

# **An Empirical Analysis of Regional Economic Development Level in Fujian Province Based on PCA**

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## **ABSTRACT**

Fujian, a coastal province which lies in southeast China, has already become the indispensable part of the economic boost of China due to its high-quality development of the market economy. However, differences still exist in the aspect of regional economic growth. According to this assumption, this paper firstly defines the GDP(Gross Domestic Product) of 9 cities of Fujian as the dependent variable, and uses principal component analysis (PCA) to simplify the multidimensional data into 17 comprehensive indicators to compare the development level of nine cities. Then, make statistical analysis and assess the outcomes to find out the differences of regional development in Fujian. Finally, consider the policy Fujian province may adopt and the road that the Fujian government can choose to achieve the harmonious development of the regional economy, as a reference to the Fujian government.

**Keywords:** *PCA, Fujian province, regional economy, economic development, empirical analysis*

## **1. INTRODUCTION**

Fujian is one of the first provinces to conduct the policy of “reform and opening up”. After a 41-years reform and opening up, Fujian has received a considerable achievement and its economy has grown rapidly. As one of the provinces with the fastest economic growth,[1] its regional gross domestic product has a significant growth from 1978 to 2019, increasing from 6.637billion to 4239.5billion. Fujian is a coastal province located in southeast China, across the channel by Taiwan. Its advantaged regional merit and political importance make Fujian a pioneer of reform, known as “the Western Taiwan Straits Economic Zone”. Fujian is endowed new missions in the new era: to build a digital economy development and innovation pilot zone of China, to become a scientific and technological innovation source of China, to construct a modernized and beautiful eco-friendly Fujian. Therefore, Fujian plays a vital role in China’s comprehensive reform and opening up as well as constructing a modernized society. Amongst all constructive strategies of the Chinese government, implementing coordinated development among regions is a crucial one. Hence in 2019, Fujian published *Implementation plan for the establishment of a new mechanism for more effective coordinated regional development* in order to promote the balanced regional development.

## **2. CONSTRUCTION OF THE ASSESSING MODEL OF FUJIAN’S REGIONAL ECONOMIC DEVELOPMENT LEVEL**

### ***2.1. Index choosing and data collecting***

In order to objectively, comprehensively and scientifically measure the degree of regional economic differences, following the feasibility, comparability and scientificity of the economic index system [2], this paper selects 10 variables as the objects of study. These variables are the gross regional domestic product of 9 cities of Fujian respectively in 2019( $X_1$ ), the proportion of GDP of tertiary industry in GDP ( $X_2$ ), the urbanization rate of permanent resident population( $X_3$ ), the general fiscal revenue( $X_4$ ), the number of health institutions( $X_5$ ), the number of institutions of higher learning( $X_6$ ), the per capita GDP ( $X_7$ ) and the gross value of imports and exports( $X_8$ ) as the objects of study. All the data come from the Statistical Yearbook of Fujian Province 2020. Table1 illustrates the specific value of the 8 variables of all cities, all the raw data are from Statistical Yearbook of Fujian Province 2020.

**Table1** Raw data

Name of city	Gross domestic product ( GDP/100 million yuan ) : X1	The proportion of tertiary industry in GDP ( % ) :X2	urbanization rate of permanent resident population ( % ) :X3	general fiscal revenue ( 100million yuan ) : X4	number of health institutions X5	number of institutions of higher learning :X6	GDP per capita ( yuan ) :X7	Gross value of imports and exports ( 100million yuan ) :X8
Fuzhou	9392.3	53.61	70.5	1095.36	2252	35	120879	367.41
Xiamen	5995.04	58	89.2	1328.52	2111	22	142739	930.24
Putian	2595.39	42.14	61.7	226.39	422	2	89342	56.96
Longyan	2678.96	43.78	58	324.90	668	2	101476	43.96
Nanping	1991.57	42.42	57.5	149.10	564	4	74036	17.68
Quanzhou	9946.66	38.94	67.2	838.97	5040	18	114067	306.16
Zhangzhou	4741.83	41	60	356.20	894	7	92074	105.30
Ningde	2451.70	36	57.6	221.58	701	2	84251	61.85
Sanming	2601.56	40.14	60.9	168.41	2627	4	100641	26.78

**2.2. Research approach and the formation of model**

At present, scholars mainly study regional economic differences from two aspects. On the one hand, they use statistical methods such as absolute difference, relative difference, Gini coefficient and Sihl coefficient to select a single index to evaluate and analyze regional economic differences.[3] On the other hand, a single method, such as Delphi method, factor analysis, cluster analysis and analytic hierarchy process, is used to evaluate the regional economic differences.[4] This paper uses PAC to investigate the correlation among several variables, which reveals the shortage of regional development and makes proposals for the government. Principal Component Analysis (PAC) is a method that reflects the original index information as much as possible by linear transformation and discarding a small part of the information, replacing the original variables with a few comprehensive variables that are unrelated to each other.[5] The model is expressed as follows: calculate the correlation coefficient matrix P of the standardized data matrix.  $(a_{ij})_{n \times m}$ . Then calculate the characteristic root of the correlation coefficient matrix P,  $\lambda_1 \geq \lambda_2 \dots \geq \lambda_m$ , next, compute cumulative contribution rate of characteristic roots, when  $E \geq 80\%$ , get the lowest p ( $p \leq m$ ), and choose the number of p of the principal

component to analyze. The principal component score value of the ith evaluation object was calculated with the formula:

$$F_i = \sum_{j=1}^p a_j F_{ij} \dots\dots\dots (1)$$

Formula (1) shows that  $F_{ij}$  is jth principal component factor score of the ith evaluation object, and  $a_j$  is the information contribution rate of the jth principal component .

**3. EMPIRICAL ANALYSIS ON THE LEVEL OF REGIONAL ECONOMIC DEVELOPMENT IN FUJIAN PROVINCE**

In terms of economic aggregate, Fujian has reached over 4 trillion yuan in 2019 and still increases rapidly. However, merely for GDP, differences can be seen among 9 cities, there are only 3 cities exceed over 500billion. Moreover, the range reaches almost 750billion, which shows an apparent imbalance. The three cities: Xiamen, Fuzhou, Quanzhou, exceed other cities too much in almost all the indexes.

**3.1. Standardize the primary data**

Some of the data are relatively big that it will exist a significantly range among the data, for example, the fiscal revenue of Xiamen is almost 10 times of that of Nanping, and considerable range also exists in terms of variable  $X_1, X_5, X_9$ , which may cause partial data loss. Therefore, analyzing the standardized data and then analyzing each index according to the principal component analysis method can make the values with different units or orders of magnitude comparable and greatly improve the accuracy of data analysis.[6]

**3.2. Applicability analysis for the primary data**

Before starting to do the factor analysis, use SPSS 26.0 to enter the standardized data, then use SPSS 26.0 to analyze the feasibility of the data. The results of KMO and Bartlett analysis are formed by dimensionality reduction. The result demonstrates that KMO measure is  $0.664 > 0.60$ , sig. (significance level) of Bartlett’s test for sphericity is 0, meeting the analysis requirement. Hence the factor analysis can be carried out.

**3.3. Extraction of principal components**

As is shown in table 2, all the variables have an excellent extraction efficiency with a high extraction ratio. Hence, the overall result of the extraction of factor is successful. According to table3, the data can get 3 principal components, and these components can be accumulated to 97.171% of the total variance.

**Table2** Communalities

	Initial	Extraction
$X_1$	1.000	.976
$X_2$	1.000	.960
$X_3$	1.000	.984
$X_4$	1.000	.986
$X_5$	1.000	.974
$X_6$	1.000	.984
$X_7$	1.000	.937
$X_8$	1.000	.971

**Table3** Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.028	75.348	75.348	6.028	75.348	75.348
2	1.283	16.043	91.392	1.283	16.043	91.392
3	.462	5.779	97.171	.462	5.779	97.171
4	.123	1.533	98.703			
5	.071	.886	99.589			
6	.021	.265	99.854			
7	.010	.129	99.983			
8	.001	.017	100.000			

**3.4. Calculate the score of principal components and compute the synthesis score as well as the rank of each city**

Use the model in Table 4, and based on the original standardized data, work out the principal component score  $F_1, F_2, F_3$  for each city. Then the variance contribution rate of each principal component in Table 5( $0.75348, 0.16043, 0.05779$  respectively) is multiplied by the score of each principal component ( $F_1, F_2, F_3$ ), which makes up the synthesis score of each city : $F(F = 0.75348F_1 + 0.16043F_2 + 0.05779F_3 \dots\dots\dots(2))$ .

Last, rank the results in descending order, the outcome shows in table 5.

**Table4** Component Matrix

Component	Component		
	1	2	3
$X_1$	.796	.537	-.232
$X_2$	.814	-.507	-.199

X3	.924	-.280	.229
X4	.991	-.022	-.055
X5	.578	.746	.291

X6	.899	.159	-.388
X7	.949	-.059	.182
X8	.923	-.272	.213

**Table5** Comprehensive development level and ranking of each city(keep 5 decimals)

city	F1	F2	F3	F	Rank
Xiamen	11.02268	-1.89403	0.53449	8.03240	1
Fuzhou	7.49788	0.35463	-0.98433	5.64951	2
Quanzhou	4.36902	2.82243	0.33855	3.76434	3
Zhangzhou	-2.51492	0.03570	-0.20310	-1.90095	4
Sanming	-2.92047	0.57575	0.47710	-2.08057	5
Longyan	-3.21444	-0.61349	-0.00763	-2.52088	6
Putian	-3.91008	-0.70791	-0.00399	-3.05997	7
Ningde	-5.13705	-0.03600	0.09976	-3.87068	8
Nanping	-5.19262	-0.53708	-0.25084	-4.01320	9

**4. SUGGESTIONS FOR FUJIAN PROVINCE**

**4.1. Three growth pole as a driven force to lead regional economic growth**

As shown in the rank, Xiamen, Fuzhou, and Quanzhou are far beyond any other cities. According to the growth pole theory, it is only an ideal situation for a country or region to achieve balanced development, which is impossible in reality. Economic growth is usually transmitted gradually from one or several "growth centers" to other sectors or regions. Therefore, if Fujian government is willing to subtract the differences between the three cities and others, the three cities should be selected as the growth pole to drive the economic development, and the growth center should be established to enhance the aftereffect of Fujian's economic development, so as to promote the high-quality development of Fujian's economy. More specifically, divide Fujian into three regions due to geographical factors, the three growth poles assist the nearing two cities adjacent to them each, which can be described as "1+2" model. In this model, Xiamen helps Longyan, Zhangzhou with all the factors including communication and share of resources in business, public health, education field and so on. For example, as is illustrated in Table 1, Xiamen has much more health and education institutions than the other two cities, so Xiamen can send some employees of these institutions to assist Longyan and Zhangzhou. Furthermore, as for fiscal revenue, if Xiamen has a financial surplus, Xiamen can lend some

revenue to the other two cities for their development with or without interest. The other two groups will be Putian, Sanming with Quanzhou as the growth pole, Nanping, Ningde with Fuzhou as the growth pole.

**4.2. Develop science and technology, set up the strategy of innovation drives industrial upgrading**

Science and technology are the primary productive forces. Developing science and technology is an essential part of regional economic development. However, Ningde and Nanping do not have a high-tech development zone, and the Proportion of Intramural R&D Expenditure to GDP (%) of Fujian is not enough. Thus, Fujian may vigorously develop science and technology, invest more in R&D and attract more researchers to Fujian for research with favorable treatment. Fujian should also keep up with the latest development of science and technology and master core technology, for example, developing 5G technology and virtual technology. Innovation is the most important source of regional economic growth. Innovation can be the driven force of industry transformation and upgrading. To enhance innovation ability and accelerate innovation drive are the internal requirements for the implementation and catch-up of high-quality economic development in Fujian Province and the guarantee for the effective shift of the old and new drivers of economic growth. Therefore, by filling the basic research, strengthen the research and development cost control, optimizes the allocation of innovation resources,

promote innovation sharing platform construction, continuously optimize the industrial structure, so as to stimulate the innovation vigor, improve the total factor productivity, build a new engine development, achieve high-quality innovation economy development of multiplier effect, promote the high-quality development of Fujian's economy and constantly make new breakthroughs.[7] Specifically, Fujian can properly use AI to promote the heavy industry's automation and intelligence and the light industry to help upgrade the industrial structure.

#### ***4.3. Deepen reform and opening up, develop free trade pilot zone***

Fujian is the pioneer of reform and opening up. In the new era, on the background of deepening reform and opening up, Fujian should also be the international window of China to welcome the guests from all over the world with an open and inclusive attitude. Fujian can focus on the China (Fujian) Pilot Free Trade Zone established in 2015 and Xiamen special economic zone, publish more preferential trade policies to attract traders worldwide, use "Internet Plus" properly to build a more convenient trade area.

#### ***4.4. Maximize cultural advantages, developing tourism economy***

Fujian is rich in cultural background and has a long history, many famous scenic spots such as Kulangsu, Mount Wuyi and Three Lanes and Seven Alleys. In 2019, the number of domestic tourists in Fujian was 526.9708 million, but the tourism economy also exists differences. Thus, each city should take its own advantages of culture and environment to develop the tourism economy and vigorously develop new tourism products and new forms of business. For example, Putian can take advantage of Mazu culture and attract people to Meizhou island. Also, for solving the unbalanced regional tourism economy, Tourism and transportation services should be strengthened, for instance, Yongding earth building is located in remote mountain villages, where traffic lags behind and tourists spend a long time in the journey, which restricts the development of tourism to a certain extent. Therefore, it is necessary to increase investment to improve traffic facilities in some heavy tourism counties and cities, implement direct traffic projects in tourist scenic spots, and improve the effective supply of tourism traffic services. Moreover, the 9 cities can open up a unique travel line in the peak tourist season based on the high-speed train to transfer tourists from hot cities like Xiamen to less popular cities like Putian.

#### ***4.5. Build an ecological Fujian, insist eco-friendly development***

"Lucid waters and lush mountains are invaluable assets." It is vital to protect the environment while developing the economy. Fujian is well-known in China because of its good ecological conditions: good air quality and the No.1 forest coverage rate in China and so on. However, in the background of comprehensively promoting ecological civilization construction, Fujian still has a long way to become the most eco-friendly China province. Therefore, control of pollution emissions, insisting eco-friendly development must be considered. As is depicted in Yearbook of Fujian province 2020, the sulfur dioxide in Sanming, the wastewater discharge in Zhangzhou are relatively high and must be investigated and controlled.

### **5. CONCLUSION**

Fujian Province is an open coastal province in China. In recent years, its economy has developed rapidly, and Fujian becomes one of the provinces with the fastest economic growth in China. Moreover, as the bellwether of the digital economy, the economy of Fujian is constantly developing with high quality. However, with the growth of its economy, the problem of regional economic difference is increasingly prominent. Therefore, how to accurately reflect and evaluate the regional economic differences in Fujian Province and take corresponding effective measures to reduce the regional economic differences has important strategic significance for promoting the coordinated development of regional economy in Fujian Province. Based on PAC and 8 variables, this paper finds out the regional economic rank of 9 cities of Fujian and gives some advice in order to promote the coordinated development of regional economies, as long as Fujian use Quanzhou, Fuzhou, Xiamen as growth pole to improve other cities. Keep up with the latest science and technology, deepen reform and opening up, develop tourism economy, and insist on eco-friendly development, the problem of regional economic differences will be significantly improved.

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