Academic Journal of Business & Management
ISSN 2616-5902 Vol. 2, Issue 5: 14-20, DOI: 10.25236/AJBM.2020.020502

Research on Regional Economic Vitality Based on Analytic Hierarchy Process

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ABSTRACT. *We identified eight major factors affecting regional economic vitality development based on the given indicators. The factors influencing the regional economic vitality are comprehensively evaluated by AHP (Analytical Hierarchy Process), so 8 indexes can be selected for analysis. The significant factors for different specific regions to improve their economic vitality include: talent attraction policy, permanent population, social security and investment attraction. Then, we select Shenzhen as the research object to analyze relevant factors to Shenzhen GDP to analogy its impact on the economic vitality. The relevant factors are as the following: (1) The added value of the primary industry O, the increase of the secondary industry Value S, tertiary industry added value T, high-tech manufacturing value added H, modern service industry added value M, advanced manufacturing value added A; (2) Shenzhen resident population n; (3) Shenzhen enterprises N. Finally, by collecting relevant data for Shenzhen from 2011 to 2019, we studied the following problems: (1) Shenzhen GDP Multiple linear regression model of the structure. (2) The changes in Shenzhen resident population in the coming years and its impact on the economic vitality of Shenzhen. (3) The impact of the enterprises on the economic vitality of Shenzhen.*

KEYWORDS: *city attractiveness, number of enterprises, number of permanent residents*

1. Introduction

The economic vitality of a region is an important part of the regional comprehensive competitiveness, and the concept of "economic vitality" is composed of a variety of factors [1]. What worth concerning is that the main representative factors are population and corporate vitality, and the functions of analyzing the economic vitality of a region is to improve its regional competitiveness [2]. However, the huge differences in economic vitality between regions still exists due to their different policies, development capabilities and location conditions. Therefore, analyzing the reasonable factors that affecting economic vitality and

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studying the important actions to improve economic vitality play an extremely important role in our future economic development [3].

2. Model Construction

2.1 Analysis of Related Factors Affecting Shenzhen's Economic Vitality from the Industrial Structure——Data-Based Fitting

Considering that the changes in Shenzhen's GDP are proportional to the changes in Shenzhen's economic vitality, the impact of related factors on Shenzhen's GDP is studied, and the analogy shows the impact of related factors on Shenzhen's economic vitality. The relevant factors are: ①The added value of the first industry is o, the added value of the second industry is modern service industry value s, the added value of the tertiary industry t is the added value of advanced manufacturing industry m; ②Shenzhen resident population n; ③Number of Shenzhen enterprises n

(1) The value added of the primary industry O, the value added of the modern industry by the second industry S, the value added of the tertiary industry T, the value added of the advanced manufacturing industry M; Shenzhen's resident population n; the number of Shenzhen enterprises N on the economic vitality of Shenzhen

Table 1 Shenzhen specific data of GDP and o, s, t, m, a, h in 2018

Statistics Time	Added value of primary industry (100 million yuan)	Added value of the secondary industry (100 million yuan)	Tertiary industry added value (100 million yuan)	Modern service industry	Advanced Manufacturing	High-tech manufacturing	Shenzhen GDP (100 million yuan)
2011	5.7	5343.33	6153.03	4899.25	3632.41	2955.44	11502.06
2012	5.56	5737.64	7206.88	4899.25	3632.41	2955.44	12950.08
2013	5.25	6296.84	8198.14	5492.37	4162.87	3370.67	14500.23
2014	5.29	6823.05	9173.64	6201.06	4823.98	4056.85	16001.98
2015	5.66	7205.53	10291.8	7134.47	5165.57	4491.36	17502.99
2016	6.29	7700.43	11785.88	8278.31	5428.39	4762.87	19492.6
2017	18.54	9266.83	13153.02	9306.54	5743.87	5302.47	22438.39
2018	22.09	9961.95	14237.94	10609.4556	6433.1344	5991.7911	24221.98

According to the statistics of the official website of the Shenzhen Municipal Bureau of Statistics, we obtained Shenzhen's 2011-2018 Shenzhen GDP and added value of the primary industry o, added value of the second industry s, added value of

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the modern service industry m, added value of the tertiary industry t, advanced the data of manufacturing value added a, and the value of high technology manufacturing value h, are shown in the table below:

A line chart of Shenzhen's industrial structure change from 2011 to 2018 can be made. Through the line chart, we can clearly see that Shenzhen, as a first-tier city in the country, its industrial structure shows that the mainly economic growth is the tertiary industry, the secondary industry is mainly advanced manufacturing, and the tertiary industry is modern service Mainly, the characteristics of the primary industry continued to decline. It can be said that the industrial structure of Shenzhen is fully in line with its status as a first-tier city. From the historical data, it presents a steady growth at a high level and excellent development indicators.

(2) Model establishment

● Assume G is Shenzhen's gross domestic product (GDP), the primary industry added value is o, and the secondary industry added value is o. S is the added value of the tertiary industry. T added value of high-tech manufacturing H Value added of modern service industry M added value of advanced manufacturing A.

● By studying relevant data, we can use g to represent the regional economic vitality as the dependent variable, and its influencing factors o, s, t, h, m, a are independent variables.

● Using Shenzhen's relevant data from 2011 to 2018 and using SPSS software to establish a multiple linear regression model, we obtained a six-factor model of o, s, t, h, m, and a. After testing and debugging, we found that the model could not accurately explain the relationship between each independent variable and the dependent variable.

(3) Model modification——Analysis of the relationship between single independent variable and dependent variable

Use spss to make scatter plots of the respective variables o, s, t, h, m, a and the dependent variable g.

The purpose of drawing a scatter plot is to observe whether there is a significant linear relationship between the dependent variable and each independent variable, so as to build an appropriate mathematical model. From the figure, it can be seen that except for the value added (o) of the first industry. The data changes drastically, resulting in an uneven distribution. The scatter plots of the other five factors are roughly linearly distributed and have a significant linear relationship. You can use a linear regression method to build a regression analysis model.

(4) Construction of new model

● Linear model of independent variables s, t, h, ma and dependent variable g

Take Shenzhen GDP(G) is the dependent variable, the added value of the secondary industry, S added value of tertiary industry, T added value of high-tech manufacturing, H added value of modern service industry, M added value of

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advanced manufacturing, A establish multiple regression models for independent variables

the regression equation: $\hat{G} = \hat{\beta}_0 + \hat{\beta}_1 S + \hat{\beta}_2 T + \hat{\beta}_3 H + \hat{\beta}_4 M + \hat{\beta}_5 A$

Substitute the relevant data of Shenzhen from 2011 to 2018, and use spss to solve the regression equation

It can be seen from the output results: goodness of fit R^2. A value of 1 indicates that the regression line fits the observations very well; a value of dw is closer to 2, indicating that there is basically no (first-order) autocorrelation, which is suitable for linear regression. The p value corresponding to f is 0.000, which is less than A significance of 0.05 is acceptable for the null hypothesis, indicating that there is a significant linear relationship between the independent and dependent variables.

After SPSS calculation, the regression coefficient is obtained

$$b = (\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5) = (-17.201, 1.001, 0.995, 0.003, 0.003, 0.008),$$

Get the preliminary regression equation: $\hat{G} = -17.201 + 1.001S + 0.995T + 0.003H + 0.003M - 0.008A$

By testing the statistics, all the equations meet the requirements, so there is a significant linear correlation between the dependent variable g and the independent variable, and the resulting linear regression model is available.

● Model of independent variable o and dependent variable g

Using SPSS to Shenzhen GDP (G) is the dependent variable, and the primary industry added value o is the independent variable for curve fitting.

It can be seen from the output results: goodness of fit R^2. The value is 0.620, which is far away from 1, which indicates that the curve fits the observations poorly. The p value corresponding to f is 0.020, which is less than the significance of 0.05, and the null hypothesis can be accepted, indicating that there is a difference between the independent and dependent variables. Obvious linear relationship

By testing the statistics, although the requirements are met, the effect is not ideal, so there is no correlation between the dependent variable g and the independent variable, and the resulting fitting function is not available.

Analysis of data:

By observing the scatter plot of residuals, we know that in 2011-2016, the added value of the primary industry was concentrated at about 500-600 million yuan, and the added value of the primary industry increased by nearly 3 in a short period of 2017. Times, the data changes drastically, so find out the adjustment of economic policies in the relevant period.

After data integration and collection, it was found that economic policies (especially the primary industry) underwent major adjustments and changes in 2017. Since the 18th National Congress of the Communist Party of China, the level of

ISSN 2616-5902 Vol. 2, Issue 5: 14-20, DOI: 10.25236/AJBM.2020.020502

agricultural mechanization in China, the labor productivity of the primary industry, and the average annual per capita net income of farmers Income has reached a new level.

China's economic adjustment policy in the primary industry is mainly reflected in the significant improvement in the effectiveness of agricultural mechanization. It means that in agricultural production, the proportion of mechanized production methods has exceeded the traditional production methods and has occupied a dominant position. The traditional agricultural elements and production methods of the Lord are gradually weakening in many agricultural fields. The direct effect of agricultural mechanization is to increase agricultural labor productivity.

Due to the role of these policies, China's economic vitality has undergone major changes and confirmed our data results. In 2017, due to policy factors, the added value of the primary industry had a very significant impact on economic vitality.

2.2 Analyze the impact on regional economic vitality changes from the perspective of population and corporate vitality trends: Taking Shenzhen as an example

(1) The impact of population changes on economic vitality

a. Forecast of Shenzhen resident population from 2020 to 2024

By consulting the data, we get the number of Shenzhen's resident population from 2015 to 2019. Through the polynomial data fitting of Excel, the following figure can be obtained:

By predicting the number of Shenzhen's future resident population through polynomial data fitting, the number of Shenzhen's resident population in the next five years can be obtained.The average value of the resident population in the next five years is 7,136,700.

The predicted values of Shenzhen's permanent population in the next five years. Establishing a fitting function of per capita GDP as a function of the number of permanent residents

- Through the collection of data, logarithmic fitting of Shenzhen's resident population and per capita GDP from 2010 to 2018 was performed.
- Suppose the population is represented by p, the per capita GDP is represented by aGDP, p is the independent variable, and aGDP is the dependent variable.

b. Model analysis and function construction

Goodness of fit of the model according to the output of SPSS R^2. The value is 0.845, and the corresponding p value of f is 0.000, which is less than the significance degree of 0.05. The null hypothesis can be accepted, indicating that there is an insignificant linear relationship between the independent variable and the dependent variable.

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According to the coefficients of the fitting function and the results of the coefficient test, a preliminary fitting function is obtained: $AGDP = 357513.24ln^{P} - 2.366E6$

By testing the statistics, all meet the requirements, so there is a significant correlation between the dependent variable and the independent variable, and the resulting fitting function is available

(2) The impact of the changing trend of corporate vitality on economic vitality

a. Forecast of the number of enterprises from 2020 to 2024

● By consulting the data, we get the number of Shenzhen 2012-2019 companies. And obtain the polynomial data fitting of Excel.

● By predicting the number of Shenzhen enterprises by polynomial data fitting, the predicted value of the number of enterprises in the next five years can be obtained.

b. Establishing a fitting function for changes in per capita GDP with the number of enterprises

● By collecting data, the regression model of Shenzhen's number of enterprises and per capita GDP from 2010 to 2018 was established.

● Suppose the number of enterprises is represented by n, n is the independent variable, and per capita GDP is aGDP as the dependent variable.

● Model analysis and function construction

Goodness of fit of the model according to the output of spss. R^2 value is 0.969, and the corresponding p value of f is 0.000, which is less than the significance of 0.05. The null hypothesis can be accepted, indicating that there is an insignificant correlation between the independent variable and the dependent variable.

According to the coefficient of the fitting function and the results of the coefficient test, the preliminary fitting function is obtained as: $AGDP = 50261.63ln^{N} - 5.407E6$

By testing the statistics, all meet the requirements, so there is a significant correlation between the dependent variable and the independent variable, so this fitting function is available.

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