a distributed lag nonlinear model with Poisson distribution to examine the nonlinear lagged effects of independent variable on dependent variable. The results can help us to analyze the short-term and long-term effects of independent variables on dependent variables.

1.3 Our work and some explanations to the problem

- **Key factors that effectively improve the economic vitality**

  Regional economic vitality refers to the ability and potential in the process of regional economic development. At present, the economic vitality of Chinese cities is in a period of rapid growth. Its economic vitality is mainly reflected in the ability of economic growth, the ability of introducing capital and attracting high-quality labor force. Because there are many factors influencing economic vitality, we analyze the influence of corresponding factors on economic vitality from the five following aspects: tax, residents' life, environmental resources, economic and financial trade, and educational and scientific research.

- **Analyze the effects on the regional economic vitality**

  We need to analyze the effects on the regional economic vitality change from the perspective of changing trend of population and enterprise vitality. According to a large number of literature search and experience judgment, we believe that the increase of population and the growth of enterprise vitality will lead to the increase of regional economic vitality, and the decrease of population and enterprise vitality will also lead to the decrease of regional economic vitality.

- **About the attached data file and the data surveyed by us**

  Analyzing and survey the data before modeling is necessary in big data problem. We surveyed the data which influenced the economic vitality of Jiangsu Province. The attached data file and the data surveyed by us contains much information, we will use an independent section for data preprocessing.

- **Analyze the short-term and long-term effects on the economic vitality**

  For short-term and long-term effects, we add time series to the model. We define the time vitality value through the model, and evaluate the short-term and long-term impact of economic policy transformation on the economic vitality of the region by measuring the time vitality value of each city.

- **Rank the economic vitality of cities**

  This is a typical ranking problem, and there are a lot of mature mathematical models that can be used [1]. Because there are many factors influencing economic vitality, so we establish comprehensive evaluation model to rank the economic vitality of cities. Of course, our indicators depend on the results of data preprocessing.

- **About benign sustainable development**

  If we calculate that the vitality value of Jiangsu Province is higher than the current economic vitality value in a long time in the future, we believe that Jiangsu Province presents the benign sustainable development.

2 Assumptions and Justifications

(1) **Both population growth and enterprise vitality will promote economic vitality:** population growth will increase the number of local labor force and drive the increase of local GDP. The vigorous growth of enterprises will increase the local GDP, promote the vigorous growth of economy, and ignore the indirect influence brought by other factors.

(2) **Local GDP can reflect the level of local economic vitality:** economic vitality is directly related to local GDP, so we assume that GDP can directly reflect the size of local economic vitality.

3 Symbols and Definitions

Table 1. symbols and definitions

variable	meaning
V(x)	economic vitality
x_i	the subsystem layer
β	Coefficient of fitting function
$D(x)$	Long term development value

4 Comprehensive evaluation model: evaluating economic vitality

4.1 Determination of influencing factors and analysis of influencing mechanism

According to the meaning of the question, we can judge the impact of each influencing factor on the population and the enterprise vitality with the hypothesis [1]. According to the literature [2], combining with daily experience, we sorted out the relevant key factors affecting economic vitality from the following five aspects: tax, residents' life, environmental resources, economic and financial trade, and educational and scientific research, shown in Fig.1.

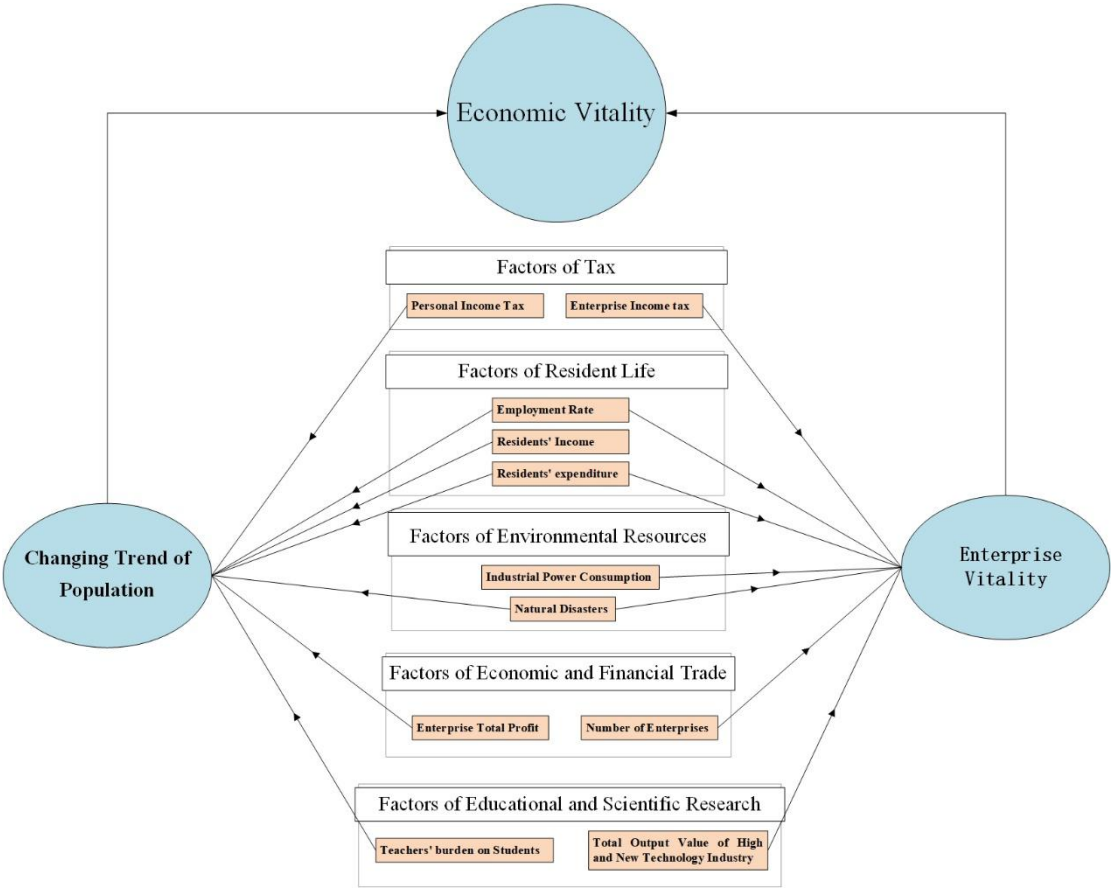

Figure 1: Factors affecting economic vitality

From the perspective of changing trend of population and enterprise vitality, the influence mechanism of each factor on economic vitality is as follows:

(1) Personal Income Tax: the higher the personal income tax, the higher the local personal

income, the higher the economic vitality.

(2) Enterprise Income Tax: the higher the enterprise income tax, the greater the vitality value of local enterprises, the higher the economic vitality.

(3) Residents' Income: the higher the local residents' income, the more they can absorb foreign labor force, resulting in the increase of local population, thus improving economic vitality.

(4) Residents' expenditure: the higher the residents' expenditure is, the growth of migrant population will be restrained, but it will promote the increase of enterprise vitality. The impact on economic vitality needs to be analyzed quantitatively.

(5) Employment Rate: the higher the local employment rate is, the more attractive it will be to migrant workers, which will increase the vitality of the local population and enterprises, thus enhancing the economic vitality.

(6) Natural Disasters: the higher the frequency of natural disasters, the lower the local population and the vitality of enterprises, thus reducing the economic vitality.

(7) Industrial Power Consumption: we assume that all industrial power consumption is used for production without waste. So, the higher the industrial power consumption, the greater the vitality of the enterprise and the higher the economic vitality.

(8) Total Import and Export Volume of Foreign Trade: the larger the total import and export volume of foreign trade in a month, the higher the vitality of enterprises and the higher the economic vitality.

(9) Quantity of Surviving Enterprises: the more the number of local enterprises, the greater the vitality of enterprises and the greater the employment opportunities, resulting in the increase of population and economic vitality.

(10) Enterprise Total Profit: the higher enterprise total profit, the higher the vitality of the enterprise, thus reflecting the higher the vitality of the local economy.

(11) Teachers' burden on Students: the smaller the number of teachers' burden on students, the better the local teaching resources can attract more foreign population, resulting in the increase of population and economic vitality.

In order to more intuitively see the influence of each influencing factor on economic vitality, Tab.2 lists the influencing mechanism of influencing factors.

Table 2: Influence mechanism of influencing factors

FACTORS	POPULATION	ENTERPRISE VITALITY	ECONMIC VITALIY
Personal Income Tax (↑)	↑	--	↑
Enterprise Income Tax (↑)	--	↑	↑

Residents' Income (↑)	↑	--	↑
Residents' expenditure (↑)	↓	↑	--
Employment Rate (↑)	↑	↑	↑
Natural Disasters (↓)	↑	↑	↑
Industrial Power Consumption (↑)	--	↑	↑
Total Import and Export Volume of Foreign Trade (↑)	--	↑	↑
Quantity of Surviving Enterprises (↑)	↑	↑	↑
Total Output Value of High and New Technology Industry (↑)	--	↑	↑
Teachers' burden on Students (↓)	↑	--	↑

4.2 Establish the program of action

Through the analysis of the above data, our system shows that the impact of factors of economic and financial trade on the local economic vitality is very small, so we omit them when establishing the action plan. We believe that the following actions can improve the economic vitality of Jiangsu province more effectively:

In terms of tax: although the local personal income tax and enterprise income tax reflect the local economic vitality, the local government can reduce the tax rate as much as possible, so as to promote the production of enterprises and attract foreign personnel, thus better improving the economic vitality.

In terms of residents' life: the government should increase the income of the residents, so as to increase the employment rate and the number of the population, thus increasing the economic vitality.

In terms of environmental resources: the government should reduce the number of natural disasters to attract foreign people and increase the population. On the premise of assuming that all industrial power consumption is used for production without waste, we can promote industrial power consumption, improve the vitality of enterprises, and thus improving the economic vitality.

In terms of economy finance and trade: the local government should increase the output value of enterprises and the number of local enterprises, so as to increase the total

profits of enterprises and enhance the vitality of local economy.

In terms of education and scientific research: the government should increase the total output value of high-tech industry, so as to improve the vitality of enterprises. Reduce the number of teachers' burden on students, improve the quality of teaching, attract foreign personnel, so as to increase the population and economic vitality.

4.3 Comprehensive evaluation model

Because there are too many factors affecting the economic vitality, we choose the comprehensive evaluation method to measure and evaluate the local economic vitality. We will consider all the influencing factors comprehensively by using the formula:

$$X_{\mathrm{p}}=\sum_{j=1}^{\mathrm{n}} w_j x_{ij}(t), \quad \mathrm{p}=1, 2, 3, 4, 5 \tag{1}$$

to construct the synthesis sequence of subsystem layer, where is the weight of the index j under the subsystem.

4.3.1 Data normalization

Considering that the measurement unit and quantity level of each index are not uniform, it is necessary to transform the absolute value of the index into the relative value before using these indexes for analysis to solve the homogenization problem of different index values, that is, standardized treatment. Because there are positive and negative indexes, that is, the higher the positive index value, the better and the lower the negative index value, the better. Therefore, different standardized treatment schemes should be adopted for different types of indexes. In conclusion, the normalization of indicators and the homogenization of heterogeneous indicators are as follows:
We can get positive indicators:

$$x_{ij}' = \frac{x_{ij} - \min\{x_{1j}, x_{2j}, \cdots, x_{nj}\}}{\max\{x_{1j}, x_{2j}, \cdots, x_{nj}\} - \min\{x_{1j}, x_{2j}, \cdots, x_{nj}\}}$$

the negative indicators are as follows:

$$x_{ij}' = \frac{\max\{x_{1j}, x_{2j}, \cdots, x_{nj}\} - x_{ij}}{\max\{x_{1j}, x_{2j}, \cdots, x_{nj}\} - \min\{x_{1j}, x_{2j}, \cdots, x_{nj}\}}$$

4.3.2 Entropy method to determine the weight

Considering the objective law relationship between each index and subsystem under each subsystem, we use entropy method to determine the weight. First, we calculate the proportion of the I-year data under the j-index in the index:

$$p_{ij} = \frac{x_{ij}'}{\sum_{i=1}^{n} x_{ij}'}, i = 1,2,\cdots,n, j = 1,2,\cdots,m$$

The entropy value of index J can be expressed as:

$$e_j = -\frac{1}{\ln(n)} \sum_{i=1}^{n} p_{ij} \ln(p_{ij}), j = 1,2,\cdots,m$$

Then we calculate the information entropy redundancy:

$$d_j = 1 - e_j, j = 1,2,\cdots,m$$

The weight of each index can be expressed as follows:

$$w_j = \frac{d_j}{\sum_{j=1}^{m} d_j}, j = 1,2,\cdots,m$$

Then the weight of each subsystem can be calculated. The flow chart of the process is shown as follows:

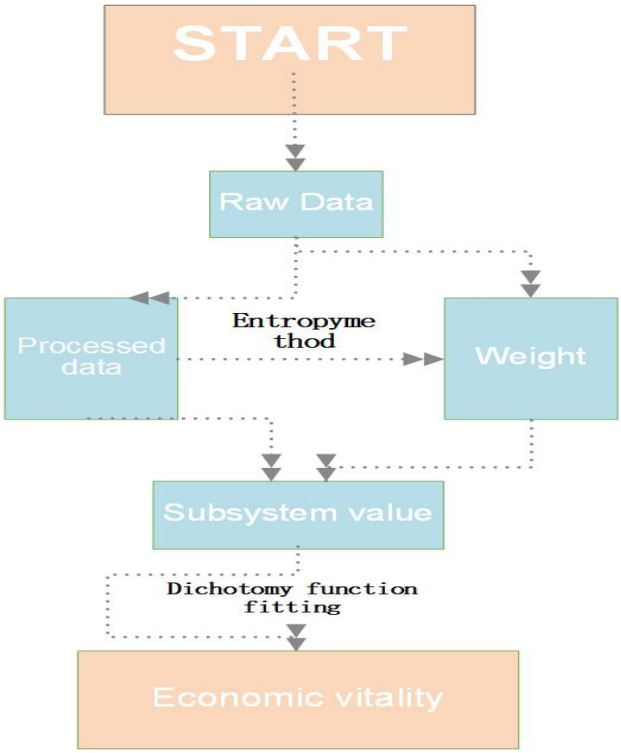

Figure 2. the flow chart

4.3.3 Function fitting based on Dichotomy

Below we use the least-square-by-divide method to obtain the functional relationship between the five subsystem layers and economic vitality. Suppose the coefficient before the different items of the fitted function is β, considering that the economic vitality of a place is the

embodiment of the strength of a place, we can assume that there is a positive relationship between the local GDP of the region and the economic vitality. For each year's regional GDP and five subsystem layer values, in Jiangsu Province, we can list a system of 12 equations, namely:

$$\sum_{j=1}^{n} X_{pj}\beta_j = V_j, \quad p=1, 2, 3, 4, 5 \tag{2}$$

where n is 12 and β is the fit function coefficient. By quantifying these equations, we can get:

$$X\beta = V$$

In the above formula:

$$X=\begin{bmatrix} X_{11} & X_{12} & X_{13} & X_{14} \\ X_{21} & X_{22} & X_{23} & X_{24} \\ X_{31} & X_{32} & X_{33} & X_{34} \\ X_{41} & X_{42} & X_{43} & X_{44} \end{bmatrix}, \quad \beta=\begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \end{bmatrix}, \quad V=\begin{bmatrix} V_1 \\ V_2 \\ V_3 \\ V_4 \end{bmatrix}$$

by calculating that the equation is not solved, we so in order to choose the most appropriate β to make the equation as far as possible to set up, the introduction of residual square sum function:

$$S(\beta) = \left\| X\beta - V \right\|^2$$

to measure the estimated value $\hat{\beta}$ and the residual difference to fit V .When $\beta = \hat{\beta}$, the residual square sum $S(\beta)$ is the minimum value, we regarded that:

$$\hat{\beta} = \arg\min(S(\beta)).$$

we differentialize the equations $S(\beta)$ to the maximum value, and we get:

$$X^T X\hat{\beta} = X^T V.$$

It is found that the matrix $X^T X$ is not singular, so the coefficient of equation sought β has a unique solution:

$$\hat{\beta}=(X^T X)^{-1} X^T V$$

so, we get the coefficients of each subsystem. The results are shown in the following table:

Table 3. Subsystem weight value

Parameter	b_1	a_1	b_2	a_2	b_3	b_4	a_3	b_5	a_4	b_6	a_5
Value	1.000	0.087	1.323×10^{-6}	-0.071	2.072×10^{-5}	5.603×10^{-6}	0.193	-3.856×10^{-6}	-0.269	-3.993×10^{-5}	0.059

From this we can get the expression of economic vitality value:

$$\mathrm{V(x)} = b_1 \times x_1 + b_2 \times x_2 + b_3 \times x_3{}^2 + b_4 \times x_3 + b_5 \times x_4 + b_6 \times x_5 + \sum_{i=1}^{5} \mathrm{a_i} \qquad (3)$$

5 Optimization Model：Based on Time Series

5.1 Based on time series model

From the perspective of time series, we can see that economic development is a dynamic process influenced by a variety of factors. It is also a multi factor dynamic evolution process to reflect the underlying cause of economic development - economic vitality. That is to say, the time series indicators reflecting the economic vitality of a region in the case of time t are as follows:

$$V(t) = F(X_1(t), X_2(t), X_3(t), X_4(t), X_5(t)) \qquad (4)$$

among them, V (T) represents regional economic vitality, and F represents a function that can comprehensively consider the impact of various system layers on regional vitality. They are represented by five subsystems: Tax subsystem, residential life subsystem, environmental resource subsystem, financial and trade subsystem, and education resource subsystem.

5.2 Measurement of long-term and short-term impact on economic vitality

Considering that there is a direct relationship between the long-term and short-term impacts of regional economy and regional economic vitality, the former is a description of the latter's changes in a long time, so we need to describe the long-term and short-term impacts of cities on the basis of regional economic vitality. Sustainability refers to the continuity of a certain state, that is, the assessment of the long-term and short-term development of the region, and the assessment of the long-term or short-term development of the region, that is, the assessment of the sustainable development of the regional economy. As the sustainable development of regional economy is a dynamic process rather than a state, it is necessary to consider the development of economic vitality within a period of time. Based on the relationship between regional developability and regional economic vitality, we can conclude that for the long-term economy of sustainable development, sustainability refers to the continuation of the dynamic state of urban economic development, so we use the derivative of the function:

$$V'(t) = \lim_{\Delta t \to 0} \frac{V(t+\Delta t) - V(t)}{\Delta t}$$

it can well describe the trend of a variable in a range. Therefore, if we use this definition for urban economic vitality value, long-term development is good, it means that for any time t, there are:

$$\frac{\mathrm{d}\,(V\ (t))}{d\,t} > 0$$

at this time, the regional economy is not only developing, but also sustainable.

This formula describes the continuity that the development of regional economy will not be "interrupted" or "decreased". "Interruption" does not mean that the city's economy does not change, but that the state of the city's economic development cannot continue to grow on the original basis, the vitality value does not change and stagnates. " The meaning of "decline" is not the decline of regional output value, but the decline of regional development trend. In relative circumstances, it is worse than the original development situation.

In the process of regional economic development, there are three situations of interruption or decline below:

- Great changes have taken place in the external environment (such as domestic environment, international environment, and natural environment). The self-stability of regional economy cannot resist the damage of environmental changes to the structural order, resulting in the system unable to develop to a more orderly and good state;
- In the process of regional internal development, the coordination between subsystems is constantly changing after a period of time. When the development of internal sub-systems is too uncoordinated, the development of regional economy stagnates or even regresses;

- For the short-term development benefit, the decision-makers of regional economic development choose a kind of decision-making which is not conducive to long-term development, which has laid a foreshadowing for the later economic development, leading to the rapid development of regional economy but lack of aftereffect.

Therefore, in the process of regional economic development, if there are:

$$\frac{\mathrm{d}\,(V\ (t))}{d\,t} \leq\ 0$$

it means that the economic development of the city fluctuates at that time, and its long-term trend is difficult to sustain.

5.3 The short-term and long-term effects of economic policies transformation on the economic vitality of Jiangsu Province

The short-term effects of economic policy transformation on the economic vitality of Jiangsu Province are as follows:

(1) Reducing the tax rate of enterprise income tax can increase the economic vitality in the short term.

(2) Promote the consumption of industrial power consumption and increase the economic vitality in a short period of time.

(3) To do well in drought prevention and flood control measures, reduce the number of natural disasters, can improve economic vitality in a short time.

The long-term effects of economic policy transformation on the economic vitality of Jiangsu Province are as follows:

(1) Improving the income and employment rate of residents can improve the economic vitality in the long run.

(2) Reducing teachers' burden on students and improving the quality of local education can improve economic vitality for a long time.

6 Simplified Model and Its Application

Scientific evaluation system of regional economic vitality is the basis of correct analysis and evaluation of regional economic vitality. Through the analysis and evaluation of regional economic vitality, we can accurately locate the economic vitality of a region, provide an effective path for the development of regional economy, and then improve the competitiveness of the region.

6.1 The simplified model

Due to time constraints and the confidentiality of relevant data, we can not collect 11 indicators of all cities in this Article 4.1. In order to make the results of our model accurate in this case, we choose the most representative index in each subsystem to replace the value of the subsystem. The results are as follows:

Table 4. Representative index of each subsystem

Subsystem	Representative index
Tax	Enterprise Income Tax
Residents' life	Residents' Income
Environmental Resources	Industrial Power Consumption
Economic and Financial Trade	Quantity of Surviving Enterprises
Educational and Scientific Research	Total Output Value of High and New Technology Industry

6.2 Ranking of economic vitality of each city

We have collected the values of all the representative factors of each city. Through the above simplified model and the functional relationship between the five subsystems and economic vitality, we can get the economic vitality of 19 cities. By comparing the economic vitality of cities, we can get the ranking which you can see in the appendix at the end of the paper and the partial results are in Table 4, as follows:

Table 5. partial results of city ranking

City	Tax	Residents' life	Environmental Resources	Economic and Financial Trade	Educational and Scientific Research	Economic vitality	Ranking
Shanghai	1104.1	53280.2	450.7	157.4	5680.3	1108.15	1
Beijing	1024.7	56801.3	400.2	118.3	5231.4	1027.89	2
Guangzhou	1014.8	50768.3	436.4	89.6	4841.2	1018.62	3
…	…	…	…	…	…	…	…
Shenyang	260.3	36862.3	234.9	21.8	2897.2	261.38	18
Kunming	210.6	32496.5	190.2	23.5	2323.7	211.30	19

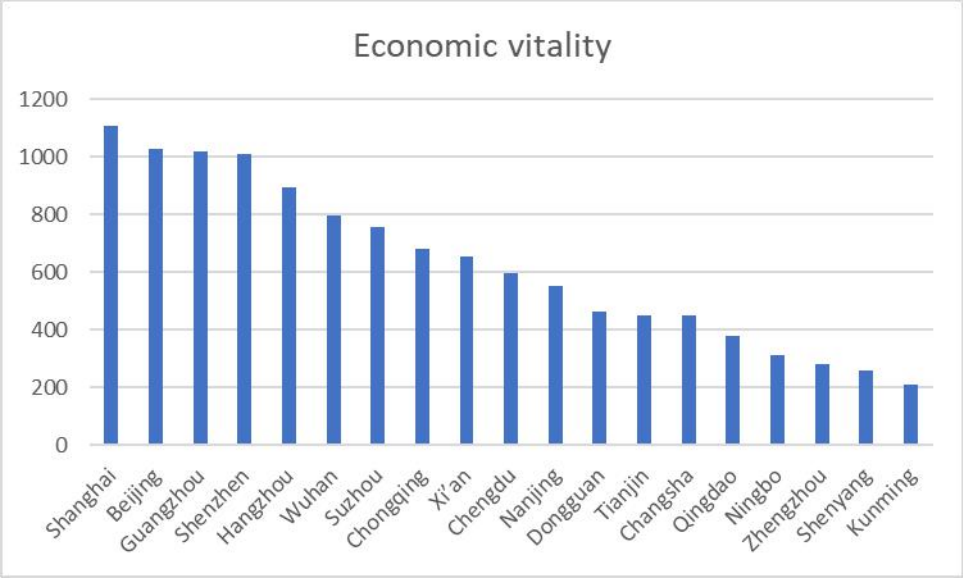

Figure 3. Economic vitality of each city

6.3 Analysis of results

It can be seen from the data in the table that Shanghai has the highest economic vitality, the highest value of its four subsystems of tax, environmental resources, financial trade and educational research, but the value of its residents' life is lower than that of Beijing; by comparing the ranking of Guangzhou and Shenzhen and the value of each subsystem, it can be found that the value of Guangzhou's other subsystems is lower than that of Shenzhen, except for the value of the tax subsystem Shenzhen, but the economic vitality of Guangzhou is higher than that of Shenzhen, so we can know that tax has the greatest impact on economic vitality.

Tax directly reflects the level of regional economy, that is, the higher the tax, the higher the economic vitality, so the relationship between tax and economic vitality is in line with the objective facts. So our model is more reliable.

7 Further Study on Economic Vitality of Jiangsu Province

7.1 Comprehensive evaluation of the sustainable development of Jiangsu Province

According to the description of sustainability:

$$\frac{\mathrm{d}(V(t))}{dt}=\lim_{\Delta t\to 0}\frac{V(t+\Delta t)-V(t)}{\Delta t}>0 \tag{4}$$

by substituting it into the formula of economic vitality, the comprehensive evaluation index of sustainable development of regional economy can be obtained as follows：

$$\mathrm{D(x)}=0.9999+4.144\times 10^{-5}\times x_3$$

We can find that for the sustainable development of regional economy, the most important subsystem is resources and environment, while other subsystems do not play a major role. The development of regional economy is inseparable from the support of people, resources, environment, policies, finance and trade, scientific research and education. Financial trade, scientific research and education must rely on high-quality people, and high-quality people have requirements for the environment. Therefore, in the final analysis, high-quality people, rich resources and optimized environment are the indispensable basis and conditions for the development of regional economy, of which the resource and environment factors are the most important. That is to say, economic development is restricted by human and resource environment.

Nowadays, the strategy of invigorating the country through science and education continues to deepen, and the competition among different regions is not as important as ever. At the same time, resources and environment have become the most important factors. Therefore, if the regional economy is to continue to develop, it is necessary to coordinate the relationship between resources, environment and economic development. Otherwise, not only economic development is difficult to last, but also human life will be affected. Therefore, the policy makers must coordinate the economic development with this and combine the current development with the long-term development. Only in this way can the national economy gradually embark on a virtuous cycle. Although the core of sustainable development is development, it must be based on the fact that sustainable development is a resource and environment friendly strategy. Not only in Jiangsu Province, but also in any region, we must seriously examine the three tasks of economic development, environmental protection and effective use of resources.

7.2 Development proposal for Jiangsu Province

If we are the decision-makers of economic development of Jiangsu Province, we must actively respond to the scientific concept of development, so that development can meet the needs of both contemporary people and future generations without compromising their ability to meet their needs. Let population, resources, environment, economy and society develop harmoniously. The following specific suggestions are made for decision makers in Jiangsu Province:

1. In the face of the relationship between environmental protection and economic development, they should be placed in the same important position, even give priority to resources and environment. As Jiangsu is located at the estuary of the Yangtze River, once its environment is damaged, it will not only cause local

pollution, but also affect rivers and oceans, which will cause overall harm. Jiangsu Province, as an area ahead of the country in economic development, must play a leading role. In economic development, we can't repeat the past mistakes, or we will have our own consequences. In fact, the development of economy and the protection of environment are not contradictory, but also provide a more solid backing for economic development. On the one hand, economic information can provide sufficient funds and more advanced technology for the environment; on the other hand, a good environment can provide good conditions for economic development. They complement each other, promote each other and develop together. If we handle the relationship between them well, we will benefit both sides.

2. Increase expenditure on resource and environmental protection. We can't let the lack of funds become an excuse and a bottleneck restricting regional environmental protection. Therefore, in addition to the increase of national investment in environmental protection, it is necessary to increase local investment and adopt multi financing. In addition, it is more important to improve the level of governance technology to reduce the cost of governance and deepen the reform of environmental protection investment system to improve investment efficiency.

3. Vigorously develop environmental protection industry. The government should focus on cultivating the market of environmental protection industry, and once again use the market mechanism to protect the resources and environment. Through the formulation of effective measures to strengthen the management of environmental protection product market, encourage a number of enterprises to take the initiative to adjust the industrial structure, so as to make the environmental protection industry shift from the government led to the enterprise led, give policy support to excellent environmental protection enterprises and high-quality environmental protection products, and promote their development and growth as soon as possible. We will encourage local excellent environmental protection enterprises to go abroad and integrate with Western and central regions that continue to develop environmental protection technologies.

4. Carry out environmental publicity and education in depth, and improve the environmental awareness and participation awareness of the people, especially the decision makers of enterprises and governments at all levels. The importance of resources and environment is deeply rooted in people's minds, and we are actively committed to the protection of environmental resources. Accelerate the implementation of relevant national strategies and the publicity of relevant policies and ideas, so that future generations will also carry out the idea of sustainable development.

8 Strengths and Weaknesses

Strengths:

(1) The model of this paper determines the weight by the entropy method, which is more accurate and objective compared to those in charge of the compound assignment method, and can better explain the results obtained.
(2) We use data from the Jiangsu Provincial Bureau of Statistics to determine indicators for evaluating economic vitality, and take into account data from 12 years, which are accurate and sufficiently numerous.
(3) When we consider the long-term and short-term effects of variables on economic vitality, we use the method of fitting functions for guidance, which is novel and reliable.
(4) We divide the evaluation indicators into five subsystems to make our research more specific and make our evaluation criteria more comprehensive.

Weaknesses:

(1) We select eleven indicators to evaluate the economic vitality of the region, not taking all factors into account.
(2) Limited by time and data, we replace the subsystem with the most representative indicators when comparing the dynamics of multiple regions, and if these can be considered well, the results will be more reasonable and valuable.

Reference

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Appendix

Ranking of economic vitality of each city

City	Ranking
Shanghai	1
Beijing	2
Guangzhou	3
Shenzhen	4
Hangzhou	5
Wuhan	6
Suzhou	7
Chongqing	8
Xi'an	9
Chengdu	10
Nanjing	11
Dongguan	12
Tianjin	13
Changsha	14
Qingdao	15
Ningbo	16
Zhengzhou	17
Shenyang	18
Kunming	19