

An Empirical Research on Statistical Measurement of Regional Economic Differences

Yu Dajin^{1,a,*} Huang Xianchi^{1,b}

^{1,2}Jiangxi University of Finance and Economics , Jiangxi ,China , 330013

^ayjdjwhh@163.com, ^b18659614816@163.com

Keywords: regional economic differences, statistical measure, Theil index.

Abstract. Selecting the economic development, living standards and social development index of 2005-2017, this paper measures and analyzes the regional economic differences of the Xiamen-Zhangzhou-Qianzhou in Fujian Province by the R-language based on method of Theil index. The research shows that the regional development gap between the three cities of Xiamen-Zhangzhou-Qianzhou has gradually narrowed during the past 13 years, but the Theil index of related indicators has presented the tendency of stable and that can no longer be reduced in recent years.

1. Introduction

It is particularly important to measure and analyze the regional economic disparities scientifically and accurately, which is of great significance to regional coordinated development. Foreign scholars focus on theoretical research on regional economic differences. The two theories of balanced development and non-equilibrium development can be roughly divided. Generally speaking, the theory of balanced development refers to a kind of regional equilibrium development based on the neoclassical regional economic growth theory. The more representative ones are the big propulsion theory, the low level equilibrium trap theory, the poverty vicious circle theory, the minimum effort proposition theory, etc.^[1,2]. Because the theory assumes that the conditions are very demanding, the theoretical model is too idealistic and far from the actual situation. In order to effectively explain the problem of regional economic differences in reality, the theory of non-equilibrium development has emerged. Representatives include Peru's growth pole theory, Friedman's core-marginal theory, and the cumulative cumulative cause and effect of Myrdal and Williamson inverted "U" type theory is equal^[3,4].

The domestic research on regional economic differences focuses on the empirical analysis of the division of spatial scope, the construction of evaluation indicators and the selection of measurement methods. In the spatial scope of regional economic differences research, most of the national, inter-provincial and urban agglomerations are used as research objects. As Fang Falin (2015) analyzes the degree of economic disparity in the three major regions of the Yangtze River Economic Belt in nine provinces and two cities^[5]. Ren Qilong et al.(2017) selected 31 provincial-level administrative regions in mainland China to calculate the economic development differences between provinces since 2000^[6]. Some also adopt the city scope, such as Tu Jianjun et al.(2018) and Han Zhenyu et al.(2018) to compare the level of comprehensive economic development from the perspective of the city^[7,8].

This paper chooses municipal units as research subjects, and on the construction of fully study the relevant index system of regional economic disparities literature, analyzes scientific choice of three large-scale indicators (economic development, living standard and social development) for minimizing the limitations and incompleteness of the single-category economic evaluation indicators. Meanwhile, based on some good properties of the Theil index, this measurement method was chosen to conduct a comprehensive survey of Xia-Zhang-Quan area, to reveal the difference in economic development level in the Golden Triangle of South Fujian. On this basis, using multivariate statistical methods such as factor and cluster analysis to conduct in-depth research on various counties (districts) under the jurisdiction of Zhangzhou City, which are lagging behind in economic development ,

aiming to find out the deeper specific reasons for the promotion of Xiazhangquan. The coordinated development of the three cities provides the necessary policy options.

2. Establishment of Index System for Evaluating Economic Differences in Xia-Zhang-Quan

As the central economic belt of the Strait West Economic Zone, Xiamen-Zhangzhou -Quanzhou is the golden triangle in South Fujian which has unique advantages in geographical conditions and huge potential for economic growth. It has become one of the most dynamic economic regions along the eastern coast of China and the most important and influential regional economic development center in Fujian Province.

It is important to construct a reasonable evaluation index system of economic disparity for accurately evaluating the regional economic development. According to the construction principles of regional economic evaluation index system, this paper constructs the evaluation index system of regional economic disparities among Xiamen, Zhangzhou and Quanzhou by combining with questionnaire survey and Delphi method. Due to space limitations, we will not repeat them here, as shown in Table 1 specifically. It should be pointed out that, generally, economic indicators include aggregate and per capita indicators. Considering that aggregate indicators are often affected by population size factors, this paper adopts per capita indicators.

Table 1 Evaluation Index System of Regional Economic Differences in Xia-Zhang-Quanzhou

Economic indicators	variable	Selection meaning
Per capita GDP	X1	the overall level of development of the regional economy
Urban per capita disposable income	X2	the improvement and quality of people's living standards in urban areas
rural per capita disposable income	X3	the improvement and quality of the living standards of rural people in the region
Total retail sales of social goods per capita	X4	the material and cultural life of the people in the region, the scale of the retail market and the degree of realization of the purchasing power of social goods
Number of health institutions per 10,000 population	X5	the level of inter-regional medical services and social development
Number of faculty members per 10,000 ordinary colleges and universities	X6	the level of inter-regional education services and social development

3. The Source of Data

The data used in this paper are from Xiamen Statistical Yearbook 2017, Zhangzhou Statistical Yearbook 2017, Quanzhou Statistical Yearbook 2017 and Fujian Statistical Yearbook 2005-2017 compiled by Fujian Statistical Bureau of Statistics prepared. In addition, since 2017, the year economic indicators related to the Statistical Yearbook has not been announced, this paper is based on the data from the Statistical Bulletins of national economic and social development issued by Xiamen, Zhangzhou and Quanzhou in March 2018.

4. Measuring Method-Theil Index

Theil index was also called Theil entropy standard which known as calculating income inequality. The study found that the Theil index is an indicator of regional economic inequality. Its greatest advantage is not only to judge the overall regional difference level, but also to decompose the internal and external differences, and to calculate the intra-group gap and the inter-group gap. The Theil index principle and Gini coefficient measure the difference of a group of data distribution.

The calculation formula is shown as follows:

$$T = \frac{1}{n} \sum_{i=1}^n \frac{y_i}{\bar{y}} \log\left(\frac{y_i}{\bar{y}}\right) \quad (4.1)$$

In style T expressed as the Theil index, it measures the overall regional differences. y_i expressed as per capita GDP of the region, \bar{y} expressed as per capita GDP of all regions, i.e. y_i the average value, n is the number of regions.

Assume that n regions are divided into k Groups, with each group as follows $g_k (k = 1, 2, \dots, K)$, The first k group g_k The number of regions in the region is n_k , then $\sum_{k=1}^K n_k = n$, y_i and y_k Representing a certain area i of GDP and a group k of GDP, remember T_b and T_w for the gap between groups and the gap within the group, the Theil index can be broken down as follows:

$$T = T_b + T_w = \sum_{k=1}^K y_k \log \frac{y_k}{n_k/n} + \sum_{k=1}^K y_k \left(\sum_{i \in g_k} \frac{y_i}{y_k} \log \frac{y_i/y_k}{1/n_k} \right) \quad (4.2)$$

In the upper formula, the differences between groups T_b and within groups T_w are expressed as follows:

$$T_b = \sum_{k=1}^K y_k \log \frac{y_k}{n_k/n} \quad (4.3)$$

$$T_w = \sum_{k=1}^K y_k \left(\sum_{i \in g_k} \frac{y_i}{y_k} \log \frac{y_i/y_k}{1/n_k} \right) \quad (4.4)$$

In general, the larger the Theil index is, the greater the difference is in regional economic development levels; on the contrary, the smaller the regional economic development level is in each region.

5. Measurement and Analysis of Regional Economic Differences in Xia-Zhang-Quan Area

Based on the above data calculated by R language, the Thiel index value of Xiazhangquan in the 13 years from 2005 to 2017 is obtained (Table 2). At the same time, the corresponding trend charts (Figures 1, 2) are drawn according to the results of the Thiel index, so as to visually reflect the trend of economic development differences among the three cities.

Table 2 Theil Index of Main Economic Evaluation Indicators in Xia-Zhang-Quan in 2005-2017

year	X1	X2	X3	X4	X5	X6
2005	0.081	0.012	0.008	0.040	0.081	0.249
2006	0.075	0.013	0.008	0.038	0.110	0.273
2007	0.069	0.014	0.008	0.031	0.122	0.242
2008	0.060	0.013	0.006	0.022	0.087	0.238
2009	0.046	0.017	0.006	0.023	0.076	0.225
2010	0.039	0.017	0.005	0.035	0.047	0.207
2011	0.035	0.017	0.006	0.032	0.053	0.190
2012	0.032	0.017	0.006	0.027	0.039	0.185
2013	0.027	0.016	0.005	0.043	0.024	0.184
2014	0.023	0.015	0.005	0.041	0.019	0.177
2015	0.019	0.014	0.005	0.039	0.015	0.159
2016	0.017	0.014	0.004	0.036	0.017	0.154
2017	0.016	0.013	0.003	0.035	0.023	

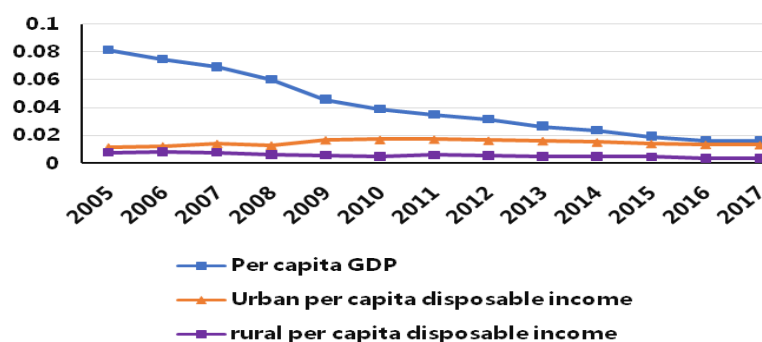


Figure 1 Trend Chart of Theil Index for Economic Development Indicators

As shown in Figure 1, the per capita GDP economic indicators of Xiamen, Zhangzhou and Quanzhou, reflecting the level of economic development, dropped sharply from 0.081 in 2005 to

0.016 in 2017. Among them, after the financial crisis in 2008, the Theil index among the three cities declined the most, which also reflects that Xiamen and Quanzhou, which account for a large proportion of foreign trade and foreign investment, experienced the financial tsunami, have significantly reduced the per capita GDP gap among the three cities. However, from the chart, the decline of the Theil index of the three cities has gradually slowed down and stabilized at the same level since 2015. Although the Theil index between the three cities is small enough as of 2017, according to the actual data of per capita GDP of the three cities, Xiamen ranked first with per capita GDP of 109,740 yuan, Quanzhou 87,615 yuan, Zhangzhou is 70,216 yuan. Xiamen's dominant position in this respect has never been instigated over the years, and the per capita GDP of Zhangzhou City is different from that of Quanzhou and Xiamen, respectively. Xiamen, Quanzhou and Zhangzhou are in a ladder-like distribution.

With regard to the change trend of per capita disposable income of urban residents, it has shown a trend of slow rise and stabilization. In particular, after a slight decline in 2007, there was a rebound in 2008. According to the actual data of this index, the difference of per capita disposable income among the three cities is between 10,000 yuan and 16,000 yuan. Among them, Zhangzhou still lags behind Xiamen and Quanzhou in this respect, and tends to be enlarged by Xiamen and Quanzhou.

In terms of the per capita disposable income of rural households, it shows that the Theil index has changed slightly in the past 13 years, and has always been below the per capita disposable income of urban residents. The regional differences in this respect between the three cities are much smaller than that between cities and towns, and tend to zero. Combined with the actual data of this index, we find that the gap between per capita disposable income of rural households in XiaZhangquan and other cities is between 2000 and 3,000 yuan. It can be seen that Xiamen, Zhangzhou and Quanzhou have achieved good results in this respect, which may be related to the similarity of agricultural conditions and the number of people and land in the three places.

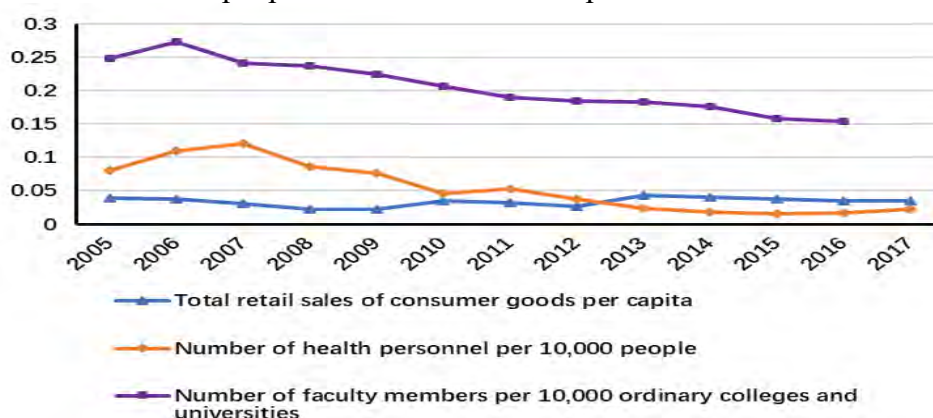


Figure 2 Trend Chart of Theil Index for Social Development Indicators

As shown in Figure 2, Theil index of total retail sales per capita change in trend presents two wavy ups and downs of certain state, floating up and down around the 0.035 level on the whole, especially in the last two or three years is not very big change, It reflects the similarity of people's living standards between the three cities. This can also be seen from the actual data of the indicator, Xiamen, Quanzhou, and Zhangzhou continue to show a stepped state distribution in the economic indicators of per capita social consumer goods retail sales. The gap between Xiamen and Quanzhou has become smaller in recent years. The gap has been floating around 1,000 yuan, while the gap between Zhangzhou and Xiamen is higher than 15,000 yuan. It can be seen that in terms of the total retail sales of per capita social consumer goods, the main gap is still caused by this aspect of Zhangzhou City.

Indicators of the number of health personnel per 10,000 people can effectively reflect the level of medical and health technology in Xiamen, Zhangzhou and Quanzhou. Figure 3-2 intuitively shows an upward trend before 2007, and then a significant decline in the three years from 2010. Although it rebounded in 2011, it has declined or stabilized around 0.02 in the following years. It can be seen that the overall gap in the number of health institutions among Xiamen, Zhangzhou and Quanzhou has

been reduced. From the actual data, it can also be seen that Xiamen continued to lead Zhangzhou and Quanzhou. It is basically similar in this respect between Zhangzhou and Quanzhou.

Indicators of the number of faculty members per 10,000 people in general colleges and universities (colleges) reflecting the educational level of the three cities showed a slow upward trend except for the differences in 2006, and then showed a downward trend in the following years. The gap in this respect between the three cities was narrowing, but it was always higher than the indicators of the number of staff members in health institutions per 10,000 people. Combining with the actual data of this index, up to 2017, Xiamen has 24 faculty members per 10,000 people in general higher education institutions (colleges) far exceeded Quanzhou, Zhangzhou. Zhangzhou and Quanzhou were 8 and 9 people. It can be seen that the educational resources of ordinary higher education institutions are obviously too much concentrated in Xiamen.

6. Conclusion

According to the six main economic disparity evaluation indicators and the actual situation of the regional economic development in Xiamen, Zhangzhou and Quanzhou, this paper chooses the Theil index method to measure and analyze the regional economic disparity in Xiamen, Zhangzhou and Quanzhou. The results show that the differences of economic and social development between Xiamen, Zhangzhou and Quanzhou regions have declined or stabilized from 2005 to 2017, without further expansion. Combined with the actual data of economic indicators, Xiamen always leads Quanzhou and Zhangzhou in all aspects, and the three cities show ladder-like distribution. The shortboard of regional differences among the three cities is mainly caused by Quanzhou and Zhangzhou, especially Zhangzhou. Therefore, if we can find out the distribution and reasons of the economic disparities among the three cities in their respective regions and make up for the shortcomings, the regional disparities among the three cities can be further greatly reduced.

Acknowledgement

This research was financially supported by the National Social Science Fund Project (13BGL010) and National Natural Science Foundation Project (71463023, 71763010).

References

- [1] Cissé A, Mendy P. Spatial relationship between floods and poverty: the case of region of Dakar[J]. *Theoretical Economics Letters*, 2018, (03):256-281.
- [2] Zahn F. A test of the escape from the persistence of backwardness[J]. *Journal of Development Studies*, 1973, (3):403-411.
- [3] Moore T G. Core-periphery models, regional planning theory, and Appalachian development[J]. *Professional Geographer*, 1994, (3):316-331.
- [4] Li Rengui. Research on Growth Pole Theory and Policy in Regional Economic Development[J]. *Economic Research Journal*, 1988, (09): 63-70(In Chinese).
- [5] Fang Falin. Analysis of regional economic differences based on Theil index—case study of Yangtze River Economic Belt [J]. *Economic Vision*, 2015, (07): 50-55(In Chinese).
- [6] Ren Qilong, Wang Li, Li Hui. Analysis on spatial disparities of regional economic development in China[J]. *Geography and Geo-Information Science*, 2017(01): 110-116(In Chinese).
- [7] Tu Jianjun, Li Qi, Zhu Yue, Liu Li, Xiang Wen. Study of economic disparity in the Yangtze River Economic Belt based on different perspectives [J]. *Journal of Industrial Technological Economics*, 2018, (03): 113-121(In Chinese).

- [8] Han Zhenyu, Cao Yipeng. Time and space analysis of regional economic development differences in Henan Province from 2005 to 2015 [J]. *Contemporary Economics*, 2018, (03): 64-67(In Chinese).