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Research on the evaluation and configuration path of China's rural common Prosperity—NCA and fsQCA based on provincial panel data

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A R T I C L E I N F O

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A B S T R A C T

Based on 2013–2019 panel data covering 31 provinces and cities in China, this paper uses the entropy weight technique for order of preference by similarity to ideal solution (TOPSIS) method to measure rural common prosperity (CP). Based on the global and local Moran's I methods, we analyze the dynamic evolutionary characteristics of China's rural CP and the regional differences. Additionally, we use the necessary condition analysis (NCA) and fuzzy-set qualitative comparative analysis (fsQCA) methods to explore how six antecedents at the technology-organization-environment (TOE) level interact to affect CP. This research finds that, first, China's rural CP showed a fluctuating upward trend, with the highest level of CP in rural areas in the eastern region, followed by the central and western regions. Additionally, the gap between the three gradually narrowed. Second, China's rural CP had "high-high" and "low-low" agglomeration characteristics, with positive spatial autocorrelation, no transition changes, and strong spatial stability. Third, individual digital economic elements and organizational and environmental elements were not necessary conditions for promoting rural CP. Fourth, the multiple concurrent factors of the digital economy, organizations and the environment constituted three diversified configurations of rural CP, showing that the driving path of rural CP was characterized by "different paths that lead to the same goal". Moreover, "perfect digital facilities" and "high entrepreneurial activity" had a universal role in promoting rural CP. The conclusions of this research hold important theoretical and practical significance for improving China's rural CP.

1. Introduction

General Secretary Xi Jinping pointed out that "Common prosperity is the essential requirement of socialism and the common expectation of the people. In the final analysis, we promote economic and social development to achieve common prosperity for all people". To that end, China has historically solved the problem of absolute poverty and laid a solid foundation for building a moderately prosperous society in all respects and achieving common prosperity (CP) in rural areas by promoting coordinated regional

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development, accelerating the protection and improvement of people's livelihoods, promoting the new urbanization and rural revitalization strategies, and targeting poverty alleviation. According to data from the National Bureau of Statistics, the ratio of per capita disposable income of urban and rural residents in 2022 was 2.44, a decrease of 0.44 compared with 2012. The relative gap will continue to narrow, showing the development trend of CP. However, while China has made outstanding achievements in economic development, problems such as the distorted allocation of financial resources, insufficient proportion of middle-income groups, prominent mismatch of data elements, relatively low per capita GDP, large urban–rural income gap, and inadequate social security system remain prominent [1]. The resulting unbalanced and inadequate development has restricted the improvement of people's livelihoods and well-being, and it has hindered the development of rural CP. Thus, there is an urgent need to explore the channels to achieve the goal of CP in rural areas, which holds great significance for China to comprehensively build a modern socialist country in the new era, promote the great rejuvenation process of the Chinese nation, and achieve the Chinese path to modernization.

In the critical period of realizing CP in rural areas, the relevant technologies of the digital economy have gradually become an important support and technical guarantee for poverty alleviation. From the perspective of the practical path, first, the digital economy cultivates entrepreneurship and an ecology of innovation through the innovation effect, aggregation effect, and symbiosis effect, and it also cultivates high-end production factors to reduce production costs. Second, through the resource allocation function, which continuously improves the effectiveness of the input and output of all kinds of factors, the digital economy significantly reduces the transaction costs of search, imitation, transmission, and verification in economic activities [2]. Additionally, it has been instrumental in promoting stable and balanced growth of the macroeconomy, improving the efficiency of economic development [3] and playing a positive role in achieving equalization of public services. As rural CP is a complex and variable process, it may be challenging to achieve this goal with the support of digital technology alone and organizational and environmental linkages, such as rural human capital, the entrepreneurial environment, and the natural environment, may also be necessary. Higher rural human capital implies a higher level of education of the population, which is more conducive to redistributing wealth and narrowing the urban–rural income gap [4,5]. Furthermore, an excellent entrepreneurial environment and natural environment can reduce the financing difficulties faced by rural farmers and increase the probability of entrepreneurial success, thus stimulating entrepreneurial enthusiasm, increasing rural farmers' income and realizing rural common wealth. Therefore, strengthening the guarantee of basic conditions such as technology, organizations and the environment and giving full play to the linkages of the three are the sustained driving force for promoting the realization of rural CP.

As an important proposition in the process of socialist modernization, CP carries the beautiful pursuit and great vision of the Chinese nation, and it is also the essential requirement of people's yearning for a better life. In previous studies, the focus of research mainly involved the ideological evolution of CP [6], its theoretical connotation [7], the evaluation system for CP [8] and its realization path [9]. In terms of the influencing factors of CP, scholars mainly focus on the industrial structure [10], promoting employment, narrowing the urban–rural income gap [11], achieving poverty reduction and an income increase [12] and promoting coordinated regional development [13]. For example, Anand et al. [14] argued that equalizing basic public services plays a vital role in CP. Calderon et al. [15] believed that infrastructure is the core power for promoting CP. Sun et al. [16] used the annual data covering 23 provinces in China from 2000 to 2021 to study the relationship between green energy equity and CP. They found a positive and meaningful impact between the two. Although some scholars also use multiple regression analysis to analyze the relationship between the digital economy and CP [17,18], such analysis cannot comprehensively explain the complex relationship between them. In addition, the development of the digital economy has obvious inclusive and spillover effects that help to narrow the development gap in different dimensions and accelerate the process of benefiting all people with the achievements of reform and development. The continuous emergence of digital dividends brings not only equal development opportunities to the masses but also benefits long-term groups such as rural farmers in remote areas [19], providing workers with more employment opportunities and helping to alleviate the adverse effects on vulnerable groups. Furthermore, the digital economy is a sustained driving force for achieving coordinated and stable growth. The spillover and synergistic effects of the development of the digital economy have significant income growth and poverty reduction effects [20].

In summary, existing research has conducted a rich discussion on the connotation of, realization mechanism of, and evaluation system for CP, providing a rich research basis for this study, but there are some shortcomings. First, few studies have paid attention to the necessity of enabling the development of CP through antecedents, as well as the configurational heterogeneity of their interdependence and interaction driving CP in specific situations. Second, the existing measurement methods cannot accurately reflect the actual situation of China's rural CP, and scientific and effective measurements of CP are lacking. Therefore, based on 2013–2019 interprovincial panel data covering 31 provinces in China, this paper first uses the entropy weight technique for order of preference by similarity to ideal solution (TOPSIS) method and other evaluation methods to build an evaluation system for China's rural CP based on four dimensions, and it comprehensively uses descriptive statistics, the global and local Moran's I and other methods to analyze the spatiotemporal evolutionary characteristics of China's rural CP level and the regional differences. Then, based on the three dimensions of technological progress, organizational operation, and environmental support, a technology-organization-environment (TOE) analysis framework for China's rural CP is constructed. Six antecedents, namely, digital facilities, digital services, the urbanization rate, rural human capital, environmental regulation, and entrepreneurial activity, are selected to investigate the combination of conditions for China's rural CP and to seek a practical path for China's rural CP.

The possible marginal contributions of this paper are as follows: (1) This research compensates for the shortcomings of previous studies that focused only on single factors such as technology, organizations, and the environment and that were unable to explore the linkage effects between various influencing factors from a systematic perspective. (2) Using the fuzzy-set qualitative comparative analysis (fsQCA) method, this paper provides a qualitative and quantitative research model for studying rural CP based on sample selection and analysis. The fsQCA method includes multiple factors at the TOE level in the research framework, providing a panoramic systematic analysis toolbox for studying rural CP. (3) Based on provincial panel data, this paper uses the dynamic fsQCA method to break the barrier between panel data and qualitative comparative analysis (QCA) methods and to explore the synergy of various influencing factors of CP under the time effect.

2. Analysis of the current situation of China's rural common prosperity

2.1. Design of the evaluation index system

By summarizing the relevant literature, this research finds that the measurement methods for rural CP mainly include single indicator and comprehensive indicator methods. A single indicator method mainly measures rural CP. For example, the Gini coefficient of income is used to measure the "common" level, and income is used to measure the "rich" level [21,22]. Since the connotation of CP requires both material and spiritual satisfaction, these two methods are highly recognized. Some scholars have also used methods such as the Theil Index [23] and the Lorenz curve [24] to measure rural CP. However, due to the volatility of indicator measurement and the singularity of dimensions, there may be significant deviations in the measurement results.

With the continuous deepening of research by scholars in China and elsewhere, a single indicator measurement method can no longer meet the needs of research. Therefore, a large number of scholars have begun to use a comprehensive indicator measurement method. For example, Li et al. [25] constructed a CP index using the analytic hierarchy process based on the four dimensions of "high-quality development", "high-quality life", "efficient service" and "high-level sharing". Ma et al. [26] used the entropy and coefficient of variation methods to evaluate China's CP index from 2010 to 2020 based on three dimensions: sustainability, development, and sharing. The index constructed by the research above uses a wide range of indicators, similar to the concept of CP. Compared with a single indicator method, a comprehensive indicator calculation method can more comprehensively and accurately reflect the connotation of CP. However, it may also lead to the situation of "good intentions but bad deeds" [27].

General Secretary Xi Jinping pointed out that "Common prosperity is the CP of all people. The people's material life and spiritual life are rich, not the wealth of a few people, nor uniform equalitarianism." This means that CP is a kind of universal prosperity that entails a sequence, a bottom line, and a level. It includes not only material and spiritual prosperity but also harmonious social life, infrastructure construction, and improvement, urban and rural integrated development, a reasonable urban–rural income gap, the environment, livability, and employment. Therefore, based on the achievements made by the literature, through the understanding of rural CP's connotation and the interpretation of relevant policy content, and taking into account the availability of data samples, this paper evaluates CP based on four dimensions through the principles of scientific, computable and independent indicator system design (see Table 1).

Dimension 1: Rural material prosperity. The reasons for the disharmony and inadequacy of regional development are complex. Single factors such as geographical differences, resource differences, and industrial structure differences are not the cause; rather, this disharmony and inadequacy are caused by a combination of factors such as income, consumption, and the geographical environment. Therefore, to promote the integrated development of urban and rural areas and facilitate rural CP, it is necessary to solve the problem of unreasonable resource allocation. The per capita disposable income of rural residents [28,29], the total output value of agriculture,

Table 1
Construction of an indicator evaluation system for rural common prosperity.

Primary indicators	Secondary indicators	Tertiary indicators	Indicator attribute	Weight (%)
Common Prosperity	Material prosperity	Per capita disposable income of rural residents	Positive direction	5.417
		Total output value of agriculture, forestry, animal husbandry, and fishery	Positive direction	8.072
		Rural consumer price index	Positive direction	1.734
	Harmonious social life	Number of household cars owned by every 100 households in rural areas	Positive direction	6.693
		Number of beds in medical and health institutions per 10,000 people in rural areas	Positive direction	3.753
		Number of urban and rural residents participating in social pension insurance	Positive direction	9.725
	Infrastructure construction	Rural electricity consumption (10,000 kW)/rural population	Positive direction	34.447
		Total power of agricultural machinery (10,000 kW)/arable land area (1000 ha)	Positive direction	6.674
		Effective irrigation area (thousand hectares)/cultivated land area (thousand hectares)	Positive direction	5.618
	Livable ecological environment	Forest cover	Negative direction	5.936
		Sewage treatment rate	Positive direction	8.852
		Carbon emissions	Positive direction	3.08

forestry, animal husbandry, and fishery [28], and the consumer price index of rural residents [29] reflect the gap in income, production scale, and consumption level between urban and rural areas, respectively, and comprehensively measure the level of rural material prosperity.

Dimension 2: Rural harmonious social life. The internal requirement of rural CP is to strengthen regional exchanges and cooperation and give full play to top advantages. Therefore, it is necessary to promote the sharing of elements such as infrastructure, healthcare, and social security and to continuously reduce income disparities. The number of household cars owned by every 100 households in rural areas [29], the number of beds in medical and health institutions per 10,000 people in rural areas [29,30], and the number of urban and rural residents participating in social pension insurance [28] reflect the gap between regional economic levels, medical levels, and social security levels, respectively.

Dimension 3: Rural infrastructure construction. This variable includes the ratio of rural electricity consumption to the rural population, measuring the average electricity consumption per 10,000 rural residents. It can reflect the improvement of rural living security infrastructure. Second, the ratio of the total power of agricultural machinery to the cultivated land area reflects the degree of infrastructure improvement in ensuring the income of rural farmers. In contrast, the ratio of the effective irrigation area to the cultivated land area reflects agricultural infrastructure construction [28]. These indicators comprehensively reflect the level of rural infrastructure construction and play an important role in ensuring rural CP.

Dimension 4: Livable ecological environment. This variable mainly includes carbon emissions [28], forest cover and the sewage treatment rate [29]. Carbon emissions include direct emissions within each municipality, indirect emissions related to the energy generated outside a municipality, and emissions generated outside a province's jurisdiction due to internal activities within the province. Forest cover is expressed as the ratio of the forest area to the land area. The sewage treatment rate is expressed as the ratio of the sewage treatment volume to the total sewage discharge. These three indicators can reflect the advantages and disadvantages of a region's natural environment and the total wealth of natural resources, reflecting the CP of the rural ecological environment.

2.2. Determination of the evaluation methods

The indicator system for China's rural CP is characterized by multiple indicators and dimensions. It is necessary to convert these multiple indicators into a single index for measurement and judgment. In this process, first, we need to assign weights to the various indicators to obtain the various subsystem indexes and comprehensive indexes of China's rural CP. The methods of indicator weighting can be mainly divided into subjective and objective categories. Subjective weighting methods include the analytic hierarchy process, expert consultation, and the relative index method, while objective weighting methods include the entropy weight method, principal component analysis, and the multiobjective programming method. We effectively combine the entropy weight method and the TOPSIS method, avoiding the subjectivity problem of indicators in evaluation and facilitating the objective processing of indicator evaluation information.

2.2.1. Entropy weight method for weight calculation

If there are m provinces and n evaluation indicators, then q_{ij} is the j-th indicator of the i-th sample ($i = 1, 2, \ldots, m; j = 1, 2, \ldots, n$). To solve the dimensional problem caused by the differences in evaluation indicator units, it is necessary to standardize the indicators and convert their absolute values into relative values. Due to the different meanings represented by positive and negative indicators, different formulas need to be used to standardize high and low indicators. Where equation (1) is the positive indicator calculation and equation (2) is the negative indicator calculation.

$$\text{Positive indicator}: q_{ij}^{+} = \frac{q_{ij} - min(q_{1j}, \ldots, q_{mj})}{max(q_{1j}, \ldots, q_{mj}) - min(q_{1j}, \ldots, q_{mj})} + 1 \tag{1}$$

$$\text{Negative indicator}: q_{ij}^{-} = \frac{max(q_{1j}, \ldots, q_{mj}) - q_{ij}}{max(q_{1j}, \ldots, q_{mj}) - min(q_{1j}, \ldots, q_{mj})} + 1 \tag{2}$$

Next, determine the weight of the i-th sample in the j-th indicator: $P_{ij} = \frac{q_{ij}}{\sum_{i=1}^{m} q_{ij}}$.

Calculate the entropy value of the j-th indicator:

$$e_j = -k \times \sum_{i=1}^{m} P_{ij} \times ln(P_{ij}), k = \frac{1}{ln(m)}, 0 \leq e \leq 1$$

Calculate the redundancy of the entropy value for the j-th indicator: $g_i = 1\text{-}e_i$. The larger the value of g_i is, smaller the entropy value. Finally, calculate the weight, $w_j = \frac{g_j}{\sum_{j=1}^{m} g_j}$, (j = 1, …, n). W_j is the weight calculated by the entropy weight method for each indicator.

2.2.2. TOPSIS method

Since different dimensions of indicators in the TOPSIS method will affect the final results, at the same time, to compensate for the shortcomings of the statistical indicator system method and to facilitate the overall comparison of the evaluated objects in different times and spaces [31], the original data should be assimilated. Additionally, each indicator q_{ij} should be transformed as follows: $V_{ij} = \frac{q_{ij}}{\sqrt{\sum_{i=1}^{m} q_{ij}^2}}$.

Based on the entropy weight method, weight w_j is obtained by multiplying the corresponding elements to further obtain the weighted normalization matrix:

$$z = \begin{bmatrix} v_{11} & \cdots & v_{1n} \\ \vdots & \cdots & \vdots \\ v_{m1} & \cdots & v_{mn} \end{bmatrix} \begin{bmatrix} w_1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & w_n \end{bmatrix} = \begin{bmatrix} f_{11} & \cdots & f_{1n} \\ \vdots & \cdots & \vdots \\ f_{m1} & \cdots & f_{mn} \end{bmatrix}$$

After calculating the weighted normalization matrix, it is necessary to find the positive ideal solution (Z+) and the negative ideal solution (Z-). Based on weighted normalization matrix z, the calculation formulas for the positive and negative ideal solutions are as follows:

$$Z^+ = \left(z_j^+\right)_{j\in J} = \left\{\left(max\ \ z_{ij} \middle| j \in J\right) \middle| i = 1, 2, \ldots, m\right\}$$

$$Z^- = \left(z_j^-\right)_{j\in J} = \left\{\left(min\ \ z_{ij} \middle| j \in J\right) \middle| i = 1, 2, \ldots, m\right\}$$

where J is the normalized index set.

Next, calculate the positive and negative ideal distances: $\begin{cases} d_i^+ = \sum_{j=1}^{n} (z_{ij} - z_j^+)^2 \\ d_i^- = \sum_{j=1}^{n} (z_{ij} - z_j^-)^2 \end{cases}$, where $i = 1, 2, \ldots, n$. Finally, calculate the relative closeness progress C ($0 \leq C \leq 1$). The higher the closeness is, the better the goal. The calculation formula is as follows: $C_i = \frac{d_i^-}{d_i^+ + d_i^-}$.

2.3. Time-series changes in China's rural common prosperity

Based on the measured data, this paper uses a line chart to intuitively display the dynamic changes in the rural CP index of the whole country and its regions from 2013 to 2019 (Fig. 1). Overall, the rural CP index in the eastern, central and western regions has fluctuating and rising characteristics, indicating that China's policy of supporting CP had a significant effect. The rural CP in all regions continued to improve. Among them, the sharp decline in the 2018–2019 period may be due to the impact of COVID-19, the poor ability of rural farmers to resist risks, the shutdown of production and other reasons, which hindered the process of rural CP. From the regional perspective, the eastern region had the highest level of CP, which was far higher than the national average, followed by the central region, which was the same as the national average, while the western region was far lower than the national average. These results show a large gap between rural CP in all regions of China. One possible reason is that the eastern region is rich in resources, is relatively perfect in terms of its institutional environment, and has a high level of economic development. Rural farmers can better benefit from these advantages, increase their income, and thus have a high level of rural CP. However, the realization of CP in the central and western regions is restricted by human capital, the entrepreneurial environment, institutional security, and other factors, leading to a

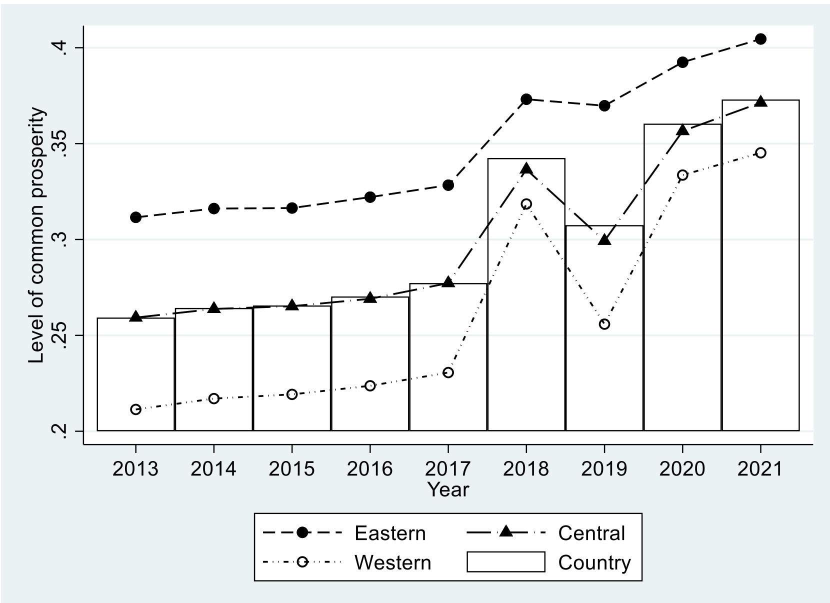

Fig. 1. Time-series changes in China's rural CP index, 2013–2019.

lower level of rural CP. At the same time, in addition to 2018, the opening between any two curves in the eastern, central and western regions narrowed, indicating that although there are significant differences in the level of rural CP in various regions, the gap narrowed, and there may be a convergence trend.

2.4. Spatial correlation of China's rural common prosperity

With the continuous development of China's socialist market economy, the links between regions are becoming increasingly closer. The level of CP in a region depends not only on the impact of the local market environment but also on the level of economic development in neighboring regions. In particular, under the guidance of economic policies, the level of CP between regions may impact adjacent areas through spatial radiation. Thus, there is a specific spatial correlation [32]. Therefore, this paper uses the local and global Moran's I to analyze the spatial evolutionary process of China's rural CP level [33]. The weight matrix mainly adopts a nested matrix of economic and geographical distances. This matrix considers economic and geographical factors and can better reflect the differences between different regions. Table 2 shows the global autocorrelation test of China's rural CP index under the economic and geographical matrix. Figs. 2–4 report the local autocorrelation results of China's rural CP index in 2013, 2015, and 2019, respectively.

Based on the global autocorrelation test results, under the nested economic and geographical distance matrix, the global Moran's I of China's rural CP index in other years was statistically significant to varying degrees except in 2018. Moreover, all of the results were significantly positive, showing the characteristics of first falling and then rising. This finding indicates that China's rural CP level had a significant agglomeration feature in spatial distribution from 2011 to 2019, showing a "high agglomeration-low agglomeration-high agglomeration" trend.

Based on the local Moran's I scatter plot of China's rural CP index, this paper classifies the rural CP index into four regions based on the spatial correlation characteristics of each region, namely, "high-high" (the first quadrant), "low-high" (the second quadrant), "low-low" (the third quadrant), and "high-low" (the fourth quadrant). Among them, the level of rural CP in the provinces and cities in the first quadrant is relatively high, and the level of rural CP in the surrounding cities is also relatively high, showing a positive spatial correlation. In the second quadrant, the level of rural CP of provinces and cities is low. However, the level of rural CP of surrounding provinces and cities is high and negatively spatially correlated. The level of rural CP of the provinces and cities in the third quadrant and their surrounding provinces and cities is low and is positively spatially correlated. In the fourth quadrant, provinces and cities have a higher level of rural CP. However, the surrounding provinces and cities have a relatively low level, showing a negative spatial correlation.

According to Figs. 2–4, the level of rural CP in China has a significant spatial correlation, showing aggregation characteristics. Specifically, (1) most provinces and cities in China are located in the first and third quadrants, and the agglomeration types are mainly "high-high" and "low-low", showing a significant positive correlation. (2) Drawing on Rey's [34] spatiotemporal leapfrog method, we observe the evolution of the spatial correlation pattern of China's rural CP in 2013, 2015 and 2019. It is found that there was no leap change in the distribution of rural CP in Chinese provinces and cities during these three years, indicating solid spatial stability. (3) Most provinces and cities are located in the third quadrant, and their distribution characteristics remain basically unchanged. The results show that the overall level of rural CP in China is still low, and narrowing the urban–rural income gap and achieving CP for all people are still the focus of current economic work.

3. Theoretical analysis and model construction

3.1. Theoretical analysis

According to resource dependence theory, entrepreneurship can alleviate poverty when a sufficient resource supply exists in the market [35]. The main cause of poverty is a lack of resources, such as financial capital or other material assets. Therefore, providing low-cost loans to vulnerable groups such as rural farmers who have entrepreneurial needs and lowering the threshold for financial services can increase the disposable income of rural residents and positively impact the noneconomic performance of households. Based on the spillover effect and property rights theory, ecological products and services are mostly external economies, while environmental problems are external diseconomies. Unclear property rights are an important reason for externalities. Ecological

Table 2
Global autocorrelation test.

Year	CP		
	Moran's I	Z value	P value
2013	0.072	2.179	0.029
2014	0.058	1.894	0.058
2015	0.052	1.738	0.082
2016	0.063	1.960	0.050
2017	0.060	1.912	0.056
2018	−0.035	−0.031	0.975
2019	0.082	2.344	0.019

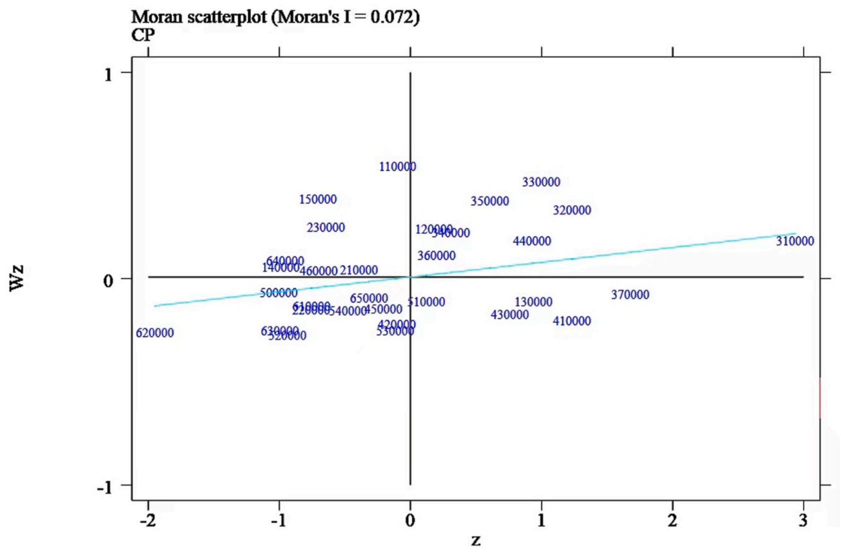

Fig. 2. Partial Moran's I scatter plot of China's rural CP index in 2013.

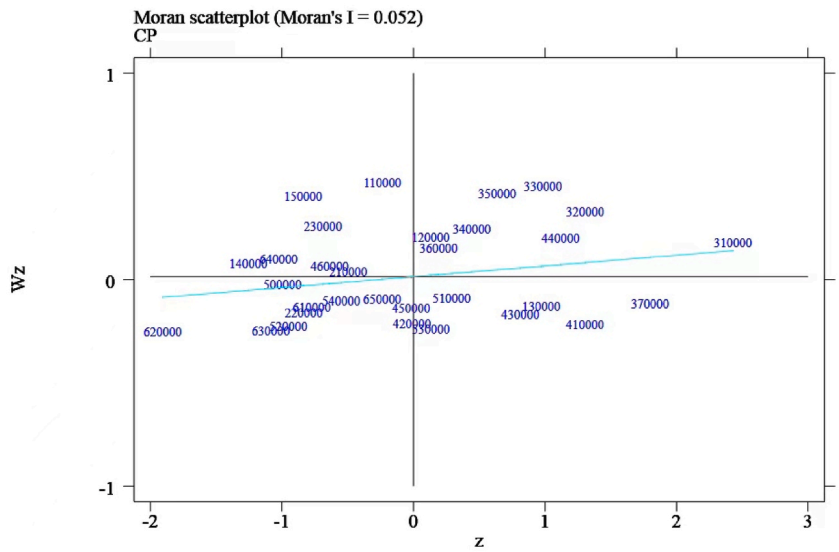

Fig. 3. Partial Moran's I scatter plot of China's rural CP index in 2015.

environment compensation is an important channel for correcting the externalities of natural resources and ecosystem services. When environmental regulation is strong, ecological environmental compensation can compensate for the protection costs of local governments, collectives, and residents, promote the rational allocation of green water and green mountains, improve overall social welfare, and promote the realization of the goal of CP. According to resource dependence theory, it is difficult for a single organization to achieve self-sufficiency and full control of resources. External resources can be obtained only when organizations exchange with the environment. A region with a high level of urbanization and high entrepreneurial enthusiasm can facilitate the sharing of resources among regions, reduce the difficulty of obtaining all kinds of resources, and then give full play to the top advantages to provide security for CP.

3.2. Theoretical model construction

Based on the theoretical analysis above, this paper combines the digital economy, the natural environment, the entrepreneurial environment, and organizational relationships with China's rural CP through the TOE theoretical framework to build a theoretical framework model of China's rural CP. Furthermore, by combining necessary condition analysis (NCA) and fsQCA, this paper explores the synergistic effect of technological, organizational and environmental factors on China's rural CP and reveals the interaction

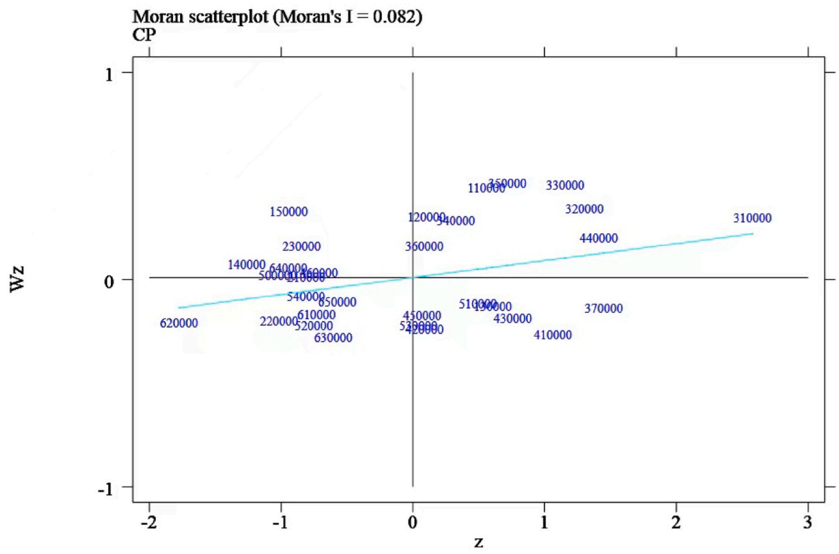

Fig. 4. Partial Moran's I scatter plot of China's rural CP index in 2019.

between different elements.

(1) Technology level. This level mainly includes antecedent variables that represent the development of the digital economy, such as digital services and facilities. In the context of the digital economy, based on the decentralized nature of the Internet, the digital economy naturally has the attribute of inclusive sharing, and digital infrastructure should also be built with sharing as the basic requirement. Digital technology facilities provide technical support for rural CP by improving the speed of information dissemination, overcoming geographical barriers, strengthening regional exchanges and cooperation, and reducing the cost of information exchange. Furthermore, they promote the sharing of development achievements by improving public participation. That is, they promote sharing through joint construction and gradually promote CP [36].
(2) Organizational level. This level mainly includes two secondary conditions: the urbanization rate and rural human capital. Urbanization can promote the exchange speed of human capital between urban and rural areas, give full play to the maximum effect of human capital, and thus help to narrow the urban–rural income gap [37] and provide conditions for rural CP. Lewis [38] conducted an empirical analysis through the dual-sector model structure model and reached the same conclusion. Improving rural human capital can release more of the rural labor force and stimulate laborers to engage in nonagricultural industries. Rural farmers will strengthen their willingness to invest in human capital to better enter the nonagricultural sector. At the same time, accumulating rural household human capital will increase family members' access to high-income jobs, thereby reducing the income gap with urban residents and facilitating rural CP [39].
(3) Environmental level. The environmental level also includes the natural and entrepreneurial environments, mainly covering two variables: environmental regulation and entrepreneurial activity. Strong environmental regulations can lead to an increase in the price of environmental resource factors, thereby encouraging enterprises to replace environmental resource factors with labor factors, improving employment levels, and increasing income levels [40,41]. Additionally, the cost increase caused by environmental regulations will force enterprises to introduce new clean technologies, promote the development of the environmental protection industry, and provide employment opportunities for the market. An excellent entrepreneurial

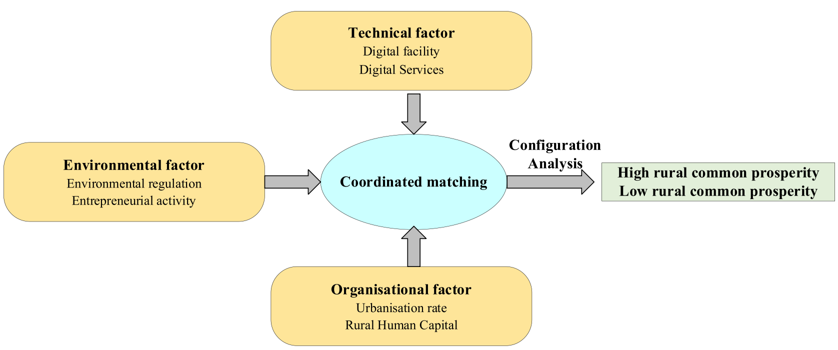

Fig. 5. TOE analysis framework of China's rural common prosperity.

environment is the basis for achieving CP in rural areas. Entrepreneurial activities stimulate the vitality of new industries and new formats through employment creation [42], industrial upgrading, and structural transformation [43], and they provide a new impetus for CP. In addition, entrepreneurial activities increase employment opportunities for rural farmers and other long-tailed groups, address the employment needs of rural migrant populations, and help to improve the income level of low-income groups such as those in rural areas, narrowing the income gap. Entrepreneurial activities also strengthen scientific and technological innovation ability by stimulating the development of the private economy, providing strong support for the government to give full play to the redistribution of wealth and the rational allocation of income, and providing a suitable environment for realizing rural CP.

Based on the TOE analysis framework, we build a theoretical model framework of rural CP (see Fig. 5).

4. Research design

4.1. Research methods

Using panel data, this paper chooses the method of combining NCA and fsQCA to explore the configuration path to improve China's rural CP. The main reasons are as follows: First, to reveal the path for improving China's rural CP, traditional regression analysis of the independent or two-way interaction of various factors has failed to meet the requirements. FsQCA can reveal the combination of causes for generating outcome variables and the interaction between internal generating factors, and it can then be used study the mechanism of the impact of multiple factors on CP from the overall perspective [44]. Second, the path of CP improvement is diverse, and the traditional regression method, which seeks a balanced and unique solution, cannot provide a full explanation [45]. The complete equivalence of fsQCA solutions can generate multiple causal chains that lead to the same result. Through in-depth analysis of the linkage effect of numerous factors, we can find a variety of paths for high CP that conform to the law of development. Third, NCA can determine the necessary conditions under on which each antecedent variable belongs to the outcome variable, effectively compensating for the shortcomings of fsQCA in essential condition analysis.

4.2. Measurement and calibration of the variables

4.2.1. Measurement of the variables

Result variable. Common prosperity (CP). This paper uses the entropy weight TOPSIS method to measure China's rural CP index as the result variable.

Technological level. Digital economy: Following the approach of Li et al. (2023) [46], the digital economy indicators of provinces are selected as antecedent variables at the technological level. Specifically, this level includes digital services (SER), expressed in terms of the mobile phone penetration rate (unit/100 people), digital facilities (FAC), and the optical line length (10,000 km).

Organizational level. The antecedent variables at the organizational level mainly include the urbanization rate (URBAN) and rural human capital (EDU). Specifically, referring to the research of previous scholars, this article uses the proportion of the urban population to the total population to measure the urbanization rate [47,48], and it uses the average years of education of rural residents to represent rural human capital [30]. The proportion of the labor force with different levels of education among rural residents is multiplied by the corresponding years of education to obtain the average years of education for rural residents. Based on the current educational system in China, the per capita length of education is calculated based on the number of years of education received. The educational levels of illiterate and semi-illiterate individuals, those with a primary school education, those with a junior high school education, those with a high school education and a vocational school education, and those with a higher educational level are calculated as 0 years, 6 years, 9 years, 12 years, and 16 years, respectively.

Environmental level. This article sets the antecedent variables from two perspectives: the natural and entrepreneurial environments. The natural environment is represented by environmental regulation (ENVI), and the measurement of environmental regulation by scholars in China and elsewhere can be mainly divided into the following aspects. First, environmental regulation is measured using a single indicator, including environmental regulatory standards, discharge fees, environmental supervision, pollution control effectiveness, pollution emission intensity, and pollution control expenditures [49,50]. Second, composite indicators are used to measure the intensity of environmental regulation. For example, Aiken and Pasurk [51] used dual indicators of environmental investment and sulfur dioxide emissions to measure environmental regulation. Third, there are comprehensive exponential-type indicators. Xu and Song [52] used basic environmental indicators such as air, water sources, and land collected by the World Bank to evaluate the intensity of environmental regulations in various countries. This article combines the practices of previous scholars [53] and uses the reciprocal of the comprehensive environmental pollution index to measure the intensity of environmental regulation. In general, a region's environmental regulation intensity shows an inversely proportional relationship with its comprehensive environmental pollution index. The lower the comprehensive environmental pollution index is, the higher the intensity of environmental regulation. The comprehensive environmental pollution index is calculated using the average ratio of the emission intensity of industrial sulfur dioxide, industrial wastewater, and industrial smoke (powder) dust to the total pollutant emission intensity. The entrepreneurial environment is represented by entrepreneurial activity (ENTRE), calculated as the proportion of the sum of urban private enterprise employees and self-employed individuals to the total population [54].

4.2.2. Calibration of the variables

A necessary step in set analysis and operation is to convert the initial data of the sample into set membership score data that can reflect the membership relationships between sets. The calibration process determines the degree of membership of each case of the corresponding variables based on the anchor position. This article refers to previous studies and uses the direct calibration method to calibrate the data [55,56] to further analyze intragroup, intergroup, and overall consistency and coverage. This paper sets the 95 % quantile, 50 % quantile, and 5 % quantile as calibration anchors, representing full membership, intersection, and nonmembership, respectively. The specific calibration results are shown in Table 3.

4.3. Sample selection and data sources

This study takes 2013–2019 data covering 31 provincial administrative units in China as samples, and using these panel data, we combine NCA with fsQCA to explore the configuration path to improve China's rural CP under the TOE framework. The data for the antecedent and outcome variables are sourced from the China Statistical Yearbook. To maintain the integrity of the data, we use the moving average interpolation method to fill in some missing data and ultimately obtain 279 observation data points.

5. Analysis of the empirical results

5.1. Analysis of the necessary conditions for a single condition

The NCA method can identify whether the existence of specific elements is a necessary condition for the occurrence of a particular result, and it can also analyze the bottleneck level of the necessary condition, that is, the lowest level of necessary conditions required to produce a certain result [57]. This article uses upper-bound regression (CR) and upper-bound envelope (CE) analysis to generate upper-bound functions and analyze the effects of antecedent conditions. Table 4 shows that from the results of the CE analysis, although the Monte Carlo simulation permutation test of the six antecedents is significant, their effect quantities (d) are less than 0.1, indicating that they are not necessary conditions to lead to rural CP. However, from the CR analysis results, the Monte Carlo simulation permutation test of FAC, ENVI, and ENTRE is nonsignificant, and the effects are all less than 0.1. The CR estimated effect quantities of SER, URBAN, and EDU are 0.167, 0.172, and 0.283, respectively, which are higher than 0.1. Additionally, they pass the Monte Carlo simulation permutation test, indicating that only SER, URBAN, and EDU are necessary conditions for CP when the CR method is used to generate functions.

Table 5 further reports the results of the NCA method bottleneck level analysis. The bottleneck level represents the corresponding level (%) that needs to be met within the maximum observation range of each antecedent condition when reaching a certain level of the maximum observation range of the outcome variable [57]. Table 5 shows that to reach a 40 % level of CP, a 1.7 % level of FAC is needed, and there is no bottleneck in other antecedents. To achieve a 90 % level of CP, a 68.5 % level of EDU, a 42.2 % level of ENTRE, a 17.5 % level of FAC, a 61.1 % level of SER and a 62.6 % level of URBAN are required.

Furthermore, this article tests the necessity of the six antecedent conditions using the QCA method, and the results are shown in Table 6. In the necessity test of leading to high CP, the intergroup adjustment distances of the six antecedent variables are all less than 0.1, and the aggregate consistency is less than 0.9. These results indicate that none of the six antecedent conditions is necessary for generating high CP, which is consistent with the NCA results.

5.2. Sufficiency analysis of conditional configurations

As the core of the QCA method, configuration analysis examines how different combinations of antecedent conditions affect result generation. Next, this paper studies the role of conditional configurations in high CP or low CP through sufficiency analysis. The premise of sufficiency analysis is constructing a truth table, which shows all logically possible condition combinations and results (high CP or low CP). This article mainly has 6 antecedent variables, with $2^6 = 64$ logically possible configurations to consider. Among these 6 antecedent variables, the eigenvalues of the conditional combination are 0 and 1, where 0 represents nonexistent and 1 illustrates the existence of each condition. For observations from province to year, the correlation between a condition's membership score and 0 or 1 is based on strong membership (depending on whether its value is greater than 0.5). Based on previous studies, combined with the

Table 3
Variable calibration.

Variable		Calibration		
		Full membership	Intersection	Nonmembership
Outcome variable	PC	0.436	0.307	0.193
Conditional variables	SER	148.4	102.1	74.5
	FAC	2947668	935322	152329
	URBAN	0.868	0.588	0.422
	EDU	8.87	7.91	6.65
	ENVI	1.67347	0.36434	0.00585
	ENTRE	0.3448	0.1659	0.0907

Table 4
NCA results.

Condition	Method	Accuracy	Ceiling zone	Effect size (d)	P value
SER	CE	100 %	0.091	0.094	0.000
	CR	87.5 %	0.162	0.167	0.006
FAC	CE	100 %	0.033	0.035	0.000
	CR	92.5 %	0.063	0.068	0.175
URBAN	CE	100 %	0.091	0.094	0.000
	CR	87.1 %	0.165	0.172	0.003
EDU	CE	100 %	0.070	0.071	0.000
	CR	84.2 %	0.234	0.283	0.000
ENVI	CE	100 %	0.015	0.016	0.003
	CR	95.7 %	0.030	0.033	0.167
ENTRE	CE	100 %	0.049	0.052	0.000
	CR	94.6 %	0.079	0.085	0.142

Table 5
Bottleneck level (%) analysis results.

CP	EDU	ENTRE	ENVI	FAC	SER	URBAN
0	NN	NN	NN	NN	NN	NN
10	NN	NN	NN	NN	NN	NN
20	NN	NN	NN	NN	NN	NN
30	NN	NN	NN	NN	NN	NN
40	NN	NN	NN	1.7	NN	NN
50	10.7	NN	NN	4.9	NN	NN
60	25.1	NN	NN	8	3.1	3.4
70	39.6	NN	NN	11.2	22.4	23.1
80	54.1	NN	NN	14.4	41.8	42.9
90	68.5	42.2	NN	17.5	61.1	62.6
100	83	86.3	77.8	20.7	80.4	82.4

Note: The CR method is used to obtain data; NN = unnecessary.

Table 6
FsQCA necessity test for individual conditions.

Conditional variable	High CP				Low CP			
	Pooled consistency	Pooled coverage	Consistency adjustment distance between groups	Consistency adjustment distance within a group	Pooled consistency	Pooled coverage	Consistency adjustment distance between groups	Consistency adjustment distance within a group
SER	0.713	0.712	0.052	0.061	0.521	0.595	0.149	0.081
~SER	0.594	0.521	0.059	0.071	0.747	0.748	0.036	0.054
FAC	0.798	0.793	0.024	0.070	0.472	0.536	0.116	0.097
~FAC	0.533	0.469	0.091	0.080	0.817	0.822	0.042	0.037
URBAN	0.714	0.708	0.019	0.066	0.549	0.622	0.103	0.084
~URBAN	0.619	0.546	0.043	0.072	0.742	0.748	0.024	0.060
EDU	0.758	0.692	0.031	0.060	0.576	0.600	0.088	0.085
~EDU	0.562	0.573	0.095	0.072	0.704	0.769	0.036	0.066
ENVI	0.648	0.649	0.044	0.058	0.574	0.657	0.085	0.061
~ENVI	0.657	0.575	0.038	0.048	0.693	0.692	0.021	0.039
ENTRE	0.734	0.702	0.042	0.059	0.561	0.613	0.113	0.077
~ENTRE	0.595	0.542	0.066	0.081	0.728	0.758	0.042	0.060

Note: ~represents "not".

specific situation of this study, in the process of building the truth table, the consistency threshold selected in this paper is 0.9, the frequency threshold is 2, and the proportional reduction in inconsistency (PRI) threshold is 0.75 [55,58], which ultimately covers 279 cases. This article mainly focuses on intermediate solutions and assists with simplified solutions to find the core and edge conditions. Table 7 shows the results of this overall configuration analysis. When the result variable is high CP, the consistency of the overall solution is 0.893, which is greater than 0.75. The intragroup adjustment distance and intergroup adjustment distance of a single configuration are both less than 0.1, indicating that the consistency of the summary has good explanatory power. We think that the three configurations are sufficient conditions to promote the realization of high CP. When the result variable is low CP, there are five configurations.

Table 7
Sufficiency analysis results.

Conditional variable	High-CP			Low-CP				
	H1	H2	H3	NH1	NH2	NH3	MH4	NH5
SER	▲		▲			△		△
FAC	▲	▲	▲	△	△	△	△	
URBAN		▲	▲				△	△
EDU	▲	▲		△				△
ENVI	△	▲	▲			○	○	▲
ENTRE	▲	▲	▲		○			▲
Consistency	0.900	0.908	0.903	0.901	0.919	0.948	0.941	0.914
Coverage	0.350	0.382	0.364	0.621	0.630	0.531	0.520	0.289
Unique coverage	0.088	0.039	0.021	0.032	0.049	0.005	0.005	0.023
Consistency distance within a group	0.029	0.027	0.027	0.039	0.039	0.030	0.025	0.028
Consistency distance between groups	0.034	0.028	0.030	0.036	0.018	0.022	0.029	0.024
Overall PRI	0.762			0.784				
Overall consistency	0.893			0.874				
Overall coverage	0.491			0.772				

Note: ▲ represents the existence of core conditions, △ represents the absence of core conditions, ○ represents the absence of edge conditions, and blank areas indicate that the presence or absence of conditional variables does not affect the outcome variables.

5.3. Results analysis and discussion

5.3.1. Analysis of high configuration results

(1) The consistency of configuration H1 is 0.900, the original coverage is 0.350, and the unique coverage is 0.088 This configuration can explain approximately 35 % of the sample cases and approximately 8.8 % of the provincial and municipal rural high CP cases. Digital services, digital facilities, rural human capital, and entrepreneurial activity have played a core role. This configuration shows that although there are greater restrictions on environmental regulation in provincial and municipal rural areas, under the combined effect of a high level of digital economy development, high rural human capital, and high entrepreneurial activity, China's rural areas can still achieve high CP. First, a series of new formats and models derived from the digital economy have provided a large number of new jobs [59], weakened the barriers to labor mobility, provided more career choices for employees of the primary sector of the economy, driven rural farmers to increase their income and become rich, and helped to consolidate the material foundation of CP [60,61]. Second, the digital economy promotes the transformation of the traditional business operation model and the reconstruction of economic development and income distribution patterns by readjusting the factors and value distribution among market entities [62,63]. The accumulation of rural human capital significantly impacts economic performance by improving labor production efficiency and personal utility levels and promoting technological innovation and progress [64]. Improving labor productivity and human capital policy can help cause wealth creation to form a virtuous circle [65], reduce urban and rural income, and achieve rural CP. CP mainly solves the problem of unbalanced and insufficient regional economic development. Entrepreneurial activity can stimulate the vitality of new industries and formats and provide a new impetus for achieving CP. It can also drive market competition, accelerate resource integration and improve the efficiency of resource allocation. Improving residents' income levels and distribution patterns is an important way to achieve CP. Finally, giving full play to entrepreneurial activity will improve people's livelihoods and promote social equity [66]. Therefore, rural CP will be improved by linking digital technology, rural human capital, and entrepreneurial activity.

(2) The consistency of configuration H2 is 0.908, the original coverage is 0.382, and the unique coverage is 0.039. This configuration can explain approximately 38.2 % of the sample cases and approximately 3.9 % of the provincial and municipal rural high CP cases. Under this configuration, gradually improving digital infrastructure, improving the urbanization level, improving rural human capital, strengthening environmental regulations, and promoting entrepreneurial enthusiasm in all provinces and cities will help China's rural areas achieve high CP. Improvements in digital facilities alleviate barriers such as land, policy, and trade among market participants, promoting cross-regional exchanges and cooperation [67]. They help regions play a role in linkage, achieve common development, and provide a foundation for rural CP. Furthermore, they can enable more long-tail groups to enjoy financial services, ease the financing constraints of all social strata and groups, small and medium-sized enterprises, rural farmers, rural low-income groups, and other long-tail groups, attract more groups to participate in the construction of rural CP, and help to form a good atmosphere of "co-creation, co-construction and sharing" for CP [68]. A high level of urbanization means that the rural labor force is constantly shifting to cities, and the surplus rural labor force is decreasing. It will help speed up the transformation of poor people into middle-income groups, increase the disposable income of rural farmers, narrow the gap in disposable income between urban and rural residents, and enable all people to share in prosperity. Through empirical analysis of the relationship between CP and environmental quality, Boyce [69] found that a lower level of CP is usually accompanied by environmental quality deterioration and increased carbon emissions. When environmental regulations are strong, the benefits that wealthy individuals may derive from natural resources will decrease, reducing the urban–rural income gap. Furthermore, the environmental cost will increase when rich individuals invest. Due to

environmental regulations, they may tend to relinquish some high-quality projects, further compressing their profit space and thus promoting the realization of rural CP.

(3) The consistency of configuration H3 is 0.903, the original coverage is 0.364, and the unique coverage is 0.021. This configuration can explain approximately 36.4 % of the sample cases and approximately 2.1 % of the provincial and municipal rural high CP cases. Under this path, digital services, digital facilities, the urbanization rate, environmental regulations, and entrepreneurial activity play a core role. Similar to the two configurations above, this study confirm that digital technology, the urbanization rate, and other antecedents are essential in achieving rural CP.

5.3.2. High configuration path case analysis

Configuration H1. The representative cases of this configuration path include Jiangsu Province from 2016 to 2017, Shandong Province from 2020 to 2021, and Guangdong Province from 2019 to 2021. In terms of the digital economy, the scale of the digital economy in Jiangsu Province increased from 2.4 trillion yuan in 2016 to 5.1 trillion yuan in 2021, accounting for 11.8 % of China's GDP. The proportion of the scale of the digital economy in Shandong Province's GDP increased from 25.4 % in 2013 to 42.1 % in 2021. In 2019, the National Development and Reform Commission and the Central Cyberspace Administration issued the "Implementation Plan for the National Digital Economy Innovation and Development Pilot Zone", deciding to designate six provinces, namely, Zhejiang, Hebei, Fujian, Guangdong, Chongqing, and Sichuan, as the "National Digital Economy Innovation and Development Pilot Zone" and to initiate the creation of the pilot zone. The rapid growth in the scale of the digital economy and the initiatives of the pilot area have laid the foundation for achieving rural CP.

Regarding rural human capital, Jiangsu Province adheres to the principle of being "problem oriented", implements targeted policies based on rural education issues in Jiangsu, increases training for rural teachers, and comprehensively improves the overall level of rural teachers. Shandong Province has increased financial support; it has strengthened the main responsibility of county-level governments' financial investment, and it adheres to tilting financial investment toward weak areas, rural schools, and vulnerable groups. We need to make a collaborative effort, actively seek support from all sectors of society, and coordinate effective resources to assist in revitalizing rural education. In 2020, Guangdong Province allocated 32.2 million yuan for special funds for educational development and preschool educational development, actively contributing to the government's efforts. These measures guaranteed rural farmers' education and helped achieve CP in rural areas. In terms of entrepreneurial activity, Jiangsu Province has adopted measures such as strengthening entrepreneurship training for migrant workers and other personnel, lowering the threshold for returning home for entrepreneurship, implementing targeted tax and universal fee reduction policies, and strengthening financial support and financial services to stimulate rural farmers' entrepreneurial enthusiasm. Shandong and Guangdong Provinces have also formulated policies for entrepreneurial support, such as tax exemptions, entrepreneurial subsidies, entrepreneurial guarantee loans, and interest discounts. Since 2020, the newly issued entrepreneurial guarantee loans in Guangdong Province have increased yearly, reaching 9.562 billion yuan in 2022. The combined "technological-organizational-environmental" effect of the three provinces and cities above has resulted in rural CP.

Configuration H2. The representative cases of this configuration path include Jiangxi Province from 2019 to 2021 and Liaoning Province from 2017 to 2021. To fully leverage the fundamental and leading role of new digital infrastructure, Jiangxi has carried out a series of major projects around digital infrastructure, integrated infrastructure, and innovative infrastructure, with overall planning and an active layout. Doing so has laid the foundation for developing the digital economy and helped to solve the problem of imbalanced and insufficient development of communication infrastructure for long-tailed groups, such as those in remote rural areas. Urbanization increased from 0.49 in 2013 to 0.62 in 2021, with a growth rate of 25.5 %. In addition, Jiangxi Province has focused on strengthening its investment in rural education, with a cumulative investment of 2.5 billion yuan for renovating educational facilities during the "Tenth Five-Year Plan" period. Based on the idea of "strict control at the source, strict control in the process, and severe punishment for the consequences", air pollution prevention in Jiangxi was comprehensively standardized, the costs of illegality were increased, and the punishment was intensified, which also led to a situation of rural CP.

Liaoning Province has made significant achievements in infrastructure, urbanization, rural human capital improvement, and environmental regulations. As of 2020, the mobile communication and fixed broadband networks in Liaoning Province had achieved 100 % dual coverage in administrative villages. The length of fiber optic cable lines is 1.645 million kilometers, and the gigabit fiber optic network covers various cities. There are 13.312 million fixed broadband access users, with fiber optic broadband users accounting for 95.94 %, which is two percentage points higher than the national average. A total of 304,000 mobile communication base stations have been built and opened, including 25,000 5G base stations to provide strong support for accelerating the "digital butterfly change", comprehensively building a "digital Liaoning intelligent manufacturing province" and realizing rural CP in Liaoning. Urbanization also increased from 0.67 in 2013 to 0.73 in 2021. At the same time, the overall level of education in Liaoning Province steadily improved. "Double High" construction has been vigorously promoted, focusing on building ten high-level vocational colleges and 60 characteristic professional groups, of which 6 colleges have been selected as national-level "Double High Plan" construction units. The construction of high-level universities and advantageous characteristic disciplines has been accelerated, and 13 universities and 110 disciplines have been established, among which 4 universities and 5 discipline groups have entered the national ranks of "Double First Class" construction. To effectively prevent environmental pollution, strengthen environmental supervision and law enforcement, and better protect the ecological environment, Liaoning Province has formulated the "Liaoning Provincial Environmental Protection Regulations" and has taken their implementation as a new opportunity to sincerely implement the five major projects of "blue skies", "clear water", "green mountains", "pure land", and "rural environmental protection". On this basis, Liaoning Province has also achieved rural CP.

Configuration H3. The representative case of this configuration path includes Fujian Province from 2020 to 2021. In 2019, the total digital economy of Fujian Province reached 1.73 trillion yuan, accounting for 40 % of the gross regional product, ranking second in the country in terms of growth rate. At the same time, the digital government service index of Fujian Province ranks first in the country. Digital industrialization is multiplying, and new formats and models of digital industrialization are constantly emerging. Urbanization increased from 0.61 in 2013 to 0.70 in 2021, achieving a growth rate of 14.75 %. In terms of environmental regulation, focusing on the positioning of striving to build a leading demonstration zone that implements Xi Jinping's ecological civilization ideology, we will promote the transformation of environmental governance toward more precise, scientific as well as legal aspects, toward more systematic, integrated, and comprehensive elements, with greater emphasis on the source and green and low-carbon aspects. We will give full play to the overlapping advantages of the national ecological civilization pilot zone, the core area of the 21st-Century Maritime Silk Road and other regions, strengthen the systematic integration of reforms such as the green circular economy, the realization of the value of ecological products, rural CP, and cross-strait integration, and maintain the advantage of ecological environmental innovation as a leading demonstration zone in the country. Regarding entrepreneurial activity, we will actively implement the support policy of "entrepreneurship and innovation", establish platforms, provide services, cultivate subjects, and establish models to promote a continuous improvement in rural "entrepreneurship and innovation". As of 2021, 158 provincial-level rural innovation and entrepreneurship parks (bases) had been announced. These parks and incubation training bases have attracted many returnees to the countryside for entrepreneurship and innovation through factor aggregation, policy integration, and service aggregation. Fujian has achieved rural CP under the linkage effects of a series of policies.

6. Conclusion and suggestions

6.1. Research conclusion

First, this paper takes 31 Chinese provinces as the research object, measures China's rural CP using the entropy weight TOPSIS method, and conducts a horizontal and vertical comparative analysis. Second, using panel data, NCA and fsQCA are used to analyze the linkages and synergistic effect of six antecedents, i.e., digital facilities, digital services, the urbanization rate, rural human capital, environmental regulation, and entrepreneurial activity, on rural CP under the TOE framework. The results reveal the core influencing factors and their interactions that affect rural CP in China from 2013 to 2019. This research shows that (1) from 2013 to 2019, China's rural CP showed a fluctuating upward trend. Rural CP in the eastern region was the highest, the central region was in the middle, and rural CP in the western region was the lowest. The gap in rural CP between regions continued to narrow. (2) China's rural CP has prominent agglomeration characteristics, which are mainly characterized by "high-high" and "low-low" agglomeration. It has positive spatial autocorrelation, no transition changes, and solid spatial stability. (3) The results of NCA and fsQCA show that the digital economy, organizational factors, and environmental factors cannot independently affect rural CP. Only the combined effect of the digital economy, the urbanization rate, rural human capital, environmental regulation, and entrepreneurial activity can drive rural CP. (4) Rural CP has multiple concurrent causal effects, and the effective combination of various factors can improve rural CP under the mechanism where "different paths lead to the same goal". There are three paths for the driving mechanism of high rural CP. "Perfect digital facilities" and "high entrepreneurial activity" are universal in promoting rural CP, indicating that realizing high rural CP requires the support of perfect digital facilities and high entrepreneurial enthusiasm.

6.2. Managerial implications

(1) We can start with the TOE CP element for rural areas. We should actively integrate into the industrial digitalization and innovation ecological network and improve the top-level design of CP by combining its own conditions and resource endowments. Focusing on the internal relationship between different influencing factors and creating a linkage mechanism conducive to rural CP are the key to achieving high rural CP. Additionally, we should emphasize the universal role of digital facilities and entrepreneurial activity in promoting rural CP. The construction of digital facilities such as 5G base stations and broadband in rural areas should be strengthened, the integration mechanism between the digital economy and rural economy should be accurately grasped, and the foundation for the modernization of the rural economy should be laid. We will improve the investment and financing environment needed for entrepreneurial activities, encourage people to start businesses, drive employment through entrepreneurship, stimulate entrepreneurial enthusiasm, increase the proportion of rural farmers' disposable income in the initial distribution, and promote the development process of CP.

(2) The government should pay attention to the coordination and integration of technological, organizational, and environmental factors, explore the diversified paths of digital economy development, organizational relations, and environmental conditions to promote rural CP, and actively formulate preferential policies to improve rural CP. We should accelerate the cultivation and promotion of digital transformation-enabling platforms by strengthening financial support and the collaborative service system. We will intensify efforts to control environmental pollution, practice the value proposition of "harmonious development between humans and nature", and make suggestions for achieving rural CP. We should also objectively understand the advantages and disadvantages of rural areas in various regions and take appropriate policy measures based on the local resource endowment and locational characteristics. We will assist rural areas in breaking through bottlenecks and weaknesses and then solve the "bottleneck" problem in achieving CP in rural areas.

6.3. Limitations and prospects

Although this study has theoretical and methodological advantages, there are also limitations that provide opportunities for meaningful future research. First, we conducted research in a single context, i.e., China, targeting 31 provinces and cities, and the focus on a single national context may not be universal. Moreover, this article focuses only on provincial-level rural areas, and further exploration is needed to determine whether the research conclusions can be extended to the city level. Second, this article screened influencing factors based on the TOE framework. Although there are many variables that have been tested, there may still be factors that have not been considered, such as the policy environment, labor environment, and financial environment. Finally, this study uses second-hand public data and explores only from a macro level. In the future, we need to combine qualitative interviews and participatory observation to further reveal the impact mechanism underlying rural CP at the micro level.

Data availability statement

Data will be made available on request.

CRediT authorship contribution statement

Liang Cheng: Writing – original draft, Resources, Methodology. **Lihua Yang:** Writing – original draft, Validation, Software, Methodology. **Xing Li:** Writing – review & editing, Software, Methodology. **Sheng Xu:** Funding acquisition, Formal analysis, Conceptualization. **Ying Cao:** Supervision, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

[1] W. Guo, B.C. Zhang, Research on the income distribution effect of the misallocation of dua economic, Modern Economic Research 486 (6) (2022) 33–46 (In Chinese).
[2] A. Goldfarb, C. Tucker, Digital economics, J. Econ. Lit. 57 (1) (2019) 3–43.
[3] J. Hjort, J. Poulsen, The arrival of fast internet and employment in Africa, Am. Econ. Rev. 109 (3) (2019) 1032–1079.
[4] G.S. Becker, Investment in human capital: a theoretical analysis, J. Polit. Econ. 70 (5) (1962) 9–49.
[5] J. Tinbergen, The impact of education on income distribution, Rev. Income Wealth 18 (3) (1972) 255–265.
[6] R. Tang, N. Meng, T. Ye, The evolution, practical value and realization path of the thought of common prosperity, Reform 35 (1) (2022) 16–27 (In Chinese).
[7] H. Wan, J. Chen, Theoretical connotation and quantitative measurement of common prosperity, China Finance and Economic Review 11 (2) (2023) 23–45.
[8] E. Zhang, F. Yu, T. Jiang, S. Zeng, D. Wang, Common prosperity level evaluation: a comprehensive method based on probabilistic linguistic ordered weighted distance measure, prospect theory, and TOPSIS, Front. Psychol. 14 (2023), 1152333.
[9] P.S. Heo, D.H. Lee, Evolution of the linkage structure of ICT industry and its role in the economic system: the case of Korea, Inf. Technol. Dev. 25 (3) (2019) 424–454.
[10] R. Ran, X. Wang, T. Wang, et al., The impact of the digital economy on the servitization of industrial structures: the moderating effect of human capital, Data Science and Management 6 (3) (2023) 174–182.
[11] A. Demirgüç-Kunt, R. Levine, Finance and inequality: theory and evidence, Annu. Rev. Financ. Econ. 1 (1) (2009) 287–318.
[12] V. Couture, B. Faber, Y. Gu, et al., E-Commerce Integration and Economic Development: Evidence from China Cambridge, National Bureau of Economic Research, MA, 2018.
[13] G. Zhou, K. Gong, S. Luo, et al., Inclusive finance, human capital and regional economic growth in China, Sustainability 10 (4) (2018) 1194.
[14] R. Anand, M.S. Mishra, M.S.J. Peiris, Inclusive Growth: Measurement and Determinants, International Monetary Fund, 2013.
[15] C.A. Calderon, L. Servén, The Effects of Infrastructure Development on Growth and Income Distribution, *Available at*: *SSRN 625277*, 2004.
[16] Y. Sun, J. Wang, X. Wang, X. Wei, Achieving energy justice and common prosperity through green energy resources, Resour. Pol. 81 (2023), 103427.
[17] L. Chen, Y. Zhang, Does the development of the digital economy promote common prosperity?—analysis based on 284 cities in China, Sustainability 15 (5) (2023) 4688.
[18] J. Zhang, F. Qian, Digital economy enables common prosperity: analysis of mediating and moderating effects based on green finance and environmental pollution, Front. Energy Res. 10 (2023), 1080230.
[19] C. Forman, A. Goldfarb, S. Greenstein, How did location affect adoption of the commercial Internet? Global village vs. urban leadership, J. Urban Econ. 58 (3) (2005) 389–420.
[20] A. Ahmed, A. Al-Roubaie, Poverty reduction in the Arab world: the use of ICTs, World Journal of Science, Technology and Sustainable Development 10 (3) (2013) 195–211.
[21] J. Klugman, F. Rodríguez, H.J. Choi, The HDI 2010: new controversies, old critiques, J. Econ. Inequal. 9 (2011) 249–288.
[22] A.W. Qasim, United Nations development programme (UNDP). Human development report 2013, Pakistan Dev. Rev. 52 (1) (2013) 95–96.
[23] A. Woloszyn, F. Wysocki, Income inequality of Polish rural and urban households in 2010-2017, Annals of the Polish Association of Agricultural and Agrobusiness Economists 22 (1) (2020) 360–368.
[24] D.M. Wright, M. Rosato, G. Raab, C. Dibben, P. Boyle, D. O'reilly, Does equality legislation reduce intergroup differences? Religious affiliation, socio-economic status and mortality in Scotland and Northern Ireland: a cohort study of 400,000 people, Health Place 45 (2017) 32–38.
[25] M. Li, D. Qian, L. Yan, Z. Lin, X. Li, J. Zhang, Research on the construction of the common prosperity communication service index, Information Systems and Economics 3 (5) (2022) 20–27.

[26] X.F. Ma, R. Zhang, Y.F. Ruan, Evaluation of common prosperity level and regional difference based on the background of green development, Sustainability 14 (23) (2022), 15863.
[27] M. Ravallion, Troubling tradeoffs in the human development index, J. Dev. Econ. 99 (2) (2012) 201–209.
[28] S. Zhang, J. Tian, Q. Zhang, Can digital lnclusive finance effectively contribute to common prosperity of rural farmers? Agricultural Economics and Management 78 (2) (2023) 110–122 (In Chinese).
[29] Y. Wang, Z. Huo, D. Li, M. Zhang, Evaluation of common prosperity level and regional difference analysis along the Yangtze River economic belt, Int. J. Environ. Res. Publ. Health 19 (19) (2022), 11851.
[30] Xie, T., Zhang, Y., & Song, X. Research on the spatiotemporal evolution and influencing factors of common prosperity in China. Environ. Dev. Sustain., 1-27.
[31] A.I. Maghsoodi, M. Khalilzadeh, Identification and evaluation of construction projects' critical success factors employing fuzzy-TOPSIS approach, KSCE J. Civ. Eng. 22 (2018) 1593–1605.
[32] X. Guo, X. Sun, Y. Zhai, Analysis of the measurement and spatial and temporal evolution of the upgrading speed of regional industrial structures, Journal of Quantitative & Technological Economics 38 (9) (2021) 98–116 (In Chinese).
[33] L. Anselin, Local indicators of spatial association—LISA, Geogr. Anal. 27 (2) (1995) 93–115.
[34] S.J. Rey, Spatial empirics for economic growth and convergence, Geogr. Anal. 33 (3) (2010) 195–214.
[35] C. Sutter, G.D. Bruton, J. Chen, Entrepreneurship as a solution to extreme poverty: a review and future research directions, J. Bus. Ventur. 34 (1) (2019) 197–214.
[36] B. Ren, Q. Zhang, New requirements and realization paths of high-quality digital lnfrastructure construction in the NewJourney of Chinese-style modernization, Seeking Truth 50 (2) (2023) 48–56 (In Chinese).
[37] R.E. Lucas Jr., On the mechanics of economic development, J. Monetary Econ. 22 (1) (1988) 3–42.
[38] W.A. Lewis, Economic development with unlimited supplies of labour, Manch. Sch. 22 (2) (1954) 139–191.
[39] Z. Huang, J. Zhou, X. Huang, Does the transfer of farmland use rights increase farmers' long-term intention to work in cities? Economics of Transition and Institutional Change 30 (2) (2022) 373–392.
[40] R.H. Bezdek, R.M. Wendling, P. DiPerna, Environmental protection, the economy, and jobs: national and regional analyses, J. Environ. Manag. 86 (1) (2008) 63–79.
[41] W.B. Gray, R.J. Shadbegian, C. Wang, M. Meral, Do EPA regulations affect labor demand? Evidence from the pulp and paper industry, J. Environ. Econ. Manag. 68 (1) (2014) 188–202.
[42] E.L. Glaeser, S.P. Kerr, W.R. Kerr, Entrepreneurship and urban growth: an empirical assessment with historical mines, Rev. Econ. Stat. 97 (2) (2015) 498–520.
[43] F. Noseleit, Entrepreneurship, structural change, and economic growth, J. Evol. Econ. 23 (2013) 735–766.
[44] F. Hernández-Perlines, J. Moreno-García, B. Yañez-Araque, The mediating role of competitive strategy in international entrepreneurial orientation, J. Bus. Res. 69 (11) (2016) 5383–5389.
[45] P.C. Fiss, Building better causal theories: a fuzzy set approach to typologies in organization research, Acad. Manag. J. 54 (2) (2011) 393–420.
[46] X. Li, Y. Qi, G. Zhang, Research on multiple concurrent causality of enterprise lnnovation in high-end equipment manufacturing, Forum on Science and Technology in China 322 (2) (2023) 82–92 (In Chinese).
[47] Q. Wang, J. Lin, K. Zhou, et al., Does urbanization lead to less residential energy consumption? A comparative study of 136 countries, Energy 202 (2020), 117765.
[48] J. Fan, J. Wang, J. Qiu, et al., Stage effects of energy consumption and carbon emissions in the process of urbanization: evidence from 30 provinces in China, Energy 276 (2023), 127655.
[49] R. Li, R. Ramanathan, Exploring the relationships between different types of environmental regulations and environmental performance: evidence from China, J. Clean. Prod. 196 (2018) 1329–1340.
[50] X. Li, G. Zhang, Y. Qi, Differentiated environmental regulations and enterprise innovation: the moderating role of government subsidies and executive political experience, Environ. Dev. Sustain. (2023) 1–31.
[51] D.V. Aiken, C.A. Pasurka Jr., Adjusting the measurement of US manufacturing productivity for air pollution emissions control, Resour. Energy Econ. 25 (4) (2003) 329–351.
[52] X. Xu, L. Song, Regional cooperation and the environment: do "dirty" industries migrate? Weltwirtschaftliches Archiv 136 (1) (2000) 137–157.
[53] W. Wang, Environmental regulation, spatial spillover and regional industrial competitiveness, China Popul. Resour. Environ. 23 (8) (2013) 123–130 (In Chinese).
[54] T. Zhao, Z. Zhang, S. Liang, Digital economy, entrepreneurship, and high-quality economic development: empirical evidence from urban China, Journal of Management World 36 (10) (2020) 65–76.
[55] M.J. Guedes, V. da Conceição Gonçalves, N. Soares, M. Valente, UK evidence for the determinants of R&D intensity from a panel fsQCA, J. Bus. Res. 69 (11) (2016) 5431–5436.
[56] Z. Gao, D. He, S. Niu, On what could Chinese mining enterprises achieve high-level environmental performance?—based on the fsQCA method, Int. J. Environ. Res. Publ. Health 18 (14) (2021) 7290.
[57] Y.Z. Du, Q.C. Liu, J.Q. Cheng, What kind of business environment produces high entrepreneurial activity in cities: analysis based on system configuration, Journal of Management World 36 (9) (2020) 141–155 (In Chinese).
[58] A.G. Woodside, Moving beyond multiple regression analysis to algorithms: calling for adoption of a paradigm shift from symmetric to asymmetric thinking in data analysis and crafting theory, J. Bus. Res. 66 (4) (2013) 463–472.
[59] P. Hukal, O. Henfridsson, M. Shaikh, G. Parker, Platform signaling for generating platform content, MIS Q. 44 (3) (2020) 1177–1205.
[60] D. Acemoglu, P. Restrepo, The race between man and machine: implications of technology for growth, factor shares, and employment, Am. Econ. Rev. 108 (6) (2018) 1488–1542.
[61] J. Zhou, X. Fan, Y.J. Chen, C.S. Tang, Information provision and farmer welfare in developing economies, Manuf. Serv. Oper. Manag. 23 (1) (2021) 230–245.
[62] G. Han, Z. Zhang, W. Shao, et al., Research on the lnfluence of digital economy on common prosperity: from the perspective of lndustria structure upgrading, Journal of Technology Economics 42 (5) (2023) 104–118 (In Chinese).
[63] H. Rees, A. Shah, An empirical analysis of self-employment in the UK, J. Appl. Econom. 1 (1) (1986) 95–108.
[64] R. Barro, J.R. Barro, Three Models of Health and Economic Growth, Harvard University Working Paper, 1996, pp. 623–635.
[65] D.E. Bloom, D. Canning, J.P. Sevilla, Economic Growth and the Demographic Transition, 2001.
[66] Y. Yang, Y. Zhang, Digital inclusive finance, entrepreneurial vitality and common prosperity, Journal of South-Central Minzu University (Humanities and Social Sciences) 43 (6) (2023) 129–138 (In Chinese).
[67] D. Yu, L. Yang, Y. Xu, The impact of the digital economy on high-quality development: an analysis based on the national big data comprehensive test area, Sustainability 14 (21) (2022), 14468.
[68] Han, L., Peng, Y., & Meng, Q. Digital lnclusive finance, entrepreneurial activity and common wealth–an empirical study based on inter-provincial panel data in China. Soft Sci., 37(3), 18-24.
[69] J.K. Boyce, Economic inequality and environmental quality: evidence of pollution shifting in Russia, PERI Working Papers (2010) 189.

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