# Measurement and Spatio-Temporal Differentiation of Common Prosperity Level in China

## Evidence From the Analysis of Location-Based Big Data

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**Abstract.** This paper constructs an evaluation index system from the dimensions of affluence and common degree, and uses entropy-TOPSIS method to measure the common affluence level of China's provinces during 2016–2020. Based on Dagum Gini coefficient, Moran index and effect model, regional differences, spatio-temporal evolution and convergence steady state were analyzed. The results show that: ① Education expenditure has a negative effect on affluence, but the regression coefficient of the interaction between per capita GDP and education expenditure is significantly positive; ② In the original model, the influence of science and technology expenditure on affluence is not significant, but the influence of science and technology expenditure becomes significantly positive after the interaction effect between research expenditure and unemployment rate is added; ③ In the interaction effects, it is found that the interaction terms containing unemployment rate are significant, and all are negative effects. Based on the research conclusions, this paper puts forward suggestions from the aspects of governance means, development patterns, and financial system. Trying to provide relevant policy suggestions for the government.

**Keywords:** common prosperity · level measurement · spatial-temporal pattern · location-based big data

## 1 Introduction

Common prosperity is an essential requirement of socialism with Chinese characteristics and an important part of the Chinese dream of national rejuvenation. After completing the building of a moderately prosperous society in all respects, China has entered a new historical stage of promoting common prosperity.

In recent years, domestic scholars have interpreted common prosperity from the perspectives of connotation, measurement, influencing factors and realization path (Peilin Liu [1], 2021). Jinchang Li [2] (2022) constructed a process evaluation index system of common prosperity composed of six first-level indicators and a result evaluation index system of common prosperity composed of three first-level indicators. Finally, they took

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Zhejiang Province as an example to measure the realization degree of common prosperity from 2015 to 2020. Wenmei Liu [3] (2019) calculated the degree of co-prosperity and the degree of affluence, and conducted an empirical study using SAR (spatial lag model) and SEM (spatial error model), and learned that the development of co-prosperity should increase the investment in education, health care and science and technology on the basis of strictly controlling the unemployment rate in the region. Shengwei Tu [4] (2022) believed that the integrated development of rural industries promotes the activation and reconstruction of rural collective economic organizations, which will have an impact on farmers' income increase and prosperity. Zhaolei Zhan [5] (2021) proposed that not only strengthen the "three pockets", but also improve the "three pockets" to strengthen the linkage.

This paper takes China's common affluence level as the research object, mainly investigates the differences in common affluence of 31 provinces and cities in China, and tries to find the factors that cause these differences through the differences in common affluence of different regions, so as to provide certain reference and significance for China to achieve high-quality common affluence.

## 2 Data Sources and Analysis

### 2.1 Source of Data

This paper takes the common affluence level as the research object and measures the common affluence level of 31 provinces and cities in China from two dimensions of time and space. In order to study the development trend of common prosperity in different cities from time to time, this paper collected data from the national statistical yearbook from 2016 to 2020. According to the measure index, The data collected and collated include the data of ten indicators, such as per capita GDP, savings amount of urban and rural residents, per capita net income of rural residents, per capita disposable income of urban residents, foreign trade dependency, urban registered unemployment rate, urbanization rate of permanent residents, proportion of R&D expenditure in GDP, proportion of education expenditure in ten thousand yuan in GDP, proportion of medical input in GDP.

### 2.2 Model and Measure Formula

#### 2.2.1 Measure of Affluence

The per capita disposable income of urban residents, per capita net income of rural residents, per capita savings of urban and rural residents and urbanization rate are selected to measure the affluence. Considering the regional quantificability of economic indicators, the purchasing power parity index is included in the evaluation system, so that each index in the index system of affluence is replaced by equal utility. The specific formula for calculating affluence is as follows:

$$f_i = C_i * \propto_i + N_i * (1 - \propto_i) + Z_i \tag{1}$$

$$D_i = \frac{f_i - f_{min}}{f_{max} - f_{min}} \tag{2}$$

### 2.2.2 Measurement of Commonality

The common coefficient is calculated by the discrete coefficient of purchasing power degree. According to the value of the common coefficient, the common degree can be divided into five intervals: disparity, difference, reasonable, common and same. Its calculation formula is: $\mu = 1 - \mathrm{v}$.

In the formula, $\mathrm{v} = \frac{\partial}{\bar{f}} * 100\%$ is the dispersion coefficient of purchasing power, $\bar{f}$ is the average of purchasing power degree, and $\partial$ is the standard deviation of purchasing power degree. When u is less than 40%, it indicates a disparity. $40\% \leq \mathrm{u} < 60\%$, indicating difference; $60\% \leq \mathrm{u} < 80\%$, indicating reasonable; $80\% \leq \mathrm{u} < 100\%$, indicating common; When u is greater than or equal to 100%, it means the same.

### 2.2.3 Effect Model

Model 1: Fixed effects model

$$yit = \alpha i + bxit + \varepsilon \mathrm{it} \tag{3}$$

For the 31 provinces and cities studied, the slope term is the same, but the intercept term of the model is different.

Model 2: Random effects model

$$yit = \alpha i + \mathrm{ui} + bxi \tag{4}$$

Model 3: Mixed effects model

$$yit = c + bxit + \varepsilon \mathrm{it} \tag{5}$$

The mixed effects model is a mixture of random effects and fixed effects. For different provinces and cities, the same intercept term and slope means the same model.

## 2.3 Analysis of Data

### 2.3.1 Spatio-Temporal Evolution of Common Affluence in 31 Provinces and Cities in China

In order to objectively analyze the common affluence of 31 provinces and cities, this paper selects three representative years (2016, 2018 and 2020) to analyze the variation trend from the spatial distribution.

Figure 1 shows that Inner Mongolia, Guizhou, Tibet, Gansu, Qinghai, Ningxia and Xinjiang in 2016 belong to food and clothing; Hebei, Shanxi, Anhui, Henan, Guangxi, Sichuan, Yunnan, Shaanxi, Liaoning, Jilin and Heilongjiang belong to preliminary well-off; Hainan, Jiangxi, Hubei, Hunan and Chongqing belong to partial well-off; Tianjin, Jiangsu, Fujian, Shandong and Guangdong are well-off, while Beijing, Shanghai and Zhejiang are well-off. By 2018 (Fig. 2), Guizhou, Xizang and Gansu will have sufficient food and clothing, while other cities will be moderately prosperous. By 2020 (Fig. 3), Shanxi, Henan, Inner Mongolia, Guangxi, Sichuan, Guizhou, Yunnan, Tibet, Gansu, Qinghai, Ningxia, Xinjiang, Jilin and Heilongjiang will have entered the initial stage of moderate prosperity, while other cities will have entered the partial stage of moderate prosperity. As can be seen from the three figures, all 31 provinces in China have achieved moderate prosperity in 2020.

**Fig. 1.** Spatial distribution of common prosperity in 2016

**Fig. 2.** Spatial distribution of common prosperity in 2018


**Fig. 3.** Spatial distribution of common prosperity in 2020

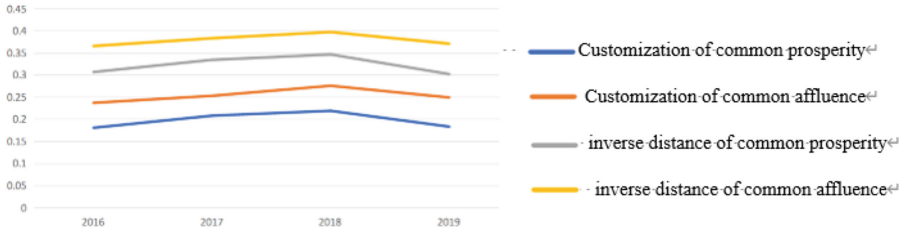


**Fig. 4.** The global Moran index of common affluence from 2016 to 2019

### 2.3.2 Morel and Index

Figure 4 shows that the Moreland coefficients of common degree and affluence calculated under different spatial weight matrices are very different. For affluence, the Moran coefficient calculated under the spatial weight matrix set under the inverse distance method presents obvious spatial effect, while the Moran coefficient calculated under the custom region method is relatively small and has no obvious spatial correlation. In order to compare the model effect under different spatial weight matrices, we choose to leave the spatial weight matrix with Moran coefficient between 0.3 and 0.4, inverse distance method. Similarly, for common degree, the coefficient of Moran coefficient is generally larger under the custom region method, so we choose to leave the space weight matrix with Moran coefficient between 0.35 and 0.45, and the inverse distance method. Considering that the reverse distance method and the custom region method both focus on the distance collar grounding market, we adopt the reverse distance method and the custom region method to create the space weight matrix for the spatial panel model of richness and common degree considering all factors. Finally, the final spatial weight matrix is determined by comparing the model results.

### 2.3.3 Analysis Results of Effect Model

Table 1 shows that although the influence of education expenditure on affluence is negative, the regression coefficient of the interaction term between per capita GDP and education expenditure is significantly positive, indicating that the higher per capita GDP, the higher the investment of education expenditure is conducive to the improvement of affluence, that is, the effect of education expenditure on affluence is positive. This may also explain why education spending has a negative effect on affluence in the original model. Because the influence of education funds on the affluence of a region is excessively dependent on the local per capita GDP, the more developed regions invest in education, the faster the economic development. Secondly, the influence of R&D expenditure on affluence is not significant in the original model. But when the interaction between research funding and unemployment is included, the effect of research funding becomes significantly positive. This suggests that increasing investment in science and technology while maintaining unemployment will boost prosperity. Finally, in the interaction effects, it is found that the interaction terms including unemployment rate have significant effects, and all have negative effects, which indicates that the higher the per capita GDP, education expenditure, R&D expenditure, medical investment and unemployment rate, the lower the unemployment rate is conducive to the improvement of affluence, that is, the unemployment rate is particularly important for the economic development of a region.

**Table 1.** Analysis results of the interaction effect between affluence and commonality

| | Degree of affluence | | Degree of commonality | |
|---|---|---|---|---|
| Log (GDP per capita) | 0.0658 | * | −0.2103 | * |
| Log (Funds for education) | −0.0420 | * | 0.1543 | * |
| Log (Funds for science and technology) | 0.0187 | * | −0.0023 | * |
| Log (Investment in medical care) | 0.4123 | * | 0.4356 | * |
| Log (Foreign trade dependence) | −0.1345 | * | 0.2753 | * |
| Log (Unemployment rate) | −1.7653 | * | −0.0203 | * |
| Log (GDP per capita) * Log(Funds for education) | 0.0538 | * | 0.0183 | * |
| Log (GDP per capita) * Log (Foreign trade dependence) | 0.0412 | * | 0.0174 | * |
| Log (GDP per capita) * Log (Unemployment rate) | −0.2193 | * | −0.0823 | * |
| Log (Funds for education) * Log (Unemployment rate) | 0.0123 | * | 0.0126 | * |
| Log (Funds for science and technology) * Log (Unemployment rate) | −0.1563 | * | −0.0733 | * |
| Log (Investment in medical care) * Log (Unemployment rate) | −0.0342 | * | 0.0295 | * |
| Log (Foreign trade dependence) * Log (Unemployment rate) | −0.1076 | * | −0.0645 | * |
| Log (Investment in medical care) * Log (Foreign trade dependence) | −0.123 | * | −0.0673 | * |
| Log (Funds for education) * Log (Foreign trade dependence) | 0.0416 | * | 0.0514 | * |

## 3 Conclusion

The research results show that education expenditure has a negative effect on affluence, but the regression coefficient of the interaction term between per capita GDP and education expenditure is significantly positive, which indicates that when per capita GDP is higher, increasing the investment of education expenditure is conducive to the improvement of affluence, that is, the effect of education expenditure on affluence is positive. This may also explain why education expenditure has a negative effect on affluence in the original model. Because the influence of education expenditure on the prosperity

of a region depends too much on the per capita GDP of the region, the more developed regions invest in education, the faster the economic development. Secondly, in the original model, the influence of science and technology funds on affluence is not significant, but after the interaction effect of research funds and unemployment rate is added, the influence of research funds becomes significantly positive, which indicates that only when the unemployment rate is guaranteed and the investment of science and technology funds is increased can the affluence be improved. Finally, in the interaction effects, it is found that the interaction terms containing unemployment rate all have significant effects, and all have negative effects. This indicates that the higher the per capita GDP, educational expenditure, scientific research expenditure, medical investment and unemployment rate, the lower the unemployment rate is conducive to the improvement of affluence, that is, the unemployment rate is particularly important for the economic development of a region. Similarly, in the model of common degree, most of the cross-terms related to unemployment rate remain. It can be seen that the lower the unemployment rate, the education and medical investment will have a positive impact on the common degree. This shows once again the importance of the unemployment rate in a region to local economic development and narrowing the gap between the rich and the poor.

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