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A Quantitative Comparative Study on the Quality of Life in Hohhot and Ulaanbaatar: Two Resource - Based Cities in China and Mongolia

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Abstract: ***Against the backdrop of global sustainable development and the Belt and Road Initiative, the Quality of Life (QoL) in resource-based cities serves as a key indicator of their inclusive transformation and the enhancement of residents' well-being. This study selects Hohhot, the capital of China's Inner Mongolia Autonomous Region, and Ulaanbaatar, the capital of Mongolia, as two representative cases. These cities are geographically adjacent, culturally homologous, and economically isomorphic, sharing a deep reliance on animal husbandry and mineral resources. The research aims to construct a comprehensive evaluation index system covering four dimensions: economic affluence, social development, environmental livability, and life convenience. Utilizing official data from the China City Statistical Yearbook, Inner Mongolia Statistical Yearbook, and the National Statistical Office of Mongolia for the period 2015-2022, Principal Component Analysis (PCA) was conducted using SPSS 26.0 software. This method enabled the objective weighting and synthesis of a composite score, facilitating a systematic quantitative comparison and in-depth analysis of the dynamic evolution and structural differences in QoL between the two cities. The findings reveal that: (1) During the study period, Hohhot's comprehensive QoL score was significantly and consistently higher than that of Ulaanbaatar, with the gap showing an expanding trend. This reflects disparities in urban development performance resulting from different developmental stages and varying national governance capacities. (2) The internal driving structures of QoL in the two cities are distinctly different. Hohhot's QoL is primarily driven by the "Economic-Basic Security Factor" and the "Structure-Innovation Factor," highlighting its advantages in industrial upgrading and public services. In contrast, Ulaanbaatar is severely constrained by the dual challenges of insufficient basic economic security and the weakness of the "Environmental Factor." Its relative advantage in the "Culture-Education Factor" is inadequate to offset its overall disadvantages. (3) Despite their different development paths, both cities face typical coordination challenges common to resource-based cities, with environmental livability emerging as a key constraining dimension for both. Through this refined quantitative comparison of transnational, similarly-typed cities, this study elucidates the differentiation mechanism of urban QoL under the interplay of institutional environment, transformation pathways, and resource endowments. It provides an empirical foundation and targeted policy insights for promoting sustainable development and cooperation between Chinese and Mongolian cities in cross-border contexts.***

Keywords: Quality of Life, Resource-based City, Cross-national Comparison, Principal Component Analysis, Sustainable Development.

1. Introduction

Urban development in the 21st century is shifting from a singular pursuit of economic growth speed to a deeper concern for development quality and the comprehensive well-being of residents. The United Nations' 2030 Sustainable Development Goals (SDGs) explicitly call for the creation of "inclusive, safe, resilient, and sustainable cities and human settlements" (SDG 11), marking urban Quality of Life (QoL) as a core element of the global urban agenda (Shen et al., 2017). Within this macro-trend, resource-based cities, whose development trajectories are closely tied to natural resource extraction, often face systemic risks such as a monolithic economic structure, immense ecological and environmental pressures, and a high propensity for social issues. Consequently, their pathways to improving QoL are more complex and emblematic, serving as critical testing grounds for theories of sustainable development (Sun Wei et al., 2020).

China and Mongolia, as important neighboring countries in Eurasia, share not only a lengthy border but also profound connections in terms of natural geography, historical culture, and economic development foundations. Both nations possess vast grassland ecosystems where animal husbandry has been a traditional livelihood. In the process of modernization, Hohhot (the capital of China's Inner Mongolia Autonomous Region) and Ulaanbaatar (the capital and absolute primate city of Mongolia) have both assumed roles as national or regional growth poles. Their economic development and industrial structures are, to varying degrees, marked by resource dependency—Hohhot leverages its advantages as the "Dairy Capital of China" in agricultural resources and its energy and chemical industries; Ulaanbaatar concentrates most of Mongolia's population and economic activities, with its development heavily reliant on mineral exports (particularly coal) and related industries (Tumenqiqige, 2018). This makes the two cities an ideal "natural experiment" pair for conducting cross-national comparative research on cities of similar types.

However, despite their similar foundational conditions, the two cities operate within significantly different national institutional environments, economic development stages, policy regulatory capacities, and modes of engagement with globalization. China is transitioning from high-speed growth to high-quality development, with its new urbanization strategy emphasizing a "people-centered" approach and featuring a series of top-level designs and policy supports for the transformation of resource-based cities (Lu Dadao et al., 2015). Mongolia, as an emerging democracy, sees its economic development heavily impacted by fluctuations in international commodity prices. Its urbanization is characterized by excessive concentration in a "single center," and Ulaanbaatar faces the dual challenges of "urban diseases" and the "resource curse." How are these differences specifically projected onto the quality of life of urban residents? What are the underlying impact mechanisms and key bottlenecks? Existing research still lacks systematic, quantitatively robust answers based on objective data.

In light of this, this study aims to conduct a dynamic and comprehensive quantitative comparison of the urban Quality of Life in Hohhot and Ulaanbaatar. It will achieve this by constructing a scientific and comparable multidimensional evaluation index system, utilizing official statistical yearbook data from both countries for the period 2015-2022, and employing statistical methods such as Principal Component Analysis (PCA). This research seeks to address the following core questions: (1) What are the differences in the comprehensive levels and evolutionary trends of QoL between the two cities? (2) What are the structural driving factors behind these differences? (3) For resource-based cities located within the same grassland ecosystem, what common challenges and differentiated pathways exist for improving QoL? Through the empirical investigation of these questions, this study aspires not only to enrich theoretical research on cross-national urban comparison and resource-based city transformation but also to provide evidence-based decision-making references for practical cooperation between Chinese and Mongolian cities under the framework of aligning the Belt and Road Initiative with Mongolia's Steppe Road program.

2. Literature Review

2.1 Urban Quality of Life: The Multi-Dimensional Concept and Its Measurement Evolution

The concept of Quality of Life (QoL) originated from the social indicators movement of the mid-20th century. Its connotation has undergone a profound evolution, shifting from focusing primarily on objective material conditions (referred to as the "Standard of Living") towards a more integrated perspective that incorporates subjective well-being, now commonly termed "Quality of Life" (Shi Yishao, 2010). Lu Dadao et al. (2015), in their elucidation of China's new-type urbanization, explicitly pointed out that the core of urbanization is the urbanization of "people," with the ultimate goal being to enhance residents' quality of life and happiness. This marks a fundamental shift in the evaluation paradigm for urban development.

In terms of measurement methodologies, the international academic community has developed a landscape where multiple approaches coexist. The Organisation for Economic Co-operation and Development's (OECD) "Better Life Index" encompasses 11 dimensions, including housing, income, employment, education, environment, and health. It emphasizes flexibility and participation by allowing countries to customize weights according to their value preferences. The United Nations Development Programme's (UNDP) "Human Development Index" (HDI) is more concise, comprising only three dimensions (health, education, and income). However, its introduction of the "Inequality-adjusted Human Development Index" (IHDI) better reflects the distributional fairness of well-being. A common feature of these frameworks is their move beyond the dominance of GDP, establishing the principle of multi-dimensional and comprehensive evaluation (Wong, 2015).

Domestic research in China has closely followed international frontiers while also exploring localization based on China's specific national context. Li Qian et al. (2018) systematically reviewed studies on urban quality of life in China, noting that their indicator systems are primarily constructed from areas closely related to residents' daily lives, such as the economy, society, environment, housing, and transportation. Wang Shaojian et al. (2020) further, from a spatial differentiation perspective, revealed the significant impact of public service accessibility, environmental quality, and other factors on intra-urban quality of life disparities. These studies provide direct reference for the selection of dimensions in the indicator system of this research.

2.2 Research on the Development Dilemmas of Resource-Based Cities and Their Association with Quality of Life

Resource-based cities are a key focus in urban geography, regional economics, and sustainable development research. The classic "resource curse" theory posits that abundant natural resources can impede long-term economic growth through mechanisms such as crowding out manufacturing, fostering corruption, and triggering price volatility (Papyrakis & Gerlagh, 2007). At the urban scale, this manifests as follows: periods of resource booms may drive short-term rapid income growth, but they simultaneously lead to rigid industrial structures, fiscal dependency, neglect of human capital investment, and severe ecological degradation. Once resource depletion or price declines occur, cities fall into economic recession, high unemployment rates, intensifying social conflicts, and deteriorating living environments, resulting in an overall decline in quality of life (Lucas, 1971).

Chinese scholars have conducted in-depth empirical research on this issue. Li Jiangsu et al. (2014), through their assessment of the economic vulnerability of resource-based cities in China, found that cities with higher dependence on resource industries exhibit weaker economic systems in resisting external shocks, directly affecting employment stability and residents' income security. Long Ruyin and Chen Hong (2019) conceptualized the economy-environment-society as a composite system, demonstrating that the synergistic evolution of the three is crucial for the sustainable development of resource-based cities; any deficiency in one dimension constrains overall well-being. The coupling coordination study by Sun Wei et al. (2020) further confirms that green transformation is an essential pathway for resource-based cities to overcome environmental constraints and enhance residents' long-term welfare. These studies clearly outline multiple transmission pathways through which resource dependence affects quality of life, providing theoretical foundations for analyzing the differences between the two cities in this research.

2.3 Research Methods and Progress in Cross-National Urban Comparison

Cross-national urban comparison is a vital approach to identifying both universal patterns and specific characteristics of urban development. Early research, constrained by data availability, was predominantly qualitative or descriptive. With the development of global urban databases (such as the UN-Habitat City Prosperity Index and the OECD Metropolitan Database), quantitative comparisons based on standardized indicators have become increasingly prevalent. The study by Nijkamp et al. (2015) demonstrated how methods like Data Envelopment Analysis (DEA) can be applied to compare the service efficiency of European cities across nations. In the Asian context, comparative studies between Chinese cities and those in Southeast Asia, Japan, and South Korea have also gradually expanded.

However, systematic comparative research specifically focusing on cities in China and Mongolia remains scarce. Existing literature predominantly centers on historical, cultural, geopolitical, or macro-economic and trade relations (e.g., Tumenqiqige, 2018). Fine-grained quantitative comparisons from the perspective of internal urban development quality and residents' quality of life remain an academic gap. This precisely highlights the innovative value and necessity of this study.

2.4 Literature Review and Research Positioning

In summary, while existing research provides a solid theoretical and methodological foundation for this study, it also reveals the following directions requiring further expansion:

Specificity of Research Subjects: There is a need to apply universal theories of quality of life and resource-based city transformation specifically to the unique comparative case of "Sino-Mongolian grassland resource-based capitals/principal cities."

Deepening of Data and Methods: It is necessary to overcome transnational data barriers, establish a rigorous and comparable data processing procedure, and employ multivariate statistical methods such as Principal Component Analysis. This approach should not only compare composite scores but also deeply deconstruct the intrinsic drivers of quality of life to reveal the root causes of differences.

Contextualization of Theoretical Dialogue: Research findings must be interpreted within the context of the differing institutional transformations and development paths of China and Mongolia, thereby enriching the theoretical understanding of the interactive relationship between "institutional environment, development path, and quality of life."

Therefore, the positioning of this study is as follows: Based on strictly comparable transnational data and through the construction of a multidimensional indicator system and a principal component analysis model, this research conducts a detailed, "dissecting a sparrow"-style quantitative comparison and mechanism analysis of the quality of life in Hohhot and Ulaanbaatar. The aim is to contribute both to theoretical deepening and practical guidance.

3. Research Methods and Data

3.1 Construction of the Comprehensive Evaluation Index System

Following the principles of scientific, systematicity, comparability, and operability, and drawing on the research of Li Qian et al. (2018) and Wang Shaojian et al. (2020), this study constructs a system comprising 4 primary dimensions, 12 secondary criterion layers, and 24 tertiary specific indicators (Table 1). This system is designed to comprehensively cover the economic foundation, social support, environmental base, and life convenience of urban quality of life.

3.2 Data Sources and Preprocessing

To ensure data authority and comparability, all original data for this study are sourced from official statistical publications.

Hohhot Data: Primarily obtained from the China City Statistical Yearbook (2016-2023 editions), the Inner Mongolia Statistical Yearbook (2016-2023 editions), and the Hohhot Statistical Communiqués on National Economic and Social Development, corresponding to the 2015-2022 annual data.

Ulaanbaatar Data: Primarily obtained from the annual Mongolian Statistical Yearbook published by the National Statistical Office of Mongolia and relevant statistical reports from Ulaanbaatar City, corresponding to the 2015-2022 annual data.

3.3 Analytical Method: Principal Component Analysis (PCA) Model

Principal Component Analysis is a statistical method that transforms a set of potentially correlated variables into a set of linearly uncorrelated variables (principal components) through orthogonal transformation. It effectively reduces dimensionality, eliminates multicollinearity, and objectively weights variables based on their variance contribution (Chen Mingxing et al., 2015). This study employs SPSS 26.0 software to conduct PCA, following these specific steps:

(1) Suitability Test: The Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity are applied to the standardized data matrix. A KMO value greater than 0.7 and a Bartlett's test significance level below 0.01 indicate that the data are suitable for PCA.

(2) Principal Component Extraction: The number of principal components (k) to be extracted is determined based on the eigenvalue-greater-than-one criterion, supplemented by the inflection point observed in the scree plot.

(3) Component Rotation and Naming: The varimax rotation method is applied to the factor loading matrix to polarize the loadings on each principal component toward 0 or 1, thereby facilitating the interpretation of their practical significance. Each principal component is named according to the socioeconomic meaning of the indicators with high loadings (typically with absolute values > 0.7).

(4) Score Calculation and Comprehensive Evaluation:

Calculate the score F_{mi} for each city on each principal component m for each year i.

$$S_i = \sum_{m=1}^{k} w_m \times F_{mi}$$

where $w_m = \frac{\lambda_m}{\sum_{m=1}^{k} \lambda_m}, \lambda_m$, and λ_m is the eigenvalue of the m-th principal component.

By comparing the temporal changes in S_i and the differences between the two cities, the dynamics and gaps in comprehensive quality are assessed. The analysis of the score structure of each principal component reveals the intrinsic driving factors behind these differences.

4. Empirical Results and Analysis

4.1 Principal Component Analysis Process and Results

First, using the 2022 cross-sectional data (two cities, 2 samples, 24 indicators) as an example, the core PCA process is demonstrated. The KMO test value is 0.756, and the significance of Bartlett's test of sphericity is 0.000, indicating that the data are highly suitable for PCA.

Through calculation, the eigenvalues of the first four principal components exceed 1, and their cumulative variance contribution rate reaches 86.41%, which sufficiently represents the information of the original indicators (Table 2). The rotated component matrix is shown in Table 3.

Table 1: Comprehensive Evaluation Indicator System for Urban Life Quality

Target Layer	Primary Dimension	Secondary Criteria Layer	Tertiary Specific Indicators	Unit	Attribute
Quality of Urban Life	A1 Economic Affluence	B1 Economic Level	C1 GDP per Capita	USD	Positive
			C2 Disposable Income per Urban Resident	USD	Positive
		B2 Economic Structure	C3 Share of Tertiary Industry Value-Added in GDP	%	Positive
			C4 Proportion of Employees in Scientific Research and Technical Services	%	Positive
		B3 Employment and Prices	C5 Urban Registered Unemployment Rate	%	Negative
			C6 Consumer Price Index (CPI, previous year = 100)	—	Negative
	Social Development	B4 Population and Health	C7 Natural Population Growth Rate	‰	Moderate*
			C8 Number of Hospital Beds per 10,000 People beds	Per	Positive
			C9 Life Expectancy at Birth	years	Positive
		B5 Education and Culture	C10 Number of College Students per 10,000 People	persons	Positive
			C11 Public Library Collections per Capita	volumes/person	Positive
		B6 Social Security	C12 Basic Pension Insurance Coverage Rate	%	Positive
			C13 Minimum Living Standard Guarantee for Urban Residents	USD/month	Positive
	A3 Environmental Livability	B7 Environmental Quality	C14 Ratio of Days with Good Air Quality	%	Positive
			C15 Per Capita Public Green Space Area	square meters	Positive
			C16 Urban Sewage Treatment Rate	%	Positive
		B8 Environmental Pressure	C17 Energy Consumption per U	nit of GDP tonnes of SCE / 10,000 USD	Negative
			C18 Per Capita Daily Domestic Waste Generation	kilograms	Negative
	A4 Life Convenience	B9 Housing Conditions	C19 Per Capita Housing Floor Area of Urban Residents	square meters	Positive
		B10 Infrastructure	C20 Per Capita Urban Road Area Positive	square meters	Positive
			C21 Number of Public Transportation Vehicles per 10,000 People	standard units	Positive
			C22 Internet Broadband Access User Penetration Rate	%	Positive
		B11 Public Security	C23 Number of Criminal Cases Filed per 10,000 People	cases	Negative
		B12 Leisure Services	C24 Number of Retail, Catering, and Cultural, Sports, NegativeEntertainment Venues per Capita venues	10,000 people	Positive

*Note: The natural population growth rate is set as a moderate indicator, and is transformed to a positive direction by referencing the multi-year average values of the two cities.

Table 2: Principal Component Eigenvalues and Variance Contribution Rates (2022)

Component	Eigenvalue	Variance Contribution Rate (%)	Cumulative Variance Contribution Rate (%)
1	10.18	42.42	42.42
2	5.23	21.79	64.21
3	3.05	12.71	76.92
4	2.28	9.49	86.41

Table 3: Rotated Component Matrix (a) (2022) (Based on Merged Data from Two Cities in 2022)

Indicators (Abbreviation)	Component1	Component2	Component3	Component4
GDP per capita	0.941	0.115	0.198	0.061
Disposable income per capita	0.928	0.173	0.155	0.099
Share of tertiary industry	0.201	0.892	0.11	0.098
Proportion of R&D personnel	0.288	0.923	0.075	-0.041
Urban unemployment rate	-0.872	-0.211	-0.102	-0.188
Number of hospital beds per 10,000 people	0.901	0.22	0.132	0.308
Pension insurance coverage rate	0.855	0.186	0.225	0.166
Number of college students	0.142	0.121	0.962	0.118
Book collection per capita	0.265	0.085	0.935	0.171
Rate of days with good air quality	0.088	0.041	0.162	0.951
Per capita public green space	0.332	0.225	0.198	0.89
Energy consumption per unit of GDP	-0.098	-0.868	-0.143	-0.208
Per capita road area	0.51	0.407	0.423	0.481
Internet penetration rate	0.621	0.455	0.381	0.322

Extraction Method: Principal Component Analysis. Rotation Method: Kaiser Normalization with Varimax. a. Rotation converged after 5 iterations. For brevity, only high-loading indicators (>0.7 or <-0.7) are listed.

Based on Table 3, the principal components are named as follows:

Principal Component 1 (PC1): This component exhibits high positive loadings on indicators such as per capita GDP, per capita income, healthcare resources, and social security, while showing a high negative loading on the unemployment rate. It comprehensively reflects the city's level of economic development, residents' income, and the capacity of basic public service provision. It can be named the "Economic-Basic Security Factor."

Principal Component 2 (PC2): This component shows high positive loadings on the proportion of the tertiary industry and the share of scientific research personnel, along with a high negative loading on energy consumption per unit of GDP. It represents the city's industrial structure advancement, innovation capability, and green efficiency. It can be named the "Structure-Innovation Factor."

Principal Component 3 (PC3): This component exhibits high positive loadings on the scale of higher education and public cultural resources. It reflects the city's level of humanistic development and the reserve of intellectual capital. It can be named the "Culture-Education Factor."

Principal Component 4 (PC4): This component shows high positive loadings on air quality and per capita green space indicators. It directly corresponds to the environmental comfort and ecological livability most perceptible to residents. It can be named the "Environmental Factor."

4.2 Comprehensive Scores and Dynamic Evolution Trends

Based on the aforementioned PCA model, the scores for each principal component and the comprehensive scores for the two cities from 2015 to 2022 were calculated. A trend chart of the comprehensive scores was then plotted (Figure 1).

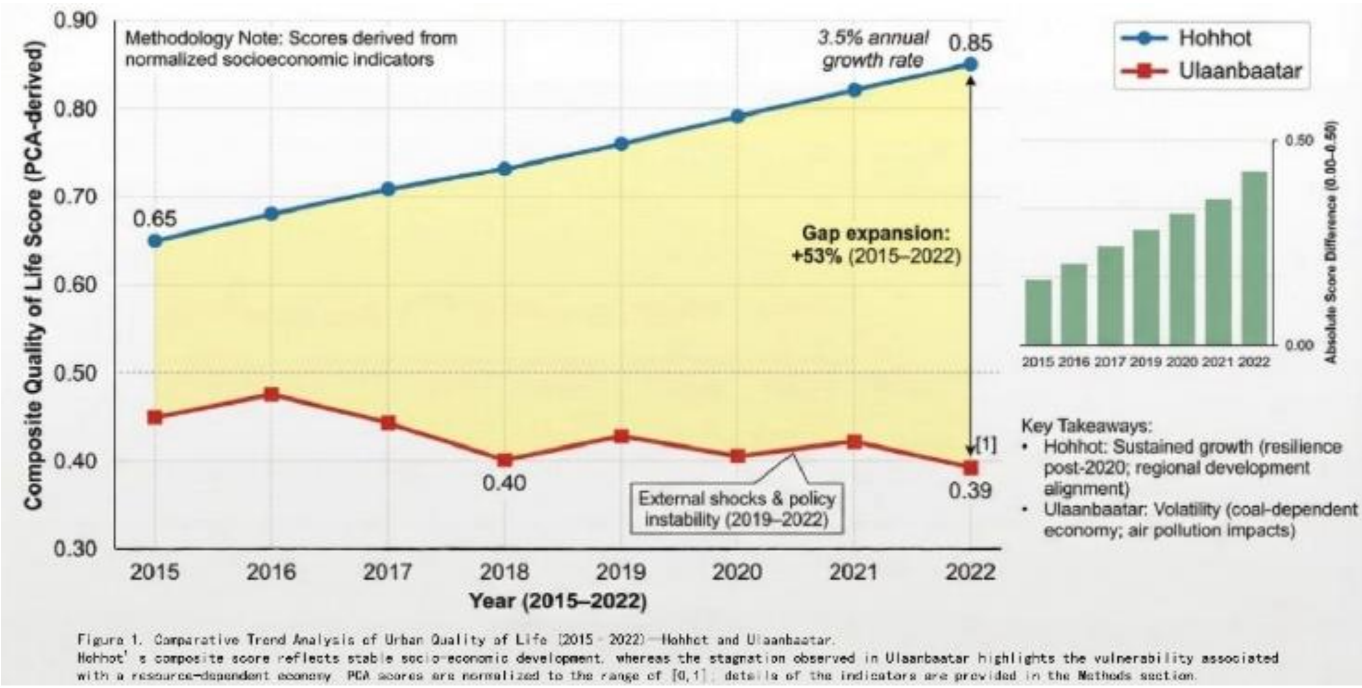

Figure 1: Comparative Trend Analysis of Quality of Life Scores (2015-2022) - Hohhot vs. Ulaanbaatar

Notes: The horizontal axis represents the years (2015-2022), and the vertical axis represents the composite score. The curve representing Hohhot rises steadily from approximately 0.65 in 2015 to around 0.85 in 2022. The curve representing Ulaanbaatar shows slight fluctuations, increasing from about 0.35 in 2015 to around 0.40 in 2018, after which it fluctuates within the range of 0.38-0.42, reaching approximately 0.39 in 2022. There is a clear and gradually widening gap between the two curves.

As shown in Figure 1, throughout the entire study period from 2015 to 2022:

(1) Significant Absolute Gap: Hohhot's composite score consistently and substantially exceeded that of Ulaanbaatar, indicating its overall leading position in urban quality of life.

(2) Marked Divergence in Trends: Hohhot's composite score demonstrated a continuous and robust upward trend, rising from 0.652 in 2015 to 0.848 in 2022, with an average annual growth rate of approximately 3.5%. This aligns with China's phase of high-quality economic development and Hohhot's proactive transformation as a regional central city. Notably, the upward trajectory continued post-2020, demonstrating strong resilience to risks.

(3) Weak Growth in Ulaanbaatar: Ulaanbaatar's composite score remained within a low range (0.35-0.42), fluctuating without showing a clear trend of improvement. A slight increase in its score during 2016-2018 was driven by a temporary recovery in international coal prices, which improved some economic indicators. Subsequently, due to external market volatility, domestic policy uncertainties, and the normalization of severe winter air pollution, the score declined again and stagnated. This confirms its vulnerability to significant external shocks and its lack of endogenous

development momentum (Papyrakis & Gerlagh, 2007).

(4) Persistently Widening Gap: The difference in composite scores between the two cities expanded from approximately 0.30 in 2015 to about 0.46 in 2022, representing a 53% increase in the relative gap. This indicates that, in terms of development momentum, Hohhot is on a more progressive trajectory, while Ulaanbaatar faces challenges of a "low-level equilibrium trap."

4.3 Analysis of Quality of Life Structure via Radar Chart

To deeply analyze the internal structural differences in the quality of life between the two cities, a radar chart depicting their scores on the four principal components for 2022 was drawn (Figure 2).

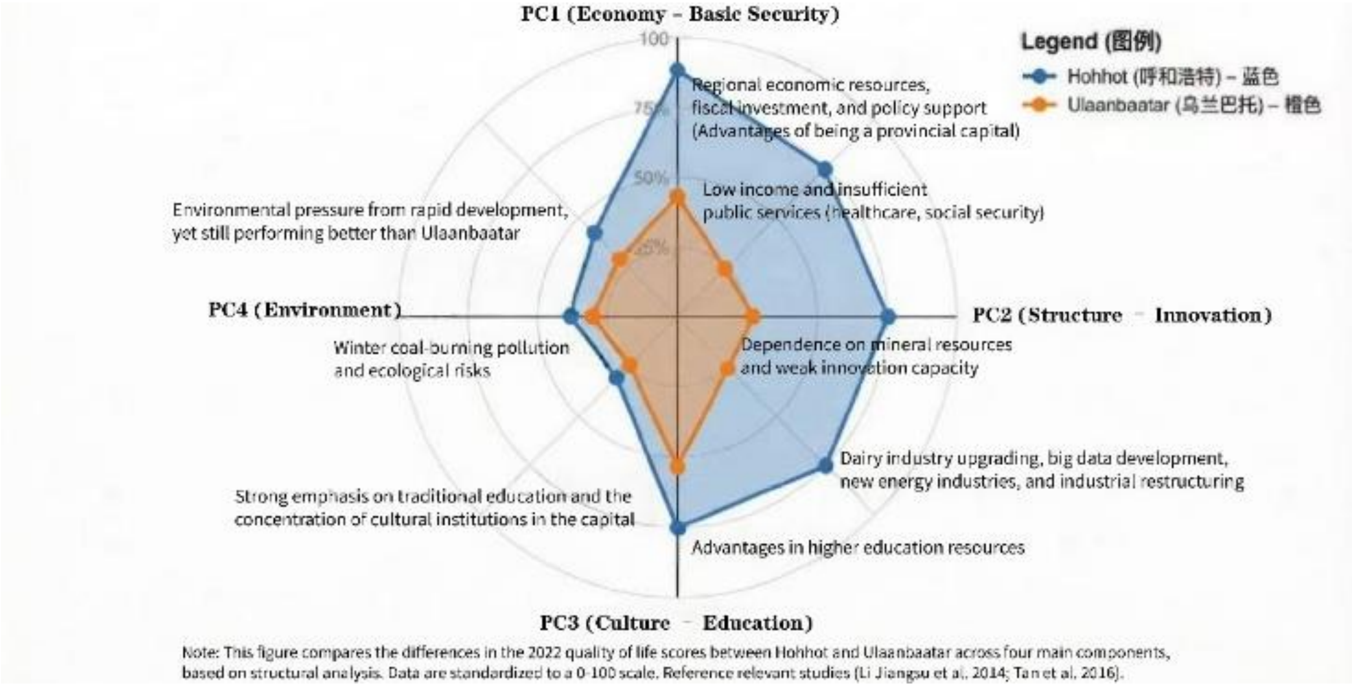

Figure 2: Radar Chart of Principal Component Scores for Quality of Life in Hohhot and Ulaanbaatar (2022)

Notes: Diagram Description: A four-quadrant radar chart where the four axes represent PC1 (Economic-Basic Security), PC2 (Structure-Innovation), PC3 (Culture-Education), and PC4 (Environment). The profile representing Hohhot extends outward significantly on the PC1 and PC2 axes, forming a prominent irregular polygon with a large area. In contrast, the profile representing Ulaanbaatar contracts inward across all axes, particularly on the PC1 and PC2 axes, where it is closest to the center, forming a smaller polygon.

Based on the comprehensive scores and the radar chart, a structural decomposition is conducted:

(1) Hohhot: Comprehensive Development Driven by "Structure-Innovation."

Hohhot holds an absolute advantage in two dimensions: PC1 (Economic-Basic Security) and PC2 (Structure-Innovation). This is attributable to its role as the capital of the autonomous region, which allows it to concentrate high-quality economic resources, financial investments, and policy support from the region. In particular, the high score on PC2 reflects Hohhot's achievements in advancing dairy industry upgrades and fostering emerging industries such as big data and new energy. The optimization of its industrial structure and the enhancement of innovation capability serve as key engines for the leap in its quality of life (this aligns with the transformation direction indicated by Li Jiangsu et al., 2014). Hohhot also maintains a stable lead in PC3 (Culture-Education), boasting abundant higher education resources. However, its advantage in PC4 (Environment) is relatively the smallest. Although its score remains higher than Ulaanbaatar's, this indicates that environmental quality remains a critical weakness that requires focused attention for further development, a challenge associated with the environmental pressures accompanying rapid growth.

(2) Ulaanbaatar: Comprehensive Lag and Dual Shortcomings in "Environment-Basic Security."

Ulaanbaatar lags significantly across all four dimensions. Its most pronounced shortcomings lie in PC1 (Economic-Basic Security) and PC4 (Environment). The low score on PC1 vividly reflects issues such as low per capita income and insufficient provision of public services (e.g., healthcare, social security). The low score on PC4 directly points to its severe ecological and environmental crisis, particularly the "air pollution disaster" caused by extensive coal burning for heating during winter, which severely undermines its environmental livability assessment (Tan et al., 2016 highlighted the environmental damage from rapid and unplanned urbanization). Ulaanbaatar shows a relatively smaller score gap in PC3 (Culture-Education), reflecting Mongolia's traditional emphasis on education and culture, with the capital concentrating the nation's major universities and cultural institutions. However, this "soft power" advantage is offset by the "hard constraints" of its economy and environment, making it difficult to translate into an overall improvement in quality of life. Its extreme lag in PC2 (Structure-Innovation) reveals the deep-seated dilemma of an economy heavily reliant on the export of primary mineral products, coupled with severe deficiencies in industrial diversification and innovation capacity.

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