Postprint: Spatio-temporal Differentiation Patterns and Driving Factors of County-level Common Prosperity in Ningxia

Authors: Wang Xin, Zheng Fang, He Lingyao, He Haoliang, HOU Ying

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Abstract

Gradual realization of common prosperity constitutes the pathway and objective of Chinese-style modernization. As fundamental units of urban-rural integrated development, counties hold significant importance for advancing common prosperity. Based on panel data of Ningxia counties from 2006 to 2022, this study constructs a comprehensive evaluation index system for county-level common prosperity and employs exploratory spatial data analysis, Theil index, and benchmark regression analysis to investigate the spatiotemporal differentiation patterns and driving factors of common prosperity levels in Ningxia counties. The results indicate: (1) From 2006 to 2022, the overall level of common prosperity in Ningxia counties demonstrated an upward trend, yet significant growth disparities existed among different regions (northern, central, and southern Ningxia) and across various indicator dimensions. (2) From the perspective of the Theil index, development disparities in common prosperity among Ningxia counties have persisted, though the overall gap is gradually narrowing. Following decomposition of the Theil index, the growth in contribution rate of between-group disparities far exceeds that of within-group disparities. (3) The overall level of common prosperity in Ningxia counties has achieved a transition to higher levels, exhibiting a "block distribution" spatial pattern with pronounced spatial agglomeration characteristics. (4) The common prosperity process in Ningxia counties is relatively slow. Economic level, education level, industrial structure, and infrastructure construction exert positive promoting effects on common prosperity development, whereas urbanization level demonstrates a stage-specific inhibitory effect on advancing common prosperity in Ningxia counties.

Full Text

Preamble

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Research on Spatiotemporal Differentiation Patterns and Driving Factors of Common Prosperity Levels in Ningxia County Areas

WANG Xin[1], ZHENG Fang[1,2], HE Lingyao[1], HE Haoliang[1], HOU Ying[1,2]

[1] College of Geography and Planning, Ningxia University, Yinchuan 750021, Ningxia, China

[2] Ningxia (China-Arab) Key Laboratory of Resource Assessment and Environment Regulation in Arid Region, Yinchuan 750021, Ningxia, China

Abstract

The gradual achievement of common prosperity represents both the pathway and objective of Chinese-style modernization. As the fundamental unit for urban-rural integrated development, counties play a crucial role in advancing common prosperity. Based on panel data from Ningxia county areas spanning 2006–2022, this study constructs a comprehensive evaluation index system for county-level common prosperity. Employing exploratory spatial data analysis, the Thiel index, and baseline regression analysis, we investigate the spatiotemporal differentiation patterns and driving factors of common prosperity levels in Ningxia counties. The results reveal: (1) From 2006 to 2022, the overall level of common prosperity in Ningxia county areas demonstrated an upward trend, though significant variations existed in growth rates across northern, central, and southern Ningxia, as well as across different index dimensions. (2) According to the Thiel index, disparities in common prosperity development have persisted in Ningxia county areas, yet the overall gap has gradually narrowed. Upon decomposition, the contribution rate of between-group disparities has increased far more substantially than that of within-group disparities. (3) The common prosperity level in Ningxia county areas has undergone a comprehensive transition to higher levels, exhibiting a "patchy distribution" spatial pattern with pronounced spatial agglomeration characteristics. (4) The progression toward common prosperity in Ningxia county areas has been relatively gradual, with economic development, education levels, industrial structure, and infrastructure construction exerting positive driving effects, while urbanization levels have demonstrated stage-specific inhibitory effects on common prosperity advancement.

Keywords: county areas; common prosperity; spatiotemporal pattern; driving factors; Ningxia

Introduction

Common prosperity constitutes the essential requirement of socialism and a critical feature of Chinese-style modernization, wherein "prosperity" serves as

the prerequisite and foundation, and "commonality" represents the mode of social wealth distribution. Following the complete victory in poverty alleviation, achieving common prosperity for all people has become the central task of China' s second centenary goal, with the 14th Five-Year Plan explicitly calling for more tangible substantive progress by 2035. Common prosperity encompasses multiple spatial scales, and counties, as entry points for urban-rural integrated development, represent key units for achieving socialist modernization and hold significant importance for promoting common prosperity. China has 2,841 county-level administrative units whose economy accounts for approximately 38% of national GDP. In Ningxia, county economies already reach 65.7% of the autonomous region' s total, making vigorous promotion of county-based common prosperity both a practical objective for Ningxia' s socioeconomic development and a crucial strategic measure for achieving common prosperity for all. However, as a less-developed western region, Ningxia still faces challenges including weak economic foundations and a single industrial structure in its pursuit of common prosperity.

Current academic research on common prosperity has been increasing, focusing primarily on two aspects. First, theoretical connotations and measurement of development levels. Common prosperity is a composite, multidimensional, and dynamic concept. Understanding has evolved from initially narrow economic categories to "dual prosperity" in material and spiritual dimensions, and further to encompass political transparency, social stability, and environmental livability. Overall, it can be understood as a gradual process of common prosperity for all people across different time periods and non-homogeneous spaces. Based on these characteristics, existing evaluation index systems are mainly constructed from two dimensions— "commonality (or sharing)" and "prosperity" —with some scholars developing multi-dimensional, multi-level comprehensive evaluation systems. The former approach is generally applied to large-scale studies at the national level, while the latter focuses on city or provincial scales. Measurement methods primarily include single-factor evaluation, comprehensive evaluation, and analytic hierarchy processes. Overall, existing research concentrates on national or provincial scales, neglecting the critical role of county units in advancing common prosperity, and the evaluation index system for county-level common prosperity requires further improvement.

Second, research on driving factors and implementation pathways. Studies on driving factors are relatively rich, focusing on the promoting effects of single-factor frameworks such as culture-tourism integration, digital economy, ecological environmental protection, and education levels, with few discussions on comprehensive influencing factors. Discussions on implementation pathways are relatively unified, with the key lying in resolving imbalanced benefit distribution. As productivity continuously improves and social wealth accumulates, improved distribution policies and mechanisms are urgently needed to narrow income gaps among all residents. Simultaneously, focusing on urban-rural differences and prioritizing farmers and rural areas, enhancing governance capabilities for relative poverty, and implementing more substantial transfer payments to low-income

groups and relatively impoverished populations will ultimately achieve common prosperity for all.

Given that different counties exhibit variations in common prosperity advancement and different factor frameworks operate through distinct mechanisms, how can county-level common prosperity be promoted adaptively? Fundamental research on spatiotemporal differentiation patterns and driving factors is necessary. Therefore, based on existing research gaps, this paper will: (1) Focus on the county scale to construct an adaptive comprehensive evaluation index system for county-level common prosperity, measure development levels in Ningxia county areas, and reveal spatiotemporal differentiation characteristics; and (2) Examine the driving effects of comprehensive factors in common prosperity advancement to provide theoretical support for high-quality economic development in Ningxia counties and scientifically guide the common prosperity process.

1.1 Study Area

This study selects Ningxia' s county-level administrative units as the research area [Figure 1: see original paper]. The study area includes 14 counties (Yongning, Helan, etc.) and 2 county-level cities (Lingwu, Qingtongxia), covering 65.7% of the region' s total land area and 45.7% of its population. The region is divided into three sub-regions: northern, central, and southern Ningxia. Counties such as Helan and Yongning, located near the Yellow River, belong to the northern Yellow River irrigation area; Yanchi and Tongxin counties belong to the central arid zone; and Xiji and Pengyang counties, with complex terrain conditions, belong to the southern mountainous area. Over the past decade, relying on resource endowments and the poverty alleviation strategy, Ningxia' s counties have achieved steady socioeconomic development with significantly improved living standards. However, challenges persist, including large urban-rural gaps, a single industrial structure, and prominent contradictions between socioeconomic progress and ecological environmental protection. Promoting county economic development and achieving common prosperity for all people represent future development priorities.

1.2 Data Sources and Processing

This study uses Ningxia counties as samples, collecting panel data from 2006–2022 to measure and analyze common prosperity development levels. Data sources include the *Ningxia Statistical Yearbook*, statistical data from various cities and counties, and government bulletins. The comprehensive evaluation index is calculated using Excel, exploratory spatiotemporal data analysis employs Geoda, and Thiel index, baseline regression, and robustness tests utilize Stata 16 and ArcGIS 10.6.

1.3 Indicator System Construction

Referencing relevant studies and considering Ningxia' s regional characteristics and data availability, this study adheres to scientific and comprehensive principles to construct a comprehensive evaluation index system comprising 4 dimensions and 18 indicators . The development dimension includes per capita GDP, economic stability, urban-rural employment rates, and regional development disparity coefficients to examine economic development levels and regional coordination during common prosperity advancement. The sharing dimension includes school enrollment numbers at all levels, medical bed numbers, and per capita transportation area to reflect the allocation of infrastructure and public service resources. The sustainability dimension encompasses social, economic, and ecological sustainability, represented by indicators such as overall social labor productivity, per capita disposable income of all residents, and unit GDP industrial waste gas emissions to examine regional sustainable development capacity in achieving common prosperity. Compared with national-level studies, Ningxia county areas have some missing long-term time series data, significantly affecting the selection of environmental sustainability indicators. Therefore, unit GDP industrial waste gas emissions are used as a proxy indicator.

1.4 Methodology

1.4.1 EWM-CRITIC Combination Weighting Method Weight Calculation. The Entropy Weight Method (EWM) allocates weights based on information entropy and primarily considers internal indicator differences. The CRITIC (Criteria Importance Through Intercriteria Correlation) method allocates weights based on indicator variability and conflict, reducing the impact of inter-indicator correlation. Combining both methods balances indicator differences and correlations, improving weight calculation scientificity. Following Wang Fanglei et al., this study employs the EWM-CRITIC combination weighting method to calculate indicator weights.

Comprehensive Index Calculation. The range method standardizes raw data to eliminate magnitude differences and dimensional effects. Based on standardized values and indicator weights, the linear weighted summation method calculates the comprehensive common prosperity evaluation index for each county.

1.4.2 Thiel Index The Thiel index is widely used to measure regional disparities or equity in resource utilization. This method decomposes overall regional disparities into within-group and between-group variations while revealing their contribution rates. This study employs the Thiel index to analyze regional disparities in Ningxia county common prosperity levels. The basic expression is:

$$T = (1/n) \Sigma (yi / y) \ln(yi / y)$$

where T is the regional development Thiel index, n is the number of counties, yi

is the comprehensive common prosperity evaluation index for each county, and y is the mean common prosperity development index for Ningxia counties. Decomposing all counties into three regions (northern, central, southern Ningxia) yields:

$$T = \Sigma k\ Yk \ln(Yk / (nk / n)) + \Sigma k\ Yk\ \Sigma l\ (yl / Yk) \ln((yl / Yk) / (1 / nk))$$

where Yl is the proportion of county l' s common prosperity index to the total sum, Yk is the proportion of the sum of common prosperity indices for counties in region k to the total sum, nk is the number of counties in region k, yl is county l' s common prosperity index in region k, Tbetween represents between-group disparities, and Twithin represents within-group disparities, enabling calculation of the contribution rates of within-group and between-group disparities to the overall Thiel index.

1.4.3 Exploratory Spatial Data Analysis The global Moran' s I examines overall spatial agglomeration characteristics of common prosperity levels in the study area, while the local Moran' s I measures the evolution of spatial agglomeration patterns.

1.4.4 Baseline Regression Model To investigate influencing factors of common prosperity levels in Ningxia counties and referencing relevant studies, this study employs panel data regression analysis and constructs the following baseline regression model:

$$Cop = \lambda + \Sigma\ Xi + Wij \ln(Cop) + u$$

where Cop represents county common prosperity level, λ is the constant term, u is the random disturbance term, Xi represents independent variables, n is the number of independent variables, and Wij is the spatial weight coefficient for independent variables. Since economic levels are closely related to common prosperity, this study adopts an economic distance spatial weight matrix.

2.1 Temporal Evolution Characteristics

2.1.1 Sub-Regional Temporal Evolution

The overall common prosperity level in Ningxia county areas showed stable growth from 2006 to 2022 [Figure 2: see original paper], with the evaluation index increasing from 0.192 to 0.487 at an average annual growth rate of 6.03%. This indicates that since the 11th Five-Year Plan period, Ningxia has prioritized gradual achievement of common prosperity for all people through comprehensive deepening of reforms, poverty alleviation, and high-quality economic development strategies, leading to improved living standards, narrowed regional gaps, and a strong start in common prosperity construction. Examining regional index evolution, all three regions demonstrated upward trends. Northern Ningxia led with its index rising from 0.274 to 0.612; central Ningxia ranked second, increasing from 0.168 to 0.449; and southern Ningxia, constrained by relatively

weak economic foundations and regional development disparities, had the lowest index, growing from 0.145 to 0.378. However, in terms of average annual growth rates, southern Ningxia ranked first, followed by central Ningxia, with northern Ningxia last, demonstrating heterogeneous characteristics between development levels and growth rates in Ningxia counties.

2.1.2 Sub-Dimensional Temporal Evolution

Evaluation values across all dimensions of the county common prosperity index also exhibited growth trends [Figure 3: see original paper]. The development index increased from 0.048 to 0.135, indicating continuously improving productivity levels, wealth growth from social progress, stable regional economic operation, and gradual movement toward coordinated development. The sharing index rose from 0.089 to 0.215, attributable to the victory in poverty alleviation and achievement of the first centenary goal, which enhanced education, healthcare, and public infrastructure resources that have progressively extended to counties and townships, creating a solid foundation for common prosperity advancement. The sustainability index grew from 0.055 to 0.137, reflecting sustained positive development in Ningxia' s county economy and ecological environment during the study period, with continuously improving labor productivity, increasing resident income, effective pollution control, and gradually strengthening sustainable development capacity.

2.1.3 Regional Disparity Evolution Characteristics

The Thiel index reveals not only overall disparities in Ningxia county common prosperity levels but also, through decomposition, the contributions of within-group and between-group disparities. Analysis shows that while regional disparities have persisted, the overall Thiel index decreased from 0.051 to 0.032, indicating gradually narrowing overall gaps in common prosperity levels. Regarding contribution rates, within-group disparity contributions declined from 81.51% to 63.67%, while between-group disparity contributions increased from 18.49% to 36.33%. The significant growth in between-group disparity contributions indicates that narrowing inter-regional gaps is key to addressing common prosperity development disparities in the short term. This aligns with Ningxia' s socioeconomic reality, where large terrain differences between northern and southern regions, coupled with imbalanced economic foundations, resource endowments, and talent structures, have gradually expanded inter-regional development differences. Meanwhile, within regions, similar development paths have initially formed stable coordinated development patterns, continuously reducing Thiel indices.

Examining Thiel index distributions across the three regions reveals that northern, central, and southern Ningxia all show narrowing trends with significant regional differentiation, generally following the pattern: central > northern > southern. Specifically: (1) In northern Ningxia, the primary cause of development disparities lies in resource allocation efficiency and urban-rural develop-

ment differences. Lingwu, Qingtongxia, Helan, and Yongning counties, adjacent to Yinchuan city, can effectively undertake the spillover of non-core functions from the central city, resulting in relatively high economic income and infrastructure investment and high common prosperity indices. By contrast, Pingluo County has experienced narrowing economic development pathways and severe population outflow in recent years, leading to expanding urban-rural gaps and a lower common prosperity index. (2) Central Ningxia' s relatively high Thiel index stems from development differences among its counties. Yanchi County possesses favorable industrial advantages and location conditions, while Tongxin County has achieved remarkable results in green and low-carbon transformation, placing these two counties at the forefront of common prosperity levels. Conversely, Haiyuan County has a small economic aggregate and relatively weak industrial foundation, and Zhongning County, despite its distinctive goji berry industry, has a relatively singular industrial structure, resulting in lower common prosperity indices for these two counties. (3) Southern Ningxia consistently maintains a low Thiel index because the southern mountainous terrain has low accessibility, and counties such as Xiji, Longde, Pengyang, and Jingyuan face similar development challenges, resulting in small development differences and low Thiel indices.

2.2 Spatial Evolution Characteristics

2.2.1 Global Spatial Evolution Characteristics

Selecting 2006, 2014, and 2022 as study time points and classifying common prosperity indices into four levels [Figure 4: see original paper] reveals that Ningxia county common prosperity levels have overall transitioned to higher levels, with spatial evolution showing significant regional heterogeneity and generally presenting a "patchy distribution"pattern. High common prosperity index areas are located in counties adjacent to Yinchuan city, benefiting from open terrain, developed transportation, and substantial capital, technology, and industrial support. Low common prosperity index areas are concentrated in Xiji County and neighboring counties, primarily due to their spatial distance from Ningxia' s central city, limited radiation effects, and constraints from economic foundations and natural conditions in the southern mountainous area. Examining spatial agglomeration characteristics shows that the distribution pattern evolved from random to agglomerated , where counties with high common prosperity levels are adjacent to each other, as are those with low levels. Overall, the spatial dependence of county common prosperity levels has continuously increased, demonstrating significant spatial clustering features.

2.2.2 Local Spatial Evolution Characteristics

Selecting the same time points to examine local spatial agglomeration evolution characteristics [Figure 5: see original paper] reveals that spatial distribution is dominated by homogeneous agglomeration with heterogeneous agglomeration as a supplement. High-high agglomeration counties are mainly distributed in

Helan, Lingwu, and Yanchi, which generally exhibit high economic development levels, coordinated industrial structures, and relatively prosperous living conditions with low spatial differentiation from neighboring counties and similar development states. Low-low agglomeration counties are primarily distributed in Xiji, Longde, Pengyang, and Jingyuan in southern Ningxia, which are in a state of underdevelopment lacking economic vitality, with both their own and neighboring counties' common prosperity levels being low, showing significant homogeneous low-value clustering characteristics. Heterogeneous (low-high and high-low) agglomeration counties show negative spatial correlation, with Haiyuan County as a representative case exhibiting high-low agglomeration features. Located in central Ningxia' s arid zone, Haiyuan County has a relatively high common prosperity index with stable change trends, while surrounding counties such as Xiji and Tongxin have lower development levels, creating a spatial disconnect.

2.3 Driving Factors

2.3.1 Variable Selection

Combining existing research with Ningxia county development realities, this study employs a baseline regression model to analyze driving factors of common prosperity levels. Since socioeconomic elements significantly impact income growth and industrial efficiency in common prosperity advancement, this study selects comprehensive socioeconomic development factors as primary drivers . Following Hausman test and other diagnostics, a two-way fixed effects model is ultimately used for panel data regression analysis.

2.3.2 Baseline Regression

Regression results show that economic level, education level, industrial structure, and infrastructure construction have regression coefficients of 0.483, 0.121, 0.089, and 0.132, respectively, all significant at the 1% level, indicating these four factors positively promote common prosperity level improvement in Ningxia counties. Education level and industrial structure have relatively low regression coefficients, suggesting smaller promoting effects. The possible reasons are that Ningxia counties have relatively scarce educational resources with overall backward education levels, and county leading industries remain primarily agricultural, contributing less to common prosperity advancement. Urbanization level has a regression coefficient of -0.156, significant at the 5% level, indicating that during the study period, increasing urbanization levels in Ningxia counties did not benefit common prosperity development. A possible explanation is that in the early stage of urbanization, large populations migrated from rural and suburban areas, causing high population and industry concentration. However, the "people-land 挂钩" (people-land linkage) policy has not been fully implemented, making it difficult to break the urban-rural dual structure in the short term and resulting in large income gaps, thus exerting stage-specific inhibitory effects on common prosperity development.

Sub-sample regression tests by region show that regression coefficients for northern, central, and southern Ningxia are consistent in direction with the full-sample coefficients , indicating that economic level, education level, industrial structure, and infrastructure construction have positive effects on common prosperity development across different regions, while urbanization level also produces stage-specific inhibitory effects.

2.3.3 Driving Factor Mechanism Analysis

Different driving factors exhibit significant variations in their regulatory effects on Ningxia county common prosperity advancement. (1) **Economic development level.** Economic prosperity serves as the key engine for common prosperity advancement, exerting significant driving effects. From 2006 to 2022, Ningxia' s county economic levels grew steadily, accelerating infrastructure construction, improving public service quality, gradually enhancing living standards, and alleviating poverty and income inequality, thereby effectively promoting county common prosperity. Additionally, economic prosperity facilitates sharing development achievements among all people, narrowing gaps between regions, urban and rural areas, and resident groups, thus accelerating common prosperity for all. (2) **Infrastructure construction.** Imbalanced and insufficient development remains prominent in Ningxia counties. For relatively backward counties, incomplete infrastructure and public service facilities constitute important bottlenecks limiting regional economic development and living standard improvements. Taking southern Ningxia as an example, natural geographical factors have left some counties lacking modern transportation facilities and high-level medical facilities, with insufficient extension from county seats to villages, affecting the common prosperity process. Promoting equalization of basic urban-rural public services, balancing infrastructure construction, and facilitating smooth resource and information flows among regions can create new development opportunities, promote coordinated regional development, and gradually achieve common prosperity for all. (3) **Industrial structure.** A rational industrial structure can improve production efficiency, promote technological innovation and employment, and ensure sustained healthy economic growth, which is crucial for achieving common prosperity. Currently, Ningxia counties show insignificant industrial structure differences, contributing little to common prosperity advancement. However, as new quality productive forces transform, some counties achieving breakthroughs in industrial structure evolution will see enhanced promoting effects on common prosperity development. (4) **Education level.** Education is fundamental to national development and the prerequisite for human capital improvement. Currently, Ningxia' s overall county education level is relatively low, with insignificant promoting effects on common prosperity. However, as education levels improve, human capital quality will be enhanced to better adapt to social development needs and shift resident needs from single material requirements to combined material and spiritual development, driving more industry development and accelerating the common prosperity process. (5) **Urbanization level.** Urbanization

exhibits stage-specific characteristics in promoting common prosperity. In the past, Ningxia' s county urbanization focused on rapid urbanization consuming large land resources and centered on industrialization, causing continuous concentration of population, economy, and industry in urban areas while rural development gradually lost core elements, negatively impacting resources and environment and continuously expanding urban-rural gaps, thus hindering common prosperity advancement. When county urbanization reaches its mid-to-late stage, the new-type urbanization and rural revitalization strategies will cause capital, talent, and industry to flow back to rural areas, effectively driving rural development and narrowing urban-rural economic gaps. At this stage, urbanization level increases will help achieve common prosperity for all.

2.3.4 Robustness Tests

This study selects alternative regression models to test robustness . The direction of each factor' s coefficient remains consistent with baseline regression results, indicating that economic level, education level, industrial structure, and infrastructure construction all positively affect common prosperity development, with economic development level having the most significant impact, and urbanization level also showing stage-specific characteristics. Therefore, the regression results are basically robust.

Conclusions

This study draws the following conclusions: (1) From 2006 to 2022, Ningxia county common prosperity levels were effectively improved. Despite remaining gaps compared with national and eastern regions, Ningxia counties show rapid growth rates, laying a foundation for common prosperity advancement. From a regional growth perspective, the order is northern > central > southern Ningxia; from a dimensional growth perspective, the order is sharing > sustainability > development, indicating that unbalanced and insufficient development constitutes the main challenge facing Ningxia county common prosperity advancement. (2) According to Thiel index decomposition, the overall gap in Ningxia county common prosperity levels is gradually narrowing, but the contribution rate of between-group disparities shows a significant increasing trend. Therefore, the key to resolving common prosperity level disparities in the short term lies in narrowing development gaps among northern, central, and southern Ningxia. (3) From 2006 to 2022, Ningxia county common prosperity levels overall transitioned to higher levels, presenting a "patchy distribution" spatial pattern with significant spatial agglomeration characteristics. High values concentrate in counties adjacent to Yinchuan city, low values concentrate in Xiji and neighboring counties, and Haiyuan County shows heterogeneous agglomeration characteristics due to its transitional location. (4) Economic level, education level, industrial structure, and infrastructure construction positively drive Ningxia county common prosperity advancement, with economic development level having the most significant effect, while education level and

industrial structure have relatively smaller effects. Urbanization level exhibits stage-specific inhibitory characteristics. (5) Compared with central and eastern provinces, Ningxia' s county common prosperity process is relatively slow, requiring priority improvements in overall economic development levels, infrastructure expansion, accelerated new-type urbanization, optimized county industrial structures, and increased education investment and quality. Additionally, enhanced cooperation and connectivity with the Yellow River "Ji" character bay metropolitan area and the Yellow River basin are needed to promote coordinated regional development and opening-up.

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Note: Figure translations are in progress. See original paper for figures.