

Analysis of Coupling Coordination Degree between Permanent Population and Per Capita Disposable Income in Guangzhou Based on GIS

Jing Luo^{1, a}

¹School of Economics & Management, South China Normal University, Guangzhou, 510006, China

^ae-mail: dawnofgodspeed@163.com

Abstract: Regarding the economic development of the region, the per capita disposable income is closely related to the number of residents. A method of coupling coordination degree with ArcGIS analysis is used in this article for analyzing the degree of match between per capita disposable income and resident population in Guangzhou, Guangdong Province, China, between 2016 and 2020, using the method of coupling coordination degree and combining ArcGIS analysis. Based on the results, it appears that the majority of the residents of Guangzhou reside in Panyu District, Baiyun District, and Tianhe District, while Nansha District and Conghua District have relatively small populations. Despite the relatively high population income in Tianhe and Yuexiu Districts, Yuexiu Districts have significantly lower coupling coordinations between the per capita disposable income and the permanent population than Tianhe Districts, and Baiyun Districts and Panyu Districts have relatively high coupling coordination degrees. The results show that Panyu District and Baiyun District, which are located at the peripheries of the city center, are becoming the preferred areas for high-income residents. These processes are mutually causal.

Keywords: Per capita disposable income, Permanent population, Degree of coupling.

1. Introduction

With a total area of 7434.40 square kilometers, Guangzhou is located within the Pearl River Delta. It is not only a major city in China, but also a city with the functions of national transportation hub, foreign trade port and urban cultural center. It is one of the core cities in the Guangdong-Hong Kong-Macao Greater Bay Area and is also the hub city of 'the Belt and Road' [1].

Average disposable income means people's consumption ability and wealth strength. This paper calculates the per capita disposable income of urban residents in each district of Guangzhou and the number of permanent residents in each district, and discusses the relationship between the two. Due to the lack of data on the per capita disposable income of rural residents in each district and the fact that the population in Guangzhou is mainly distributed in the outer edge of the central city and the inner edge of the marginal city [2], this paper gives up using this data as a reference.

The resident population stands for the population who live at home for more than 6 months each year, and it also includes

the moving population in the city. The resident population can reflect the attraction of a region to the floating population. This paper combines it with the per capita disposable income of urban areas to reveal its coupling and coordination law.

2. Research Method

2.1. Entropy weight method (EWM)

As a way of physical measurement; entropy has been used in many sectors. Basically, it depicts the chaos level of the data. The greater the entropy, the more chaotic the data, the less useful information it contains, and the smaller the utility value, which is the reason for the lower weight. A method of measuring weight based on the information value provided by entropy is used in this study. [3]

The basic principle and analysis procedure of entropy need to be described first. Next, describe and analyse the final weight value in a deep level. The outcome of the analysis should be concluded at the end.

This paper uses the entropy method to analyze the data and presents the final weight as follows.

Table 1. Weight coefficient table.

Item	Entropy value E	Utility value D	Weight coefficient W
Permanent Population (10000 person)	0.9723	0.0277	86.73%
Disposable Income (yuan)	0.9958	0.0042	13.27%

2.2. Coupling coordination degree

In this essay, the interval processing is first performed for the analysis item. The interval processing formula is: $a + (b - a) * (X - \text{Min}) / (\text{Max} - \text{Min})$, where b is 0.99, a is 0.01, Max and Min represent the maximum and minimum values respectively and corresponding to a certain item. After interval processing, ensure all data are between 0 and 1, and then the processed data is used for formal coupling

coordination degree research. [4]

Based on the capacity coupling coefficient model in physics, we can calculate the coupling coordination degree.

To begin with, it is necessary to calculate the coupling degree C value, which determines the level of interaction between two systems;

Further, the formula: coupling degree is equal to $\sqrt{\text{coupling degree C value} * \text{coordination index T value}}$ where $\sqrt{\quad}$ represents the open root number;

Next, make sure that the coordination index T value range from 0 to 1, or an error may occurred on value D.

As a fourth step, ensure that the coupling coordination degree D value range between 0 and 1, where the greater the value is, the higher the level of coordination between the two systems;

Fifth, combined with the coupling coordination degree classification standard, for the coordination degree and grade division ;

At last, coupling coordination degree classification standard is shown in the table below.

Table 2. Classification standard of coupling coordination degree

Coupling coordination degree D value interval	Coordination level	Coupling coordination degree
(0.0~0.1)	1	Extreme disorder
[0.1~0.2)	2	Serious disorder
[0.2~0.3)	3	Moderate disorder
[0.3~0.4)	4	Mild disorder
[0.4~0.5)	5	On the verge of disorder
[0.5~0.6)	6	Reluctant coordination
[0.6~0.7)	7	Primary coordination
[0.7~0.8)	8	Intermediate coordination
[0.8~0.9)	9	Good coordination
[0.9~1.0)	10	Better coordination

3. Research and Analysis

3.1. Permanent population data

After collecting the population data of each district on the Guangzhou Statistical Yearbook, this paper imports the data into ArcGIS and obtains the following pictures. It is evident

from these pictures that the population of Guangzhou is presently concentrated at the edge of Baiyun District, which corresponds to the findings of Xie Bo et al.(2015). It is worth noting that the population growth of Panyu District is more obvious than that of other regions, which matches the ranking of Panyu District 's economic aggregate.

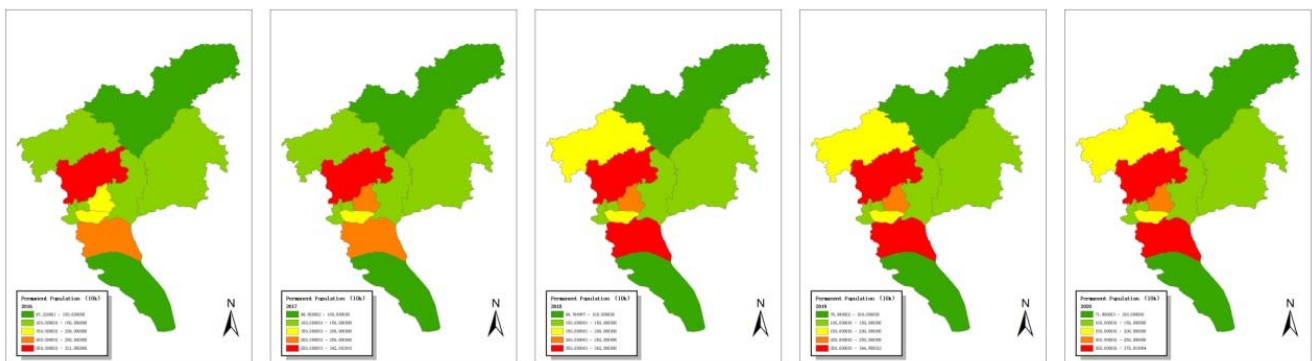


Figure 1. Permanent population map of Guangzhou from 2016 to 2020

3.2. Disposable income data

An analysis of per capita disposable income in urban areas within each district reveals that the central areas of Guangzhou represented by Tianhe District and Yuexiu District are always among the highest in the city. Conghua District and Zengcheng District, as the more remote regional

economic aggregate in Guangzhou, are relatively backward compared with other regions, and also correspond to the relatively low per capita disposable income. It is worth noting that Nansha District, which is developed as a key project in the Guangdong-Hong Kong-Macao Greater Bay Area, has surpassed Conghua District in per capita disposable income, although the development history is relatively short.

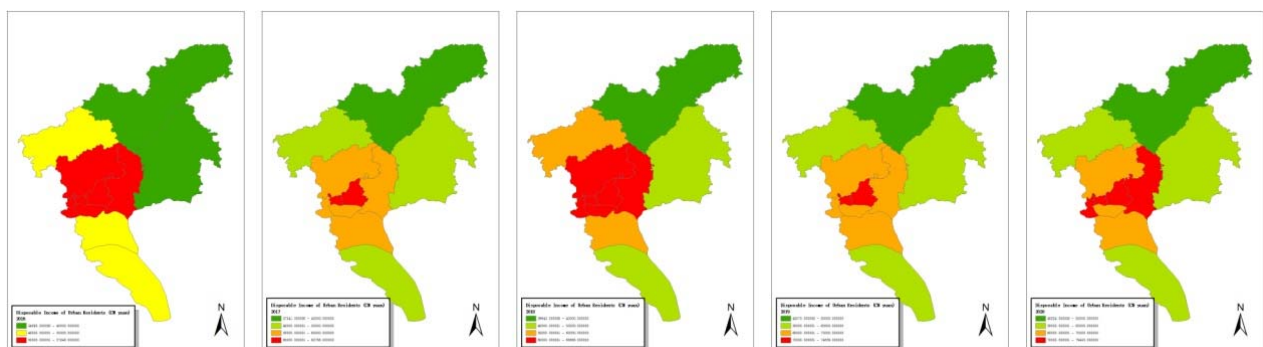


Figure 2. Guangzhou's disposable income map from 2016 to 2020

3.3. An analysis of the coupling degree C

A higher coupling degree C value indicates a greater interaction between the systems. It is found that, after data processing, the C values of eight other districts in Guangzhou remain above 0.7 from 2016 to 2020, with the exception of Nansha, Yuexiu, and Conghua districts, indicating a greater interaction between the permanent population and per capita disposable income in these districts.

3.4. An Analysis of Coupling coordination degree D

Coordinating degree D is always a value between 0 and 1. A larger value stands for a higher coordination degree between the data. The classification standard of coupling coordination degree used in this paper has been given in the research method of the previous section.

The study found that during the five years, the degree of coupling and coordination of each district in Guangzhou is relatively stable, and the coordination level of all districts is relatively stable, indicating that during the five years, the

relationship between the permanent population and per capita disposable income has little change.

Among them, Panyu District, Tianhe District and Baiyun District have the highest degree of coupling coordination, reaching intermediate coordination, good coordination and high-quality coordination in 2020, respectively. These three districts are the three districts with the largest resident population in Guangzhou, even if their area ranking is not high, which shows that their resident population and urban per capita disposable income are coordinated at a high level and cause and effect each other.[5]

However, the coupling coordination degree of Nansha District and Conghua District is the lowest, with coordination levels of 2 and 3 respectively, indicating that the permanent population in Conghua District and the per capita disposable income of rural residents are mutually restricted at a low level, which is worthy of the government's attention.[6] As a district with a short development history, Nansha, which has been developed since 1998, has a per capita income exceeding Conghua and Zengcheng in a short period of time, which may be one of the reasons for its low coupling coordination degree.

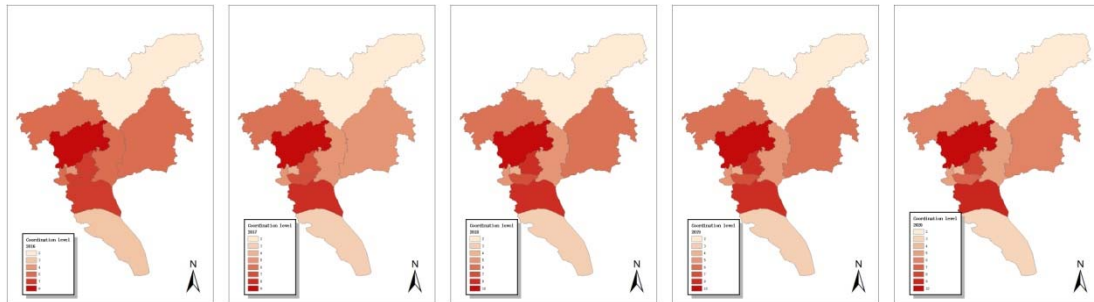


Figure 3. Coordination level map of Guangzhou from 2016 to 2020

4. Conclusion

Analysis of Guangzhou's data from 2016 to 2020 is used to calculate the coupling coordination degree. Based on the results of the study, it appears that the per capita disposable income of rural citizens is generally high compared to that of permanent residents in each district in Guangzhou, showing that the reciprocal action between the two is large. However, the difference in the coupling coordination degree of each district is large, which represents the mismatch between the population and economic space in Guangzhou, which may cause excessive population pressure in some areas in the future and the development gap among all districts.

References

- [1] Chen & Yang (2022). Comparative study on high-quality development of urban manufacturing industry in Guangdong-Hong Kong-Macao Greater Bay Area. *Urban Observation* (04), 6-22 + 159.
- [2] Zhou Jie, Luo Xiaoyao & Xie Bo. (2015). Spatial distribution and evolution characteristics of floating population in megacities from 2000 to 2010 - taking Beijing, Shanghai, Guangzhou, Wuhan and other cities as examples. *Journal of Urban Planning* (06), 56-62. doi : 10.16361 / j.upf.201506007.
- [3] The SPSSAU project (2022). SPSSAU. (Version 22.0) [Online Application Software]. Retrieved from <https://www.spssau.com>.
- [4] Zhou Di, Wang Xueqin, (2019). Wang X. Research on coupling degree and coupling path between China's carbon emission efficiency and industrial structure upgrading. *Environ Sci Pollut Res Int.* 2020 Jul;27(20):25149-25162. doi: 10.1007/s11356-020-08993-w. Epub 2020 Apr 28. PMID: 32347503.
- [5] Luo Zhengyuan & Zhao Shixiu. (2022). The Impact of Population Density on Household Consumption in the Context of Urbanization - A Case Study of Chengdu-Chongqing Urban Agglomeration. *Business Economics Research* (14), 64-67.
- [6] (2021). Bulletin of the Seventh National Population Census (No.1) - Basic information on the work of the Seventh National Population Census. *China Statistics* (05), 6-7.
- [7] Weng Yidan, Qian Qinglan, Chen Yingbiao & Han Fuzhuang. (2015). A preliminary study on the spatial equilibrium characteristics of population and economic correlation in Guangzhou. *Journal of Guangzhou University (Natural Science Edition)* (06), 84-91.