Spatial Evolution and Impact Mechanism of High-Quality Development in China' s Ethnic Regions (Postprint)

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Abstract

Achieving high-quality development in ethnic minority areas holds great significance for promoting coordinated regional development and comprehensively building a modern socialist country. This study takes the eight provincial-level ethnic minority regions as the research area, constructs an evaluation index system for high-quality development in these regions, and employs methods such as the entropy-weighted TOPSIS method and geographical detector to examine the spatial evolution patterns and influencing mechanisms of high-quality development from 2000 to 2020. The results demonstrate that: (1) From 2000 to 2020, the overall level of high-quality development in ethnic minority areas maintained an upward trajectory. From the perspective of spatial differentiation, the inter-regional distribution exhibits a pattern of "high in the Northwest, low in South China-Southwest-Qinghai-Tibet," the inter-provincial distribution shows a "high in the north, low in the south" pattern, and the intra-provincial distribution demonstrates a pattern of "coexistence of polarization and equilibrium." (2) The growth rate of high-quality development in ethnic minority areas evolved from a distribution pattern of "high in the Northwest-Southwest, low in Qinghai-Tibet-South China" to one of "high in the Southwest-Qinghai-Tibet, low in South China-Northwest" during 2000–2020. (3) The spatial evolution types of high-quality development shifted from being dominated by "low-level-low-growth, low-level-medium-growth, and medium-level-low-growth" categories to being dominated by "low-level-medium-growth, low-level-high-growth, and medium-level-medium-growth" categories between 2000 and 2020. (4) The level of high-quality development in ethnic minority areas is most strongly influenced by investment intensity, followed by income level and government regulation.

Full Text

Spatial Evolution and Influencing Mechanism of High-Quality Development in Ethnic Minority Areas of China

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Abstract

Achieving high-quality development in ethnic minority areas of China is essential for promoting coordinated regional development and building a modern socialist country. This study constructs an evaluation index system for high-quality development in ethnic minority areas, taking eight ethnic provinces and autonomous regions as the research area. Using the entropy-weighted TOPSIS method, geographical detector, and other analytical methods, we examine the spatial evolution patterns and influencing mechanisms of high-quality development in these areas from 2000 to 2020. The results show that: (1) The overall level of high-quality development in ethnic minority areas maintained an upward trend during the study period. From a spatial differentiation perspective, the inter-regional distribution shows a pattern of "high in Northwest China, low in South China, Southwest China, and the Qinghai-Tibet region"; the inter-provincial distribution exhibits "high in the north, low in the south"; and the intra-provincial distribution demonstrates a pattern of "coexistence of polarization and equilibrium." (2) The growth rate of high-quality development evolved from a pattern of "high in Northwest and Southwest China, low in the Qinghai-Tibet region and South China" to one of "high in Southwest China and the Qinghai-Tibet region, low in South and Northwest China." (3) Based on high-quality development level and growth rate, the spatial evolution types shifted from being dominated by "low-level low-growth, low-level medium-growth, and medium-level low-growth" types to being dominated by "low-level medium-growth, low-level high-growth, and medium-level medium-growth" types. (4) Investment intensity exerts the greatest influence on the level of high-quality development in ethnic minority areas, followed by income level and government regulation, while education level has the smallest effect, and natural environment factors remain consistently insignificant.

Keywords: ethnic minority areas; high-quality development; spatial evolution; geographic detector; influence mechanism

1. Introduction

The report of the 20th National Congress of the Communist Party of China explicitly states that "high-quality development is the primary task in building a modern socialist country" and that "achieving high-quality development is an essential requirement of Chinese modernization." In recent years, with

strong state support, the eight ethnic provinces and autonomous regions (Inner Mongolia, Ningxia, Xinjiang, Qinghai, Tibet, Yunnan, Guizhou, and Guangxi, hereinafter referred to as "ethnic areas") have experienced sustained rapid growth in per capita GDP, with an average annual growth rate of 12.75% from 2000 to 2020, significantly exceeding the national average. However, due to multiple coexisting challenges including harsh natural geographical conditions, lagging infrastructure, and weak economic foundations, the economic development level of ethnic areas remains far below that of developed eastern regions. Consequently, ethnic areas represent key regions for advancing China's high-quality development, playing a critical role in narrowing regional development gaps and achieving common prosperity.

High-quality development has been a hot topic in academic research. Early studies focused on the connotation and characteristics of high-quality development, target requirements, and strategic pathways, while scholars have also examined measurement methods and spatiotemporal evolution characteristics, as well as influencing mechanisms and path selection. Ethnic areas are characterized by vast territories, diverse social cultures, and unbalanced development in terms of economic level, urbanization, technological innovation capacity, and openness to the outside world. Therefore, there is an urgent need to clarify the internal spatial differentiation and influencing mechanisms of high-quality development in these areas to promote tailored and region-specific advancement. At the 2021 Central Conference on Ethnic Affairs, General Secretary Xi Jinping emphasized that "ethnic areas should base themselves on resource endowments, development conditions, and comparative advantages to identify entry points and focal points for grasping the new development stage, implementing new development concepts, integrating into the new development pattern, achieving high-quality development, and promoting common prosperity."

Existing research on high-quality development in ethnic areas has primarily focused on single dimensions such as economic development, urbanization construction, ecological civilization, or characteristic industries, with relatively few comprehensive studies. Moreover, most analyses have approached the issue from economics or management perspectives, with limited in-depth examination from a geographical perspective on spatial differentiation characteristics and influencing mechanisms. To address this gap, this study constructs a high-quality development evaluation index system based on the "innovation, coordination, green, openness, and sharing" framework. Using the entropy-weighted TOPSIS method and geographical detector, we analyze the spatial patterns and influencing mechanisms of high-quality development across 88 prefecture-level administrative units in ethnic areas from 2000 to 2020, aiming to fully grasp the spatial differentiation patterns and provide robust decision-making support for promoting high-quality development in ethnic areas through region-specific and classification-based approaches.

2. Methods

2.1 Study Area

This study focuses on eight ethnic provinces and autonomous regions (Inner Mongolia, Ningxia, Xinjiang, Tibet, Guangxi, Yunnan, Guizhou, and Qinghai) and their 88 prefecture-level administrative units. Following Fang Chuanglin et al.' s comprehensive regionalization of human geography in China, we further subdivide ethnic areas into four major regions: Northwest ethnic areas (Xinjiang, Inner Mongolia, and Ningxia), Qinghai-Tibet region (Qinghai and Tibet), Southwest ethnic areas (Yunnan and Guizhou), and South China ethnic areas (Guangxi). The study area excludes four prefecture-level cities directly under autonomous region jurisdiction: Shihezi, Alar, Tumushuke, and Wujiaqu.

2.2 Data Sources

Socioeconomic data were obtained from the *China City Statistical Yearbook*, *China Regional Economic Statistical Yearbook*, *China Urban Construction Statistical Yearbook*, various provincial and regional statistical yearbooks, national economic and social development statistical bulletins, and the official website of the National Intellectual Property Administration. Geographic information base data were sourced from the Earth System Science Data Sharing Platform.

2.3 Methodology

2.3.1 Evaluation Index System for High-Quality Development in Ethnic Minority Areas Based on the scientific connotation of high-quality development in ethnic minority areas and following principles of scientific rigor, systematic comprehensiveness, feasibility, data accessibility, operability, and objectivity, we constructed an evaluation index system comprising five dimensions: "innovation, coordination, green, openness, and sharing," with a total of 20 indicators (Table 1). The entropy method was used to determine indicator weights.

2.3.2 TOPSIS Comprehensive Evaluation Method The TOPSIS method, also known as the Technique for Order Preference by Similarity to Ideal Solution, is commonly used for multi-attribute, multi-objective decision-making. The fundamental approach involves determining positive and negative ideal values for each indicator, then calculating the distance of each indicator to these ideal values to determine the proximity to the ideal state, thereby ranking regional development levels. TOPSIS can precisely reflect development gaps between regions.

2.3.3 Classification of High-Quality Development Evolution Types This study uses two indicators—high-quality development level and growth rate—to classify development into nine types for comprehensive analysis of current characteristics and future potential (Figure 1). High-quality development levels

are divided into three intervals (low, medium, and high) based on two thresholds (α and β). High-quality growth rates are divided into three categories (low, medium, and high growth) based on two thresholds (γ and δ).

[Figure 1: see original paper]

2.3.4 Geographical Detector The geographical detector is a tool for detecting spatial differentiation of geographic phenomena, comprising four modules: factor detection, interaction detection, risk zone detection, and ecological detection. Factor detection measures the explanatory power of factor X on comprehensive index Y by comparing the cumulative variance of each sub-region with the variance of the entire study area, making it suitable for exploring influencing mechanisms.

3. Results

3.1 Spatial Evolution Characteristics of High-Quality Development

3.1.1 Spatial Distribution Characteristics To analyze spatial distribution characteristics, we used the natural breaks method to classify high-quality development levels into five categories: low, low-medium, medium, medium-high, and high. From 2000 to 2020, the overall development level of prefecture-level administrative units in ethnic areas showed an upward trend, with average annual growth rates of 10.54% (2000–2010), 14.00% (2010–2020), and 17.64% (2000–2020). The development level evolved from being dominated by "low and low-medium levels" to being dominated by "low-medium and medium levels."

From an inter-regional perspective, the spatial distribution showed a pattern of "high in Northwest China, low in South China, Southwest China, and the Qinghai-Tibet region"from 2000 to 2020, with regional differences first increasing then decreasing. From an inter-provincial perspective, the distribution exhibited a "high in the north, low in the south" pattern, with provincial differences also first increasing then decreasing. From an intra-provincial perspective, the distribution demonstrated a pattern of "coexistence of polarization and equilibrium," with Inner Mongolia showing a "polarization" trend while other provinces showed "equilibrium" development.

3.1.2 Spatial Evolution Characteristics To further analyze spatial evolution characteristics, we used the natural breaks method to classify high-quality growth rates into five categories: low, low-medium, medium, medium-high, and high growth. The growth rate pattern evolved from "high in Northwest and Southwest China, low in the Qinghai-Tibet region and South China" to "high in Southwest China and the Qinghai-Tibet region, low in South and Northwest China."

Specifically, during 2000–2010, Northwest ethnic areas were dominated by high and low-medium growth levels; Southwest ethnic areas by medium-high and low-

medium growth; the Qinghai-Tibet region by medium and low-medium growth; and South China ethnic areas by medium, low-medium, and low growth. During 2010–2020, Southwest ethnic areas were dominated by high and medium-high growth; the Qinghai-Tibet region by medium growth; and South China ethnic areas by low-medium and low growth, while Northwest ethnic areas showed low-medium and low growth.

3.2 Evolution Type Characteristics of High-Quality Development

Based on high-quality development level and growth rate, we classified spatial evolution types for ethnic areas from 2000 to 2020. Using the natural breaks method, we determined thresholds α and β for development level (0.1575 and 0.2058) and thresholds γ and δ for growth rate (0.0753 and 0.1193). The results show that evolution types shifted from being dominated by "low-level low-growth, low-level medium-growth, and medium-level low-growth" to being dominated by "low-level medium-growth, low-level high-growth, and medium-level medium-growth" (Table 2).

The four major ethnic regions also showed distinct spatial evolution patterns (Figure 2). The Qinghai-Tibet region evolved from being dominated by "low-level medium-growth" to "low-level high-growth" types. Southwest ethnic areas shifted from "low-level low-growth and low-level medium-growth" to "low-level medium-growth and medium-level medium-growth" types. South China ethnic areas consistently remained dominated by "low-level medium-growth" types. Northwest ethnic areas transitioned from "low-level medium-growth, medium-level medium-growth, and low-level low-growth"to being dominated by "low-level low-growth and high-level low-growth" types.

[Figure 2: see original paper]

3.3 Influencing Factors of High-Quality Development

3.3.1 Selection of Influencing Factors Drawing on existing research and considering the actual conditions of ethnic areas, we selected five categories of factors: natural environment, government regulation, income level, education level, and investment intensity. Specific indicators include population density (X_1), per capita fiscal expenditure (X_2), per capita employee wages (X_3), proportion of higher education teachers (X_4), and per capita total social fixed asset investment (X_5).

3.3.2 Factor Detection Analysis Using the geographical detector, we analyzed the influence of these factors on spatial differentiation of high-quality development. Except for population density, all factors passed significance tests at the 1% level, indicating they significantly influence spatial differentiation (Table 3). Overall, investment intensity has the greatest impact on high-quality development, followed by income level and government regulation, while education level has the smallest effect.

To examine core influencing factors in different periods, we conducted separate analyses for 2000–2010 and 2010–2020 (Table 4). The results show that government regulation, income level, education level, and investment intensity all exhibited decreasing influence over time, reflecting increasing equilibrium of these factors across ethnic areas. The coefficient of variation for high-quality development across prefecture-level administrative units decreased from 0.42 (2000) to 0.38 (2010) and further to 0.34 (2020), indicating narrowing regional disparities.

The influence of these factors varied significantly across periods. Per capita total social fixed asset investment consistently remained the primary influencing factor, though its impact declined as infrastructure improved. The proportion of higher education teachers became the second most important factor during 2010–2020, with influence nearly equal to investment intensity. Per capita fiscal expenditure and per capita employee wages showed continuously decreasing influence, while population density became insignificant after 2010.

3.3.3 Spatial Differentiation Mechanisms The core influencing factors differed across the four major ethnic regions (Table 5). Per capita fiscal expenditure, per capita employee wages, and per capita total social fixed asset investment were common main factors across all regions. The proportion of higher education teachers had relatively weak influence, while population density was insignificant in all regions. For Southwest ethnic areas, per capita employee wages were the primary factor ($q = 0.78$), while per capita total social fixed asset investment was the main factor for South China, Northwest, and Qinghai-Tibet regions ($q = 0.82$, 0.79, and 0.71, respectively).

Based on these findings, we constructed a framework for spatial differentiation mechanisms of high-quality development in ethnic areas (Figure 3). Overall, investment intensity represents the core influence, followed by income level, government regulation, and education level, with natural environment having minimal impact. The relative influence of these factors has also changed over time, with education level' s impact gradually strengthening while government regulation, income level, and investment intensity have relatively weakened.

[Figure 3: see original paper]

Investment intensity is the core driver of spatial differentiation. By increasing investment in infrastructure and public services, ethnic areas can provide strong support for high-quality development. Although regional differences in investment intensity have narrowed, it remains the most influential factor, particularly in South China ethnic areas.

Income level is an important influencing factor. Rising incomes improve living standards and welfare, stimulate industrial efficiency and technological advancement, and optimize industrial structures. As income levels across ethnic areas have risen and become more balanced, the relative influence of income on spatial

differentiation has gradually weakened, though it remains strongest in Southwest and South China ethnic areas.

Education level is an emerging influence. In innovation-driven modernization, most ethnic areas face challenges of single industrial structures and shortages of high-quality talent. Improving education helps cultivate skilled personnel, optimize innovation environments, and enhance technological innovation capacity. The relative influence of education on spatial differentiation has gradually strengthened, with the strongest impact on the Qinghai-Tibet region due to severe scarcity of higher education institutions.

Government regulation is another important factor. It optimizes resource allocation, balances uncoordinated regional development, and reduces development gaps. As government regulatory capacity has strengthened and become more balanced, its relative influence on spatial differentiation has gradually weakened, with the strongest effect observed in South China ethnic areas.

Natural environment has minimal impact on spatial differentiation. While favorable natural environments can support population agglomeration and provide labor resources for industrial development, natural environmental factors did not show significant driving effects on high-quality development in ethnic areas from 2000 to 2020, indicating that socioeconomic factors dominate.

4. Conclusions and Recommendations

4.1 Conclusions

1) Overall, the high-quality development level of prefecture-level administrative units in ethnic areas maintained an upward trend from 2000 to 2020, evolving from being dominated by "low and low-medium levels" to "low-medium and medium levels." Spatially, the distribution shows "high in Northwest China, low in South China, Southwest China, and the Qinghai-Tibet region" at the inter-regional level; "high in the north, low in the south" at the inter-provincial level; and "coexistence of polarization and equilibrium" at the intra-provincial level.

2) The growth rate of high-quality development exhibited a spatial shift from "high in Northwest and Southwest China, low in the Qinghai-Tibet region and South China" to "high in Southwest China and the Qinghai-Tibet region, low in South and Northwest China."

3) Using development level as the primary classification and growth rate as the secondary classification, spatial evolution types from 2000 to 2020 shifted from being dominated by "low-level low-growth, low-level medium-growth, and medium-level low-growth" types to being dominated by "low-level medium-growth, low-level high-growth, and medium-level medium-growth" types.

4) Investment intensity has the greatest influence on high-quality develop-

ment levels in ethnic areas, followed by income level and government regulation, while education level has the smallest effect and natural environment factors remain consistently insignificant. Moreover, the influencing factors show significant spatiotemporal differentiation.

4.2 Recommendations

Based on our in-depth analysis of spatial differentiation patterns, we propose the following policy recommendations to efficiently and precisely promote high-quality development in ethnic areas through tailored, region-specific, and classification-based approaches:

1) **Enhance investment intensity to substantially improve development levels.** Continued financial investment and policy support from the state and government are essential to further improve infrastructure and public service facilities, providing effective guarantees for high-quality development.

2) **Increase education expenditure and improve the scientific and technological innovation system.** Efforts should focus on cultivating high-quality talent, enhancing regional R&D and innovation capacity, and promoting the transformation and upgrading of traditional industries toward informatization, digitalization, and intelligence.

3) **Promote region-specific and classification-based high-quality development.** Ethnic areas should leverage their resource endowments, development conditions, and comparative advantages to implement new development concepts and cultivate distinctive competitive industries. Northwest ethnic areas should enhance investment intensity, promote industrial transformation and upgrading in resource-based cities, and improve public services in tourism cities. The Qinghai-Tibet region should prioritize education to strengthen innovation capacity and establish modern agricultural and pastoral industrial systems. Southwest ethnic areas should fully exploit their characteristic resources to build modern green industrial systems. South China ethnic areas should emphasize the guiding role of government while leveraging market mechanisms, giving full play to government functions in planning, policy support, market regulation, and legal protection.

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