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Analysis on Influencing Factors of Regional Economic Vitality -- Taking Anhui Province as a Case

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Abstract

This paper aims at the regional economic vitality of the region, using SPSS software, By principal component extraction factor, principal component regression, multiple linear regression method, the research on the economic vitality of 2000-2020 in anhui province, has chosen the comprehensive regional economic vitality of the 12 economic indicators, extract the common factor after build multivariate linear regression model, the dynamic influence factors of regional economy of anhui province in-depth research and analysis. From the time span of 20 years, the development of regional economy in Anhui Province in the past 20 years has been comprehensively analyzed, and the dynamic changes of regional economic vitality in Anhui province have been tested. The multiple linear regression model constructed has high goodness of fit and the overall significance of the equation is very strong. Finally, corresponding countermeasures and suggestions are given according to the results of model establishment.

Keywords

Regional Economic Vitality; Influencing Factors; Principal Component Regression; Multiple Linear Regression.

1. Background

Regional economic vitality is used to measure the development level and economic vitality of a region, and can be used to measure the relative development level and trend of a region, which is crucial to the development of a region and a country. Nowadays, all regions and countries are seeking effective factors and programs to enhance regional economic vitality, so as to enhance economic strength and find the sustainable driving force and guarantee of regional economic development. [1]The economy of the whole country is inseparable from the development of urban agglomeration in each region. The state also attaches great importance to and advocates the development of regional economy, thus contributing to the high-quality economic development of the whole country.

In today's world, all regions and countries attach great importance to the development and promotion of regional economic vitality, because economic vitality is very important to the development of countries and regions, economic vitality is an important performance of regional competitiveness, only by ensuring the economy, can promote the comprehensive and coordinated development of the region. [2]Regional economic vitality involves various aspects, how to grasp the growth factors of regional economic vitality, have a good regional economic vitality and development situation, promote the upgrading of economic structure has built their own economic system, make themselves adapt to the needs of modern economy, it is extremely important.[3]

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2. Symbols and Theoretical Basis

2.1. Symbol Description

In this paper, the regional GDP of Anhui Province from 2000 to 2020 is used to measure the regional economic vitality. The regional GDP reflects the level and trend of regional economic development to a certain extent, so this paper uses GDP to measure the regional economic vitality of Anhui Province. It selects 12 indexes which can reflect regional economic vitality effectively from each aspect., including regional economy , regional opening level, education and science and technology development level of multiple aspects of the economic indicators in order to analyze and explain the regional economic vitality. The specific symbols are described in Table 1:

Table 1. Symbols

Symbols	Definition
y	Gross Product
x_1	Added value of the primary Industry
x_2	Added value of the secondary Industry
x_3	Value-added of tertiary Industry
x_4	Total retail sales of consumer goods
x_5	Foreign registered capital of foreign-invested enterprises
x_6	Number of industrial enterprises above designated size
x_7	Resident population
x_8	Number of students enrolled in higher education institutions
x_9	Research and experimental development expenditure
x_{10}	Foreign exchange income from tourism
x_{11}	Mileage of road
x_{12}	Registered urban unemployment rate
$\widetilde{X}_t$	The normalized original variable
F1	The extracted principal component 1
F2	The extracted principal component 2

2.2. Data Sources

The data studied in this paper are from the statistical yearbook of Anhui Provincial Bureau of Statistics and the Bulletin of National Economic development and Social Development of Anhui Province 2020.

3. Empirical Analysis of Multiple Linear Regression Model

3.1. Multicollinearity Diagnosis

Preliminary test of correlation of variables: First, through the correlation of variables, the correlation coefficient of 12 variables is tested, and the correlation between variables is preliminarily judged, The correlation analysis between variables is shown in Table 2 below:

Through the above correlation coefficient matrix, it can be concluded that there is a strong correlation between variables, which is significant under Pearson correlation coefficient test, and the correlation between all variables is large. It is preliminarily judged that there is strong collinearity between variables.[4]

Judge multicollinearity based on VIF criterion:Before fitting the multiple linear regression model, it is necessary to ensure that there is no multicollinearity between explanatory variables, that is, the correlation between variables is weak. The multicollinearity test by variance inflation factor is shown by Table 3.

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Table 2. Correlations

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}
x_1	1											
x_2	0.997	1										
x_3	0.959	0.962	1									
x_4	0.954	0.955	0.995	1								
x_5	0.873	0.869	0.954	0.939	1							
x_6	0.931	0.929	0.840	0.845	0.697	1						
x_7	-0.517	-0.527	-0.315	-0.322	-0.155	-0.635	1					
x_8	0.966	0.963	0.885	0.877	0.769	0.969	-0.589	1				
x_9	0.967	0.967	0.994	0.988	0.956	0.838	-0.339	0.885	1			
x_{10}	0.796	0.821	0.774	0.790	0.577	0.802	-0.492	0.794	0.740	1		
x_{11}	0.928	0.924	0.878	0.867	0.798	0.927	-0.494	0.962	0.873	0.730	1	
x_{12}	-0.852	-0.862	-0.878	-0.890	-0.806	-0.762	0.413	-0.729	-0.884	-0.768	-0.706	1

Table 3. Multicollinearity test

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(constant)	0.140	2.369		0.059	0.954		
x1	1.000	0.000	0.068	4291.090	0.000	0.001	976.965
x2	1.000	0.000	0.431	13533.443	0.000	0.000	3921.929
x3	1.000	0.000	0.510	17645.402	0.000	0.000	3229.784
x4	0.000	0.000	0.000	-0.226	0.827	0.001	1579.570
x5	0.002	0.000	0.000	4.706	0.002	0.007	153.051
x6	0.000	0.000	0.000	0.219	0.832	0.013	78.995
x7	0.000	0.000	0.000	-0.103	0.921	0.043	23.511
x8	0.000	0.000	0.000	0.260	0.801	0.002	530.692
x9	0.001	0.001	0.000	0.761	0.468	0.001	1065.431
x10	0.000	0.000	0.000	5.592	0.001	0.033	30.467
x11	0.000	0.000	0.000	-0.722	0.491	0.036	27.740
x12	0.029	0.072	0.000	0.394	0.704	0.024	40.833

We can see from the table above, using the dependent variable y and 12 variables between multiple linear regression, expand the permissibility and variance of each variable factor (2 VIF is based) are not close to 1, and the variance of each variable expansion factor were greater than 10, to illustrate the 12 variables between extremely serious multicollinearity problem, due to economic problems studied in this paper, There is a collinearity problem between variables.

3.2. Principal Componment Factor Extraction

There are many ways to solve multicollinearity, such as deleting some variables, increasing the sample size, or using ridge regression, stepwise regression, etc. This paper deals with the multicollinearity problem of the model by principal component method. Principal component analysis can transform the original data into a few irrelevant principal component expressions by processing the original data variables. At the same time, the comprehensive index after dimension reduction of the principal component is still represented by the original variable, which will not change the number of explanatory variables. All principal component regressions are used to solve multicollinearity problems.[5] After preliminary analysis, it is found that the contribution rate of cumulative variance can reach 92.377% by extracting two

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principal components. So this paper extracts two common factors to reduce the dimension of the original variable.

Table 4. Total Variance Explained

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.960	83.000	83.000	9.960	83.000	83.000
2	1.125	9.377	92.377	1.125	9.377	92.377

According to the variance extraction Table 4, the cumulative variance contribution rate of the first two principal components is 92.377%, that is, the information of the 12 original variables can be retained 92.377% by extracting the first two common factors, indicating that the extraction effect of principal components is ideal.

The corresponding feature vectors are calculated from the first two feature roots, and the two principal components expressed by the standardized original data can be obtained from (1) and (2):

$$F1=0.3143\widetilde{x_1}+0.3152\widetilde{x_2}+0.3080\widetilde{x_3}+0.3073\widetilde{x_4}+0.2792\widetilde{x_5}+0.2956\widetilde{x_6}-0.1597\widetilde{x_7} +0.3029\widetilde{x_8}+0.3077\widetilde{x_9}+0.2639\widetilde{x_{10}}+0.2953\widetilde{x_{11}}-0.2795\widetilde{x_{12}} \quad (1)$$

$$F2=-0.0160\widetilde{x_1}-0.0255\widetilde{x_2}+0.2121\widetilde{x_3}+0.2008\widetilde{x_4}+0.3922\widetilde{x_5}-02442\widetilde{x_6}+0.7665\widetilde{x_7} -0.1678\widetilde{x_8}+2018\widetilde{x_9}-0.1706\widetilde{x_{10}}-0.0773\widetilde{x_{11}}-0.0999\widetilde{x_{12}} \quad (2)$$

3.3. Construction of Multiple Linear Model based on Principal Component Regression

The generated two unrelated principal components are used for regression with dependent variable Y, and the principal component regression results are shown in Table 5:

Table 5. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.998[a]	0.996	0.995	792.727	1.762
a. Predictors: (Constant), F2, F1					
b. Dependent Variable: y					

As can be seen from the statistical results, R^2=0.996, and the Adjusted R^2 also reached 0.995, indicating that the goodness of fit of the multiple linear regression is high, and the explanatory variable composed of two common factors can explain 99.5% of the total explained variable, and the linear regression effect is high.

Table 6. Anova

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2747376317.481	2	1373688158.741	2185.952	.000[b]
	Residual	11311495.708	18	628416.428		
	Total	2758687813.189	20			
a. Dependent Variable: y						
b. Predictors: (Constant), F2, F1						

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As can be seen from the Table 6. According to the ANOVA table, the P-value of the F test of the equation is far less than 0.05, indicating that the equation is significant, that is, there is a highly significant linear relationship between GDP and the two high factors, and multiple linear regression with the extracted common factors is better.

Table 7. Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	16225.000	172.987		93.793	0.000		
F1	11658.779	177.259	0.993	65.772	0.000	1.000	1.000
F2	1200.706	177.259	0.102	6.774	0.000	1.000	1.000
a. Dependent Variable: y							

Regression model can be constructed from Table 7. The principal component regression equation can be get from (3):

$$Y=16225.0+11658.779F1+1200.706F2 \quad (3)$$

At the same time, the constructed multiple linear regression equation also completely passed the significance test of each corresponding regression coefficient, with sig values less than 0.05. At the same time, the variance expansion factor was 1, and there was no linear relationship between variables.

In order to get the relationship between explanatory variables and original variables, F1 and F2 were used to regression the original 12 variables,meanwhile,by returning to the principal component regression equation Y=16225.0+11658.779F1+1200.706F2 , the principal component regression equation of Y to 12 original variables can be obtained, and the comprehensive regression model related to explanatory variables and original variables can be got from (4):

$$\begin{aligned} y=&-16352+0.0226x_1+0.2243x_2+0.2299x_3+0.2295x_4 \\ &+2.4014x_5+0.1311x_6+0.0047x_8+1.2007x_9 \\ &+0.8574x_{10}+0.0174x_{11}-2172.4005x_{12} \end{aligned} \quad (4)$$

4. Results and Conclusion

This article selects the influence 20 years in Anhui province regional economic vitality of the relevant economic indicators, in the original variables and explanatory variables under serious multicollinearity problems, using principal component analysis to return, after the two principal component extraction, and accordingly the construction of a multivariate linear regression model, and concludes that GDP and 12 integrated linear regression equation between the original variables.[6]

According to F value and goodness of fit of model test results, the fitting of the model is significantly effective, R^2=0.996, indicating that the two principal components constructed can explain 99.6% of GDP.The VIF of all the coefficients is less than 10. According to the principle of regression analysis, it shows that there is no serious multicollinearity between the corresponding variables, and the multicollinearity of the variables is effectively solved.

Among them, the urban registered unemployment rate has the greatest relative impact on the GDP of Anhui Province. If the urban registered unemployment rate increases by one unit on average, that is, by 1%, the GDP will decrease significantly. Therefore, it is very important to

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improve the employment rate of the region for the promotion of regional economic vitality. At the same time, the second largest factor affecting regional economic vitality is foreign registered capital of foreign-invested enterprises, and its partial regression coefficient is 0.2243, which is the most influential positive factor. It shows that improving the degree of opening up is an important guarantee for the improvement of regional economic vitality, which is of great importance to the improvement of regional economic vitality.[7]

Meanwhile, the high degree of foreign exchange influence of tourism also shows the importance of opening up to the outside world. The regression coefficient of regional R&D expenditure is 0.2299, ranking the third, indicating that the development level and investment of science and technology are also important indicators to measure regional economic vitality. The relative development of science and technology is an important embodiment of regional economic vitality, and science and technology is the primary productive force. The relative development and innovation of regional science and technology will bring continuous vitality and vitality to regional economy.

5. Suggestions and Advise

Based on the multiple linear regression model of influencing factors of regional economic vitality constructed in this paper, the following suggestions are given according to the size of partial regression coefficient of corresponding variables.

Reduce unemployment .Unemployment will have an impact on the economic system, and high unemployment rate will not be conducive to the stable development of the economy and cause the retreat of economic vitality, which is a negative indicator. The government should adopt policies to create and provide more employment conditions, so as to reduce urban unemployment rate .

The development of import and export trade also has a positive impact on the development of regional economy. Government should promote regional economic enterprises of foreign trade and create a good foreign trade environment, attract foreign investment, to attract more business to local development investment.

Highlighting the leading role of scientific innovation as a powerful underpinning for economic development. First, strengthen the cooperation between schools, research institutes and enterprises, improve the training of higher education, vigorously cultivate creative and targeted technical personnel to improve the market transformation ability of existing technologies and products, give play to the leading role of the market in integrating the whole society's innovation resources, and improve the index of social innovation activities.

The optimization of industrial structure will greatly improve the regional economic vitality, promote the development of regional economic vitality, and produce economies of scale effect. Actively guide the development of the three major industries, the development of the three major industries can reflect the stage level of regional economic development. Ensure the leading role of the tertiary industry, vigorously promote the development of the tertiary industry, rely on the growth of the service industry, comprehensively promote and assist the growth of regional economic vitality, so as to meet the national requirements for large-scale economic development and innovation of The Times.

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