Analysis and Suggestions of the Regional Economic Vitality

Qiufeng Deng[1], Yan Xie[2], Chen Ai[3]

[1]School of Economics and Management, Nanchang University, Nanchang, Jiangxi, 330000, China

[2]School of JiLuan, Nanchang University, Nanchang, Jiangxi, 330000, China

[3]School of Science, Nanchang University, Nanchang, Jiangxi, 330000, China

Keywords: regional economic vitality, gray prediction model, gray correlation analysis

Abstract: Regional economic vitality is an important composition of the city's comprehensive competitiveness. The core goal of this article is to establish a scientific mathematical model based on the relevant data, to grasp the key factors that effectively improve the regional economic vitality and to provide advice for the benign economic vitality of Shenzhen's region sustainable development and stronger regional competitiveness. Firstly, Shenzhen was selected as the reference area. The factors affecting economic vitality were analyzed from the three aspects—population, number of enterprises, and output value of enterprises. Based on the quantified results, it was concluded that the regional economic vitality was improved. Secondly, based on the previous conclusions, we use the gray prediction model to accurately describe the predicted values of each independent variable after the economic policy transition and compare them with the real values. After analyzing the comparison between the predicted value and the true value, the conclusion is that the economic policy transition has a short-term impact on the economic vitality of the region. The impact is more significant and the long-term impact is smaller. Thirdly, we use gray correlation analysis to analyze and measure the regional economic vitality as well as quantitatively sort the urban economic vitality. With the help of computer programming technology, we can minimize the loss due to information asymmetry. The comparison of reference regions gives the ranking of urban economic vitality: Shanghai first, Shenzhen second, and Beijing third.

1. Introduction

Economic vitality determines the ability and the potential of a country's or a region's sustained economic growth [1]. Through the analysis and evaluation of the economic vitality of the city, we can not only accurately locate the economic vitality of a city, but it also plays an important role in exploring the effective ways to enhance the economic vitality of the city and thus improving the competitiveness of the city [2].

2. The model of factors affecting economic vitality

2.1 Preparations before Modeling

This article selects Shenzhen as the research object, and analyzes the impact on regional economic vitality changes from the two dimensions of population change trends and corporate vitality changes, and the three indicators of population number, number of enterprises, and corporate output value. Using SPSS for statistical analysis, we established a regression model and studied action plans to improve regional economic vitality.

2.2 Model Establishment

Let the objective function of the model be as follows:

$$Y_i = \beta_0 + \beta_1 \ln X_{i1} + \beta_2 (X_{i2})^{\frac{1}{3}} + \beta_3 X_{i3} + \varepsilon_i$$

Y_i is the GDP per capita in year i; β_i is the i^{th} coefficient; x_i is the i^{th} original data sequence; x_i' is

the i^{th} sequence after the dimensionless transformation of the initial value.

Assume $X_i = (x_i(1), x_i(2), \ldots, x_i(n))$ is the original data sequence of factor X_i.

$$X_i' = \frac{X_i}{x_i(1)}, x_i(1) \neq 0, i = 1,2,\ldots,n$$

Then we substitute the processed data into SPSS for statistical analysis. Through curve simulation, the observation results are shown in Figure 1, Figure 2, Figure 3, and Figure 4. The results have good significance.

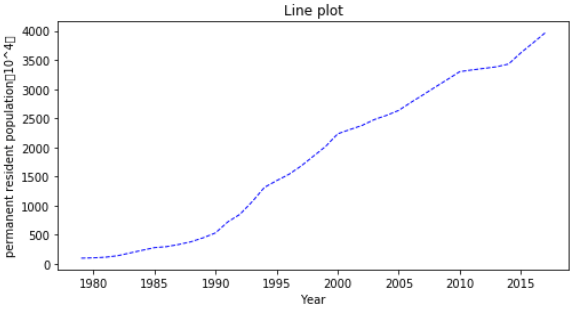

Figure 1. Permanent resident population

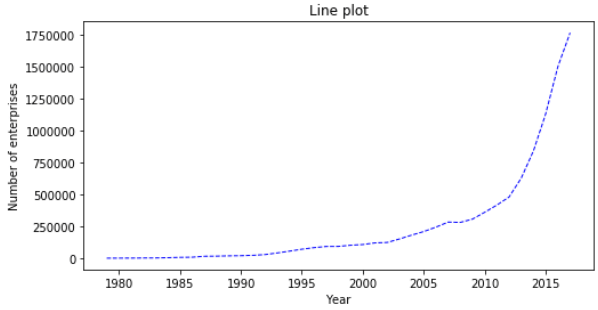

Figure 2. Number of enterprise

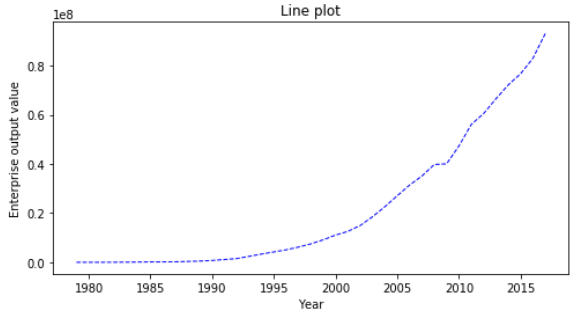

Figure 3. Enterprise output value

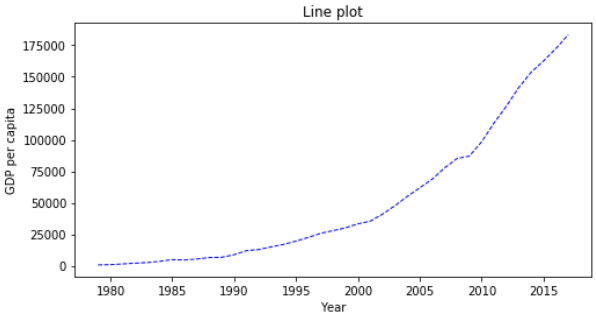

Figure 4. GDP per capital

According to the results, we artificially log the number of permanent residents, take the cubic root of the number of enterprises, and then perform a linear fit.

Also, considering that in addition to the impact of X_{ip}, there are other variables existed. So we add an error term ε_i to account for the impact of Y_i caused by other factors.

2.3 Model Inspection and Solution

This article uses SPSS analysis to measure the estimation and the fitting degree of the model to a pair of observations is shown in Table 1.

Table.1. Model summary ANOVA

	Square Sum	Variance	Mean Square	F	Conspicuousness
Regression	3.412	3	1.137	8260.992	0.001
Residual	0.005	35	0.000		
Total	3.417	38			

a. Dependent variable: GDP per person

b. Forecast variables: (constant), enterprise output value, number of permanent residents, number of enterprises

Table.2. Coefficient

	B	Standard Error	Beta	t	Conspicuousness
(Constant)	0.031	0.022		1.370	0.179
Number of permanent residents	0.010	0.005	0.040	1.982	0.055
Number of enterprises	0.136	0.059	0.110	2.314	0.027
Enterprise output value	0.869	0.034	0.864	25.583	0.000

a. Dependent variable: GDP per person

From the Table above, we can see that the model fits very well (the closer the index is to 1, the better its fit). F refers to the significance test of the regression equation. The linear relationship between the explanatory variables and all explanatory variables has a significant impact on the whole. The value of t is a test value for the regression parameters, which represents the conclusions based on the confidence level and degrees of freedom. We can see that when other explanatory variables are unchanged, the impact of a single explanatory variable on the explanatory variable is significant. Finally, in the actual observations, this paper uses B in the non-standardized parameters as the coefficient of each factor. And finally we get the model:

$$Y_i = 0.31 + 0.01\ln X_{i1} + 0.136(X_{i2})^{\frac{1}{3}} + 0.869X_{i3}$$

2.4 Action Plan to Increase Regional Economic Vitality

According to the data obtained from the model, we know that the output value of enterprises has the greatest impact on the economic vitality of cities. Therefore, improving regional economic vitality should start with increasing the output value of enterprises.

Table.3. The data obtained from the model

Influencing factors	permanent resident population	Number of enterprises	Enterprise output value
coefficient	0.01	0.136	0.869

For business:

1) Innovative technology

Technology is the primary productive force, so improving technological output is inseparable from technological innovation [3]. Companies can regularly send employees to learn new technologies in order to improve their work efficiency. Companies can also extensively absorb high-end talents to develop more advanced equipment to further increase productivity [4].

2) Establish a complete enterprise management system

A sound enterprise management system is not only conducive to improving the core competitiveness of the enterprise and promoting the development of the enterprise, but is also an important factor in increasing the output value of the enterprise [5]. The board of directors of an enterprise should establish a complete management system and optimize the system in a timely manner based on the recent problems exposed [6].

To the government:

1) Provide enterprises with relatively preferential loan policies

Corporate development is inseparable from financing. And low financing costs are more conducive to the development of corporate business. Therefore it promotes the growth of corporate output value. For example, for reputable companies, banks can reduce their borrowing costs; for difficult capital turnover but good development prospects companies, banks can provide them with liquidity support [7].

2) Attracting talent

In the past 20 years, China's economy has developed vigorously, and the most important competition among enterprises has evolved from competition in industrial technology content and management level into competition for enterprise talents [8]. Enterprise talents are the primary resource for enterprise development and the key to determining the output value of enterprises Compared to absorbing talents in various fields, Shenzhen needs more talents in the main development areas to apply to that city [9]. Therefore, Shenzhen should strengthen its strengths, avoid its weaknesses and determine its own competitive advantages and unique urban positioning to attract talents in a certain field [10].

3. Model establishment and solution of the grey prediction model

Let the objective function of this model be as follows:

$$\hat{x}^{(1)}(k+1)=\left[x^{(1)}(1)-\frac{\hat{u}}{\hat{a}}\right]e^{-\hat{a}k}+\frac{\hat{u}}{\hat{a}}$$

Table.4. Epsilon & rho

	Ω	$\sigma(k)$	p
Max	0.1766	0.1939	0.9957
Min	0.063	-0.163	0.8285

We first check the relative error of the grade ratio $_{\Omega}$, $\sigma^{(0)}(k)$ and precision p. Obtained by MATLAB programming, the results can be considered to have met the general requirements, which proves that the model fits well.

Regarding the impact of economic policies, we selected the Shenzhen Municipal People's Government General Office's Notice 2012 on Printing and Distributing the Interim Measures of Shenzhen Migrant Workers for Point Entry. The various economic data before the implementation of the policy were substituted into the model to obtain predicted values. Now compare the predicted value with the real value:

Table.5. Predicted value & True value

	Permanent resident population (10^4)	Number of surviving enterprises	Enterprise output value (10^4)
Predicted value	3614.308	1356920.733	93466284.73
True value	3967	1769876	93180979
Predictedvalue/True value	0.911	0.7666	1.003

We can conclude that the economic policy transition has a significant impact on the number of enterprises, but has little impact on the output value of enterprises.

The regional economic vitality model derived from above is as follows:

$$Y_i = 0.31 + 0.01\ln X_{i1} + 0.136(X_{i2})^{\frac{1}{3}} + 0.869X_{i3}$$

Combining above two models, we can see that the economic policy has a small long-term impact on regional economic vitality, but has a more significant short-term impact.

4. The gray correlation model

4.1 Preparations before Modeling

Through the solution of the first model, we have obtained the relationship between the regional economic vitality and the number of population, the number of enterprises, and the output value of enterprises. Here we use gray correlation analysis to conduct research.

4.2 Model Establishment

Let the objective function of the model be as the follows:

$$\gamma_{0i}=\frac{1}{n}\sum_{k=1}^{n}\gamma_{0i}(k)$$

$\gamma_{0i}(k)$is the i^{th} correlation coefficient of the comparison sequence; γ_{0i} is the i^{th}correlation of the comparison sequence.

Because each factor has a different unit of measurement, the original data has dimensional and order-of-magnitude differences, which makes it difficult to compare. Therefore, before calculating the degree of correlation, the original data is dimensionless.

Assume $X_i=(x_i(1),\ x_i(2),\ \ldots,\ x_i(n),)$ is the original data sequence of factor X_i

$$X_i^{'}=\frac{X_i}{x_i(1)},x_i(1)\neq 0,i=1,2,\ldots,5$$

Since most of the data series we collected show a stable growth trend, this initial method is suitable for the dimensionlessization of stable socioeconomic phenomena, so we can use it to make the growth trend more obvious.

We use the maximum value of each data as the reference sequence X_0.

Reference data series after data processing

$$X_0' = \{x_0'(1), x_0'(2), \ldots, x_0'(n)\}$$

While the other regions are set as comparison series

$$X_i' = \{x_i'(1), x_i'(2), \ldots x_i'(n),\}, i = 1,2,\ldots,m$$

From a geometric point of view, the degree of correlation is essentially the similarity of the curve shapes of the reference series and the comparison series. If the curve shapes are close, the correlation between the two is greater; otherwise, the correlation is smaller. Therefore, we choose the Difference as a measure of relevance:

$$\Delta_i(k) = \left| x_0'(k) - x_i'(k) \right|, k = 1,2,\ldots,n$$

$\Delta_i(k)$ is the k^{th} data in the i^{th} comparison sequence;

For this value, there are maximum and minimum differences between the poles:

$$\Delta(\max) = \max_i \max_k \Delta_i(k)$$

$$\Delta(\min) = \min_i \min_k \Delta_i(k)$$

$\Delta(\max)$ is the maximum difference between two poles; $\Delta(\min)$ is the minimum difference between two poles.

Thus determining the correlation coefficient:

$$\gamma_{0i}(k) = \frac{\Delta(\min) + \rho\Delta(\max)}{\Delta_i(k) + \rho\Delta(\max)}$$

Among them ρ is the resolution factor used to weaken the distortion effect of the correlation coefficient when $\Delta(\max)$ is excessively large. We artificially introduce $\rho = 0.5$ to improve the significance of the difference between the correlation coefficients.

Because the degree of correlation between each comparison series and the reference series is reflected by n correlation coefficients. The dispersion of the correlation information is not convenient for us to compare as a whole. Therefore, it is necessary to centrally process the correlation information to obtain the correlation degree:

$$\gamma_{0i} = \frac{1}{n}\sum_{k=1}^{n} \gamma_{0i}(k)$$

4.3 Model Solution

In this paper, the ranking results of the city's economic vitality obtained by programming with MATLAB, among which Shanghai is the first, Shenzhen is the second, and Beijing is the third.

From above, we can see that the transformation of economic policy has positive impact on the economic vitality of Shenzhen. In order to make the economic vitality of Shenzhen show benign sustainable development and enhance regional competitiveness, this paper provides the following development suggestions:

(1) Build the high ground of leading talents gathering, implement high-end talents, overseas talent introduction plan.

Talent is the core and main body of economic and social development in developed areas, and it is also the backbone and core element of the development of innovative industry. Realizing the significance of talents to urban development, Shenzhen has adopted a series of policies to lower the threshold of settlement and attract talents. In the development of Shenzhen in recent years, we can

see the overall growth of the number of resident population showing a "slow-fast-slow" trend, because Beijing, Shanghai and other first-tier cities have issued relevant high-end talent introduction policies. In order to enhance its regional competitiveness, it is necessary to improve the preferential talent incentive policy, improve rental subsidy, talent access and other preferential policies, so as to strengthen Shenzhen. The attraction of the city to high-end talents.

At the same time, Shenzhen, as a coastal city with high domestic economy and high opening-up, is facing the pressure of international competition. International talent is an important support for promoting the global innovation of the city, and attracting and retaining the international talent will become the new battlefield of the global innovation city. Therefore, the introduction of a batch of domestic and overseas "high, fine, pointed" talents is the focus of the work of the people in Shenzhen. The introduction of high-end talents and overseas talents is of great significance to the development of high-and high-tech industries and cities in Shenzhen. With regard to the introduction of international talent, the first is to develop a talent policy based on Hong Kong and Macao and open to the world, and to reduce the international high-tech talents and entrepreneurs. In particular, young people work visa thresholds, attract high-skilled migrants, retain graduates and entrepreneurs who are learning in our country. Shenzhen should actively explore the flexible introduction mechanism and safeguard system of overseas and provincial talents, optimize the environment of the people's tenure, build a one-stop service process such as medical care, children's enrollment and insurance.

(2) Provide policy preferences to mitigate the start-up financing pressure.

The Shenzhen municipal government has achieved remarkable results in reducing the examination and approval steps of attracting investment and providing financial support to start-ups. More and more enterprises have moved into Shenzhen, which has improved the economic vitality of Shenzhen. However, the financing dilemma faced by start-ups is still a hot issue. Therefore, the Shenzhen government needs to further provide financing support for innovation investment of manufacturing enterprises through policy support means, alleviate the financing constraint pressure of innovation investment, and stimulate the vitality of economic development through enterprise innovation. In addition, the role of government subsidies in enterprise innovation investment is gradually emerging, so it is necessary to further improve the efficiency of the allocation of government financial funds and make active use of them. Financial subsidies provide financial support for enterprise innovation investment. This will have a positive impact on technological innovation enterprises and start-ups, thereby enhancing the economic vitality of Shenzhen.

(3) Devote great efforts to the construction of ecological environment and improve the living environment.

The 18th National Congress of the Communist Party of China (CPC) brought the construction of ecological civilization into the overall layout of the cause of socialism with Chinese characteristics, and the environmental issue became a hot topic during the two sessions. Beautiful environment is the well-being of human survival and development, and it is an important part of urban vitality. The government needs to make it clear that GDP should not be the only goal of urban development, but should adhere to the concept of "low-carbon, circular, green" development and build a beautiful low-carbon new city. The Shenzhen government should devote itself to perfecting infrastructure and social services, building first-class urban areas with a comprehensive environment, continuing to adhere to the working concept of people-oriented and people-oriented, and constantly increasing the work concept of affordable housing, education and the public. With the investment of safety, medical and health, community service, social security and employment, we should strive to create sustainable ecological urban areas and build a first-class human settlement environment.

(4) Building a modern service-oriented government toward the modern new cities.

On the one hand, simplify the government administrative examination and approval model, establish and improve the supervision and complaint mechanism. Build a networked and intelligent administrative platform, realize the networked office of governments at all levels in the new area, flexibly use the functions of online platform consultation, question answering, appointment, acceptance and submission of materials, integrate online and offline synchronous processing, reduce examination and approval procedures, let enterprises and the masses realize "running one leg and

doing all things", and improve the efficiency and transparency of work.

On the other hand, it is to achieve cross-regional, cross-departmental, cross-level information sharing. Using big data and cloud computing technology, intelligent analysis and matching of cross-regional, cross-departmental and cross-level government data, through the analysis of the relationship between these data, find out the problems in the masses, realize the value-added use of data, such as mass household registration, wages, housing and medical care, education directly linked, through the changing trend of data, predict the possible problems in society.

References

[1] Song Laizhong, Wang Zhiming. Mathematical modeling and experiment [M]. Beijing: Science Press, 2005.

[2] Wang Zhengdong. Mathematical software and mathematical experiments [M]. Beijing: Science Press, 2010.

[3] Zhao Jing, Dan Qi, Mathematical modeling and mathematical experiment [M]. Beijing: Higher Education Press, 2008.

[4] Lou Shuntian, Yao Ruoyu, Shen Junxia. MATLAB7.x programming language [M]. Xi'an: Xidian University Press, 2008.

[5] Wang Lixia. Probability Theory and mathematical statistics——theory, history and application [M]. Dalian University of Technology Press, 2010.10.

[6] Fei Pusheng, Xu Xuming. Mathematical modeling and its basic knowledge [M]. Wuhan University Press, 2006.5.

[7] Hu Shouxin, Li Bainian. Mathematical experiments based on Matlab [M]. Beijing: Science Press, 2004, 1st edition.

[8] Yang Guiyuan, Huang Jili. Mathematical modeling [M]. Hefei: University of Science and Technology of China Press, 1st edition, 2008.

[9] Lan ChongFeng. The infiltration of mathematical modeling in probability and Statistics Teaching of economics and management [J]. Journal of Chifeng University (NATURAL SCIENCE EDITION), 2019, 35 (10): 3-6

[10] Lu Jirong, Wang Shihu, Tuo qianjuan. Application of mathematical modeling method in the operation of small and medium-sized enterprises [J]. Enterprise reform and management, 2019 (20): 86 + 100