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The Impact of Population and Business Vitality on Regional Economic Vitality

--Take Chongqing as an Example

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Abstract

We choose Chongqing as the research object, select the relevant indicators of the sample data from 2009 to 2018, the use of KMO and Bartlett test screening indicators GDP, the resident population, corporate number of other units, after the establishment of linear use of factor analysis model. The law derived by factor analysis and scoring coefficient variance contribution rate, to determine the initial impact of each indicator to economic activity. Finally, from the perspective of the population and the vitality of enterprises were estimated economic vitality measures in the case of considering only the population or the vitality of enterprises, and then with economic vitality in all indicators measure factors were analyzed using decimals after calibration standardization.

Keywords

Regional economic; Factor Analysis; Principal component analysis.

1. Introduction

Regional economic vitality is an important part of regional comprehensive competitiveness. In recent years, in order to improve economic vitality, some regions have issued many preferential policies to stimulate economic vitality. How to grasp key factors and effectively improve regional economic vitality is a topic worthy of study. This article will take Chongqing as an example to analyze the impact of changes in regional economic vitality from the perspective of population and corporate vitality changes.

2. Factors Establish Indicator System

2.1 Economic Vitality Influencing Factors of The First Selected

This model chosen Chongqing as modeled objects, most of the selected index or average quality indicators in selected indicators measure, try to follow the data available, such as with the principle of representativeness and comprehensiveness, integrated experience some experts and scholars and the status of economic development in Chongqing, this model selection from the economic, human resources, government regulation, industry structure, business vitality, quality of life, innovation capacity in this regard seven indicators [1] [2] are GDP, the resident population, over the age of 65, net in-migration of population, public spending, the number of tertiary industry accounted for, corporate units, the number of new employment, employment, employment rates, average wages, the

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Engel coefficient, health institutions beds, R & D expenditure this percentage of GDP indicators 14, as shown in table 1:

Table 1: Chongqing economic vitality indicators measure primaries

Num	Influencing factors	Index
1	Economic Benefits	GDP
2	Resoures of Population	Resident Population
3		Population over 65 Years Old
4		Net in-migration of Population
5	Government Regulation	Public Expenditure
6	Industrial Structure	The Proportion of Tertiary Industry
7	The Vitality of Enterprises	The Number of Enterprises
8		Number of new jobs
9		Employed population
10		Employment rate
11	Quality of life for residents	Average salary
12		Engel coefficient
13		Beds in Health Institutions
14	Creativity	R & D expenditure to GDP ratio

PS: This data model is selected and the time-series data collected 2009 to 2018 years.Relevant data mainly from the "Chongqing Statistical Yearbook" (2009-2018), "Chongqing Economic and Social Development Statistics Bulletin" (2009 Year - 2018). As part of the default data of 2018, so for individual missing data interpolation is filled, followed by all the data indicators standardized and uniform.

2.2 Model of factor analysis

Multiplying factor score is calculated using normalized index score coefficient matrix component as follow [3]:

$$F_i = a_{1i}x_1 + a_{2i}x_2 + a_{3i}x_3 + \cdots + a_{pi}x_p (p = 1,2,3,\ldots,m) \quad (1.1)$$

Among them,F_iRepresents the i-th factor score,x_1, x_2, …, x_p Indicates the standardized value of the indicator,a_{1i}, a_{2i}, …, a_{pi} Represents the component score coefficient.

The total factor score is equal to the weighted arithmetic mean of each sub-factor score, that is,

$$F = \sum b_i F_i (\sum b_i = 1) \quad (1.2)$$

Where f is the total factor score, which is the measure of economic vitality, b_iRepresents the contribution of the i-th factor. (Factor contribution = factor contribution rate after factor factor rotation / total variance interpretation rate), where$\sum b_i$It is about equal to 1.

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3. Measurement of Chongqing's Economic Vitality

This model initially selects 14 indicators for the comprehensive indicator of economic vitality.The sample used is the Chongqing city's 2009-2018 year data.Because the model has too many indicators and the data volume is relatively small, the correlation between the indicators is too low It will make the KMO value too low. Use SPSS software to perform correlation matrix analysis and KMO and Bartlett tests on the data in advance. The results shown in Table 2:

Table 2： Correlation matrix between indicators (partial)

		Permanent population (10,000 people)	gdp (100 million yuan)	Public expenditure (100 million yuan)	Number of corporate legal entities (ten thousand)
Correlation	Permanent population (10,000 people)	1.000	.997	.982	.992
	gdp (100 million yuan)	.997	1.000	.988	.983
	Public expenditure (100 million yuan)	.982	.988	1.000	.958
	Number of corporate legal entities (ten thousand)	.992	.983	.958	1.000
	New employment (10,000 people)	.878	.892	.941	.820
	Employment (10,000 people)	.926	.933	.951	.885
	Engel coefficient	-.727	-.706	-.619	-.797
	R&D	.940	.924	.897	.954
	Average salary (yuan / year)	.997	.990	.969	.996
	Net immigration population (10,000 people)	.865	.830	.785	.910
	Beds in health institutions (ten thousand)	.996	.990	.977	.990
	65 years and over	.945	.929	.885	.962
	Proportion of tertiary industry	.940	.922	.886	.954
	employment rate	-.220	-.169	-.088	-.286

This matrix is not a positive definite matrix.This is due to insufficient data and too many indicators, so I chose to delete the indicators that are more relevant in the explanatory variables-employment, new employment, net migration, tertiary industry. Proportion, employment rate, get a positive definite matrix, re-perform KMO and Bartlett tests, the results are shown in Table 3-1:

Table 3-1: KMO and Bartlett test

kmo Sampling suitability measure.		.583
Bartlett sphericity test	Approximate chi-square	199.294
	Degrees of freedom	36
	Saliency	.000

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The kmo value is 0.583, which has just exceeded the threshold of 0.5. Therefore, it is necessary to remove some variable data and delete the average salary indicator. The kmo value has improved significantly, as shown in Table 3-2:

Table 3-2: KMO and Bartlett test

kmo Sampling suitability measure.		.766
Bartlett sphericity test	Approximate chi-square	159.281
	Degrees of freedom	28
	Saliency	.000

The KMO value is 0.766, which is between the critical values of 0.7 and 0.8, and is greater than the threshold of 0.5, indicating that there is a correlation between the indicators, which is suitable for factor analysis, and further verify that the variables are suitable for factor analysis.

Table 4 Common Factor Variance

	initial	extract
Permanent population (10,000 people)	1.000	.997
gdp (100 million yuan)	1.000	.990
Public expenditure (100 million yuan)	1.000	.985
Number of corporate legal entities (ten thousand)	1.000	.997
Engel coefficient	1.000	.985
R&D	1.000	.927
Beds in health institutions (ten thousand)	1.000	.989
65 years and over (10,000 people)	1.000	.956

Extraction method: principal component analysis.

The meaning of the common factor variance table is that each variable can be expressed by a common factor. The larger the extracted common factor variance, the stronger the ability to interpret the common factor. The extracted common factor variance is mostly higher than the degree of interpretation. 90%, the extraction effect is very good, indicating that the original data has less information

Table 5 Total variance explanation

ingredient	Initial eigenvalue			Extract load sum of squares			Sum of rotation load squares		
	total	Variance percentage	accumulation%	total	Variance percentage	accumulation%	total	Variance percentage	accumulation%
1	7.343	91.788	91.788	7.343	91.788	91.788	4.671	58.389	58.389
2	.482	6.029	97.818	.482	6.029	97.818	2.096	26.203	84.592
3	.124	1.548	99.366	.124	1.548	99.366	1.182	14.775	99.366
4	.029	.366	99.733						
5	.016	.196	99.929						
6	.004	.056	99.984						
7	.001	.012	99.996						
8	.000	.004	100.000						

Extraction method: principal component analysis

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As shown in Table 5, the total variance explanation is to look at the contribution rate of the factor to the variable interpretation. When the initial eigenvalue reaches 2 components, the cumulative contribution rate reaches 97.818%, indicating that the first 2 factors include 97.818% of all index information, the amount of extracted information is relatively large, and the effectiveness of factor extraction of original index information is very high.

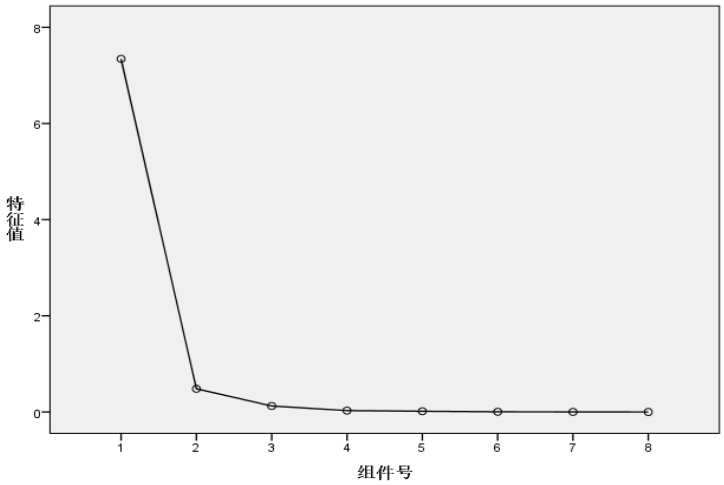

Figure 1 Crushed Stone

As shown in the gravel chart, when the number of factors reaches 2, the polyline becomes quite flat, so it is more appropriate to extract 2 factors.

Table 6 Composition matrix after rotation

	ingredient	
	1	2
Permanent population (10,000 people)	.897	.438
gdp (100 million yuan)	.908	.406
Public expenditure (100 million yuan)	.948	.294
Number of corporate legal entities (ten thousand)	.843	.535
Engel coefficient	-.352	-.928
R&D	.802	.533
Beds in health institutions (ten thousand)	.899	.424
65 years and over (10,000 people)	.760	.615

Extraction method: principal component analysis.

Rotation method: Caesar's normalized maximum variance method.

The rotation has converged after 3 iterations.

It can be seen from the rotated component matrix that after rotation, the factors are easy to name and explain. The factor 1 mainly explains the resident population, gdp, public expenditure, the number of corporate entities, r & d, beds in health institutions, 65 years and older Factor 2 explains the Engel coefficient.

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Table 5-1 Factor component index classification

index	Factor 1	Factor 2
Permanent population (10,000 people)	✓	
gdp (100 million yuan)	✓	
Public expenditure (100 million yuan)	✓	
Number of corporate legal entities (ten thousand)	✓	
Engel coefficient		✓
R&D	✓	
Beds in health institutions (ten thousand)	✓	
65 years and over (10,000 people)	✓	

Table 6 Component score coefficient matrix

	ingredient	
	1	2
Permanent population (10,000 people)	.234	-.117
gdp (100 million yuan)	.269	-.175
Public expenditure (100 million yuan)	.394	-.380
Number of corporate legal entities (ten thousand)	.111	.078
Engel coefficient	.569	-1.105
R&D	.085	.110
Beds in health institutions (ten thousand)	.247	-.140
65 years and over (10,000 people)	-.015	.272

Extraction method: principal component analysis.
Rotation method: Caesar's normalized maximum variance method.
Component score.

As shown in the coefficient matrix of Table 6, the expression of the factor is as follows:

Remember that the resident population isX_1, gdp isX_2, Public expenditure isX_3, The number of corporate legal entities isX_4The Engel coefficient isX_5r & d isX_6The beds in health institutions areX_7, 65 years and olderX_8。

$$F_1 = 0.234X_1 + 0.269X_2 + \cdots - 0.015X_8 \quad (1.7)$$

$$F_2 = -0.117X_1 - 0.175X_2 + \cdots + 0.272X_8 \quad (1.4)$$

Take the variance contribution rate under the sum of squares of rotational load in the total variance interpretation in Table 5 as the formula (2)$b_i$value,

The measure of economic viability is:

$$F = 0.67414F_1 + 0.30403F_2 \quad (1.5)$$

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Table 7 Scoring coefficient of each index component * Variance contribution rate

index	Factor 1	Factor 2	Factors and	Ranking
Permanent population (10,000 people)	0.1577	-0.0356	0.1222	4
gdp (100 million yuan)	0.1813	-0.0532	0.1281	2
Public expenditure (100 million yuan)	0.2656	-0.1155	0.1501	1
Number of corporate legal entities (ten thousand)	0.0748	0.0237	0.0985	5
Engel coefficient	0.3836	-0.3360	0.0476	7
R&D	0.0573	-0.0334	0.0239	8
Beds in health institutions (ten thousand)	0.1665	-0.0426	0.1239	3
65 years and over (10,000 people)	-0.0101	0.0827	0.0726	6

From Table 7, we can get the index weight distribution from large to small: public expenditure, gdp, beds in health institutions, resident population, number of corporate entities, population over 65 years old, Engel coefficient, r & d. Analysis of 2009 to 2018 The data shows that Chongqing wants to increase the regional economic vitality. Increasing public expenditure, that is, increasing government investment in infrastructure, is the most significant improvement in economic vitality, followed by increasing the number of beds in health institutions and attracting migrants to live in Chongqing. Both contribute to the improvement of economic vitality. In the short term, if the government attaches importance to r & d investment, the improvement of economic vitality in the short term is not significant.

4. Conclusion：Trends in population and business vitality

If you follow the “checklist” your paper will conform to the requirements of the publisher and facilitate a problem-free publication process.

4.1 The Study of Population Trends

$$\begin{cases} F_{people} = \sum b_i F_{i\,people} \ (\sum b_i = 1) \\ F_{i\,people} = a_{i\,people} x_{people} \end{cases} \tag{1.6}$$

F_{people} *Indicates the measurement of economic vitality indicators considering only population factors,* b_i

Table 8 Economic vitality measures under all factors and measures under all factors (unstandardized)

years	F_{people}	F
2009	349.305	1222.125
2010	352.435	1647.201
2011	356.635	2052.810
2012	359.812	2314.028
2013	362.866	2474.409
2014	365.481	2720.560
2015	368.554	2984.680
2016	372.449	3257.641
2017	375.715	5176.464
2018	378.994	5391.897

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Among them, F_{people} indicates the measurement of economic vitality indicator considering only population factors Represents the contribution of the i-th factor,$F_{i\ people}$Represents the ith population factor score,x_{people}Indicates the standardized value of the population index,$a_{i\ people}$Represents the population component score coefficient of the i-th population factor.

CorrectF_{people}And f for decimal calibration and standardization to draw a line chart, as shown in Figure 2 below:

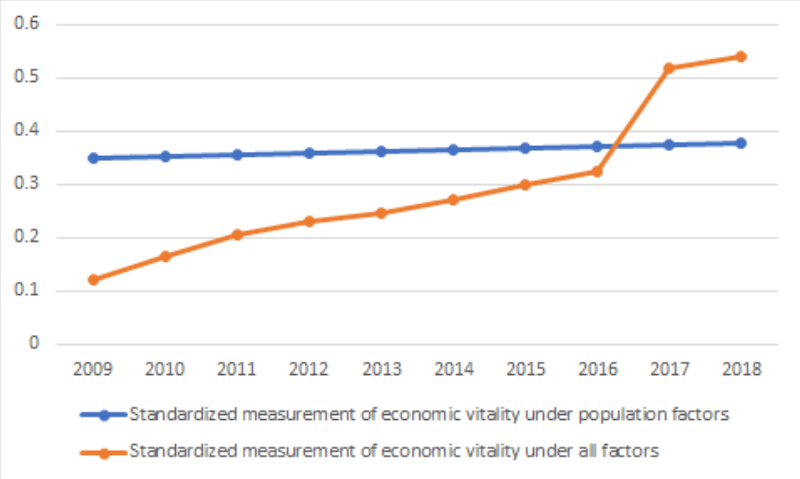

Figure 2 Comparison of economic vitality measures under different population factors and economic vitality measures under all factors

It can be seen from Figure 2 that the measure of economic vitality under population factors has been growing steadily at a slow rate from 09 to 18, and the measure of economic vitality under all factors has increased rapidly, indicating that the impact of demographic factors on economic vitality is not obvious.

4.2 Study Trends of Thevitality of Enterprises

Establishment of a Model for the Impact of Enterprise Vitality Factors on Economic Vitality.

$$\begin{cases} F_{enterprice} = \sum b_i F_{i\ enterprice} \ (\sum b_i = 1) \\ F_{i\ enterprice} = a_{i\ enterprice} x_{enterprice} \end{cases} \tag{1.7}$$

Table 9 Economic vitality measures and measures under all factors (not standardized)

years	$F_{enterprice}$	F
2009	1.108756611	1222.125736
2010	1.306	1647.20173
2011	1.762299624	2052.810081
2012	2.22222362	2314.028081
2013	2.671435897	2474.409
2014	3.120648174	2720.560175
2015	3.869926566	2984.680744
2016	4.541138496	3257.641146
2017	5.129327207	5176.464895
2018	5.61700116	5391.897855

$F_{enterprice}$ and F for fractional scaling normalized line graph as follow:

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Among them, $F_{enterprise}$ indicates that the measurement of economic vitality indicators under only corporate vitality factors, b_i Represents the contribution of the i-th factor,$F_{i\ enterprice}$ Represents the i-th enterprise vitality factor score,$x_{enterprice}$ Indicates the standardized value of the enterprise vitality index,$a_{i\ enterprice}$ Represents the i-th enterprise vitality factor.

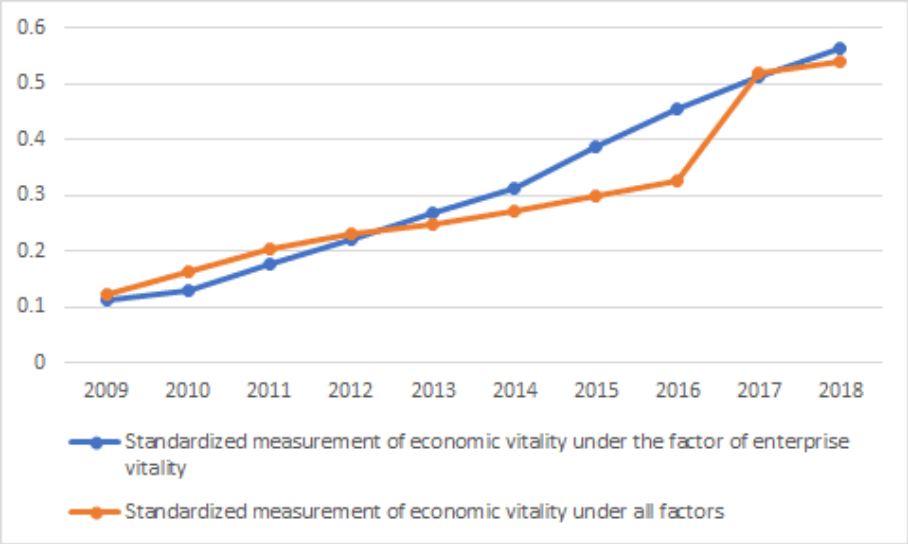

Figure 3 The economic viability of each year under the measure the vitality of enterprises and economic vitality factor in all factors measure contrast

As can be seen from Figure 3, there is a high positive correlation between the vitality of enterprises and economic vitality, the higher the vitality of enterprises, economic vitality, the better, that is the positive between closely related business vitality and economic dynamism.

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