Correlation Study Between Population Structure and Economic Development: A Case Study of Nanchang City

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Abstract. This study employs statistical methods including geographical concentration, industrial deviation degree, factor analysis, grey correlation analysis, and coupling coordination degree model to construct a comprehensive system of population structure and economic development. It investigates the coordination relationship and key influencing factors between population structure and economic development in Nanchang City from 2001 to 2022, revealing the interactive mechanism between these two systems in the region. The main conclusions are as follows: (1) The temporal evolution of industrial deviation degree reveals the imbalance in regional industrial development, where the primary sector has surplus labor while the secondary sector faces labor shortages, highlighting the urgency of industrial structure adjustment. (2) The geographical concentration of economy shows a declining trend after fluctuation, while the geographical concentration of population steadily increases. (3) Grey correlation analysis indicates that in the economic development system, the change in the proportion of primary sector output has the most significant impact on population structure; in the population structure system, the urbanization rate has the highest correlation with economic development, providing targeted reference factors for promoting the coordinated development of these two systems. (4) The analysis results of the coupling coordination degree model show that the coupling coordination degree between population structure and economic development in Nanchang City generally presents a "stepwise optimization" trend, a positive trend that should be maintained. The research findings have significant theoretical and practical implications for the coordinated development of population structure and economic development, providing important references for formulating regional development strategies.

Keywords: Population Structure; Economic Development; Grey Relational Degree; Coupling Coordination Degree; Nanchang City

1 Introduction

Since the implementation of the family planning policy, China has effectively controlled its population growth rate while simultaneously facing a series of structural challenges, including accelerated population aging, disparities in population quality,

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and gender ratio imbalances. Against this backdrop, conducting in-depth research on the coupling relationship between population structure and economic development in Nanchang City holds significant importance for promoting benign interaction between these two systems, alleviating structural contradictions, and achieving mutual optimization.

Regarding the interaction between demographic structure and economic development, most scholars have conducted their analyses focusing on the issue of population aging. He Xionglang and Li Junyi (2023) found that changes in demographic structure have a significant impact on the adjustment of industrial structure; among these factors, the deepening of aging and the rise in the new urbanization rate have the most obvious promoting effect on industrial upgrading [1]. Liu Chengkun et al. (2020) found that population aging exerts a significant positive impact on high-quality economic development through the quantity and quality effects of human capital [2]. Sun Qianqian (2021), based on the perspective of spatiotemporal heterogeneity, discovered that the impact of population aging on technological innovation differs across the eastern, central, and western regions as well as at the national level, and consequently, the further impact on economic development also varies [3].

In terms of research on the relationship between demographic structure and economic development, Wang Ruiqin (2023) found that Chongqing currently faces demographic structural issues such as declining fertility rates, severe population aging, large urban-rural gender ratio gaps, and uncoordinated population development across districts. There is a strong positive spatial autocorrelation between the demographic structure and economic development in these districts, characterized by high-value spatial agglomeration[4]. Chen Siyi and Tang Congcong (2024) found that the decline in fertility levels is closely related to changes in economic development levels, industrial structure, and modes of production. The resulting changes in population age structure are not only a result of economic and social development but also influence economic and social development by affecting consumption.[5] . Si Huaitao and Jiang Changliu (2023), based on provincial panel data from 2008 to 2020, examined the relationship between population structure, scientific and technological innovation, and high-quality economic development through the three dimensions of population structure (age, supply, and quality).[6]

In summary, while existing research has primarily focused on population aging, there remains insufficient exploration of the interactive relationship and key influencing factors between population structure and economic development. This paper constructs an indicator system and employs grey relational and coupling coordination models to analyze the influencing factors and evolutionary processes of these two systems in Nanchang City, identify key factors, and propose countermeasures, offering significant theoretical and practical value.

2 Materials and Methods

2.1 Overview of the Study Area

Nanchang, as the capital city of Jiangxi Province and its political, economic, and cultural center, has a large population and strong economic strength, serving as the province's financial and commercial hub. Among various factors constraining sustainable economic development, population structure has become a key factor. The interplay between population and economy is complex and bidirectional, and studying their coupling and coordination relationship holds significant practical importance for the coordinated development of both Nanchang and the entire province.

2.2 Data Source

This study selected population structure data and socioeconomic data of Nanchang City from 2001 to 2022, which were obtained from the Nanchang City Statistical Yearbook (2001–2023), the Jiangxi Province Statistical Yearbook (2001–2023), and the EPS Data Platform.

2.3 Construction of the Indicator System

This paper has constructed an indicator system encompassing population age structure, gender structure, cultural structure, industrial structure, urban-rural structure, economic strength, economic structure, economic vitality, and living standards of residents. This comprehensive system effectively reflects the complex interactions between population structure and economic development. To ensure the scientific validity and rationality of the indicator system, this study employs the entropy method to determine the weights of each indicator. The specific indicator contents and their corresponding weights are presented in Table 1.

Table 1. Indicator System of Population Structure and Economic Development in Nanchang

First-level Indicator	Second-level Indicator	Third-level Indicator	Entropy Weight	Indicator type
Population Structure Evaluation System	Population Age Structure	X_1 Proportion of population aged 15-64 in Nanchang	6.027	Positive indicator
	Population Gender Structure	X_2 Gender Ratio in Nanchang	12.003	Moderate indicator
	Population Cultural Structure	X_3 Number of primary school students per 100,000 population	11.073	Positive indicator
		X_4 Number of general secondary school students per 100,000 population	16.373	Positive indicator
		X_5 Number of students in regular higher education institutions per 100,000 population	5.05	Positive indicator
	Population Industrial Structure	X_6Proportion of employed population in the primary industry	16.648	Negative indicator
		X_7Proportion of employed population in the secondary industry	7.387	Negative indicator
		X_8Proportion of employed population in the tertiary industry	16.04	Positive indicator

	Population Urban-Rural Structure	X_9Urbanization Rate in Nanchang	9.398	Positive indicator
Economic Development System	Economic Strength	Y_1Gross Domestic Product (GDP) of Nanchang	11.645	Positive indicator
		Y_2GDP per capita of Nanchang	10.026	Positive indicator
		Y_3Fiscal Revenue of Nanchang	12.022	Positive indicator
	Economic Structure	Y_4Proportion of output value of the primary industry	12.482	Negative indicator
		Y_5Proportion of output value of the secondary industry	3.756	Negative indicator
		Y_6Proportion of output value of the tertiary industry	9.7	Positive indicator
	Economic Vitality	Y_7Total Import and Export Volume of Nanchang	12.746	Positive indicator
		Y_8Total Retail Sales of Consumer Goods in Nanchang	13.434	Positive indicator
	Residents' Living Standards	Y_9Engel's Coefficient of urban residents in Nanchang	7.631	Negative indicator
		Y_{10}Engel's Coefficient of rural residents in Nanchang	6.559	Negative indicator

2.4 Research Methodology

2.4.1 Min-max Normalization and Entropy Weight Method.

To eliminate the interference of dimensional differences among indicators on the analysis results, this paper employs the Min-max normalization method to render the data dimensionless within the interval [0, 1]. Considering that the effects of various indicators on population structure and economic development differ in direction—being positive, negative, or moderate—appropriate direction-specific normalization approaches are adopted in accordance with their inherent attribute characteristics. In Equation (1), X_i represents the set of all values for a given indicator, while x_i denotes a specific value within that indicator. For instance, X_1 refers to the set of all values for the proportion of the population aged 15–64 in Nanchang City from 2001 to 2022, and x_1 corresponds to the data for the year 2001. Similarly, Y_j and y_j in Equation (2) are defined under the same logical framework. For population structure indicators that exert positive effects, we adopt the following approach:

$$x_i' = \frac{x_i - \min(X_i)}{\max(X_i) - \min(X_i)} \tag{1}$$

For population structure indicators that exert negative effects, we adopt the following approach:

$$x_i' = \frac{\max(X_j) - x_i}{\max(X_I) - \min(X_j)}$$

For population structure indicators that are considered benign as long as they remain within an appropriate range, we adopt the following approach:

$$x_i{}' = \begin{cases} \frac{x_i - \min X_i}{\bar{x} - \min X_i}, x_i \leq \bar{x} \\ \frac{\max X_i - x_i}{\max X_i - \bar{x}}, x_i > \bar{x} \end{cases}$$

For economic development indicators that exert positive effects, we adopt the following approach:

$$y_j{}' = \frac{y_j - \min(Y_j)}{\max(Y_j) - \min(Y_j)} \tag{2}$$

For economic development indicators that exert negative effects, we adopt the following approach:

$$y_j{}' = \frac{\max(Y_j) - y_j}{\max(Y_j) - \min(Y_j)}$$

For economic development indicators that are considered benign as long as they remain within an appropriate range, we adopt the following approach:

$$y_j{}' = \begin{cases} \frac{y_j - \min Y_j}{\bar{y} - \min Y_j}, y_j \leq \bar{y} \\ \frac{\max Y_j - y_j}{\max Y_j - \bar{y}}, y_j > \bar{y} \end{cases}$$

In this paper, the entropy method is used to calculate the weights for the subsequent calculation of the coupling degree. The procedure for determining the weights using the entropy method is as follows: the formula for calculating the characteristic proportion of the i-th sample of the j-th indicator is given below:

$$f_{ij} = \frac{x_{ij}}{\sum_{j=1}^{n} x_{ij}} \quad g_{ij} = \frac{y_{ij}}{\sum_{i=1}^{n} y_{ij}}$$

The formula for calculating the entropy value of the j-th indicator is as follows:

$$e(x_j) = -\frac{1}{\ln n} \sum_{i=1}^{n} f_{ij} \ln f_{ij} \quad e(y_j) = -\frac{1}{\ln n} \sum_{i=1}^{n} g_{ij} \ln g_{ij}$$

The formula for the information utility of a given indicator is as follows:

$$d(x_j) = 1 - e(x_j) \quad d(y_j) = 1 - e(y_j)$$

The formula for the entropy weight of this indicator is as follows:

$$w'(x_j) = \frac{d(x_j)}{m - e(x_j)} \quad w'(y_j) = \frac{d(y_j)}{m - e(y_j)} \tag{3}$$

In Equation (3), m denotes the total number of indicators.

2.4.2 Factor Analysis.

Factor Analysis is a multivariate statistical method designed to reduce multiple original variables into a smaller number of latent common factors, thereby achieving dimensionality reduction and information condensation. In this paper, factor analysis is employed to reduce the dimensionality of the two evaluation systems—population structure and economic system—to extract common factors, and the comprehensive scores of these factors are then calculated. These scores are utilized to investigate which factors exert a greater influence on the other indicator system. Furthermore, by calculating the degree of association between the comprehensive scores of one system and the factors of the other, we can determine the magnitude and nature of the impact that specific factors have on the counterpart system.

2.4.3 Grey Relational Analysis.

Grey Relational Analysis (GRA) is a core application of Grey System Theory, designed to assess the similarity and influence between variables through the measurement of relational degrees. This method transforms data sequences into grey sequences, utilizing relational degree indicators to evaluate the consistency and trend similarity among variables. During analysis, a reference sequence is selected for comparison with other sequences to compute the corresponding relational degree sequence.

Based on the principles of Grey Relational Analysis and the construction steps of the grey relational degree model, the coupling relational model between economic development and population structure is established as follows:

$$\xi_{ij}(t) = \frac{\min_i \min_j \ |x_i{'}(t) - y_j{'}(t)| + \rho \max_i \max_j \ |x_i{'}(t) - y_j{'}(t)|}{|x_i{'}(t) - y_j{'}(t)| + \rho \max_i \max_j \ |x_i{'}(t) - y_j{'}(t)|} \tag{4}$$

In formula (4), ρ reflects the overall similarity between the reference group and the comparison group, known as the resolution coefficient, which is typically set to 0.5; hence, this study also adopts 0.5. The variable t represents the data for a specific year.

The grey relational degree is calculated by taking the average of the grey relational coefficients, resulting in a relational matrix that reveals the intrinsic connections between Nanchang City's population structure and its economic system. The calculation method for the relational degree is as follows:

$$\gamma_{ij} = \frac{1}{k}\sum_{t=1}^{k} \xi_{ij}\,(t)$$

The relational degree can be evaluated by comparing with Table 2, which provides a reference for assessing the strength and weakness of each relational degree.

Table 2. Evaluation of Correlation Strength

Range	Correlation Degree
$0 < \gamma_{ij} \leqslant 0.35$	Weak
$0.35 \angle \gamma_{ij} \leqslant 0.65$	Moderate
$0.65 < \gamma_{ij} \leqslant 0.85$	Relatively High
$0.85 < \gamma_{ij} \leqslant 1$	Very High

2.4.4 Coupling Coordination Degree Model.

Coupling analysis evaluates the intensity of interaction between system elements or between different systems, with the coupling degree[7] representing the degree of association among elements. Coupling coordination analysis, built upon this, assesses the level of coordination and synergistic effects between different systems. The coupling coordination degree is used to measure the quality of interaction, and this method is adopted in the present study.

The first step involves the calculation of the comprehensive evaluation index:

$$f(x) = \sum_{j=1}^{n} x_{ij}{}' w(x_j), \quad g(y) = \sum_{j=1}^{n} y_{ij}{}' w(y_j)$$

The larger the comprehensive evaluation index, the better the development level. Next, the coupling degree is calculated based on the comprehensive evaluation index:

$$\mathrm{c} = \sqrt{\frac{\mathrm{f(x)g(y)}}{\left[\frac{\mathrm{f(x)+g(y)}}{2}\right]^2}} = 2\sqrt{\frac{\mathrm{f(x)g(y)}}{[\mathrm{f(x)+g(y)}]^2}}$$

The comprehensive coordination calculation formula is as follows:

$$T = 0.5 \times f(x) + 0.5 \times g(y)$$

Coupling Coordination Degree Calculation Formula:

$$D = \sqrt{C \times T}$$

The coupling coordination degree between the population structure and the economic system is used to evaluate the level of coordination in the development of the two index systems. The Coupling Coordination Degree index and the corresponding evaluation criteria for the population structure and economic system are presented as follows: Specifically, a D value in the range of 0.00–0.09 corresponds to Level 1, indicating Extreme Imbalance; 0.10–0.19 represents Level 2, characterized by Severe Imbalance; 0.20–0.29 falls under Level 3 as Moderate Imbalance; 0.30–0.39 corresponds to Level 4, showing Slight Imbalance; and 0.40–0.49 is classified as Level 5,the stage of On the Verge of Imbalance. The range of 0.50–0.59 enters Level 6, marking the transitional stage of Barely Coordinated; 0.60–0.69 reaches Level 7, achieving Primary Coordination; 0.70–0.79 corresponds to Level 8, entering the state of Intermediate Coordination; 0.80–0.89 represents Level 9, forming Good Coordination; and the 0.90–1.00 range constitutes Level 10, attaining the highest standard of High Quality Coordination

2.4.5 Geographic Concentration.

Geographic concentration[8][9] is an indicator used to measure the degree of spatial agglomeration of population or economic factors within a specific region. By integrating data such as regional area, total population, or economic scale, it reflects the density characteristics of factor distribution. Its core formula is:

$$R_{popi} = \frac{pop_i \sum pop_i}{S_i \sum S_i} R_{GDPi} = \frac{GDP_i \sum GDP_i}{S_i \sum S_i} \tag{5}$$

In Equation (5), R_{popi} andR_{GDPi} represent the geographic concentration of population and economy in a specific region, respectively. $popi, GDP_i, S_i$ denote the permanent population, Gross Regional Product, and land area of that region, while $\sum pop_i, \sum GDP_i, \sum S_i$ represent the corresponding totals for the entire study area. This metric quantifies the concentration of factor distribution by comparing the ratio of the factor density in a specific region to the average density of the entire region.

2.4.6 Industrial Deviation Degree.
The structural deviation method[10]can quantify the coordination degree between employment structure and industrial structure, reflecting the equilibrium status between the two. The specific calculation formula is as follows:

$$Y_k = \frac{val_k}{emp_k} - 1 (k = 1,2,3) \tag{6}$$

In Equation (6), Y_k represents the deviation degree of the k-th industry; val_k denotes the proportion of the output value of the k-th industry to the total output value; and emp_k indicates the proportion of the employment in the k-th industry to the total employment.

3 Spatiotemporal Characteristics and Driving Mechanisms of the Coupling Coordination between Economic Development and Population Structure in Nanchang City

3.1 Industrial Deviation Degree in Nanchang City

Based on the analysis of the industrial deviation trend (Figure 1), the primary industry has exhibited a long-term surplus of labor, indicating an urgent need for transfer. In contrast, the secondary industry has experienced a persistent labor shortage, necessitating the absorption of external workforce to achieve balanced development. The tertiary industry has transitioned from an initial shortage to a mid-term surplus, eventually tending towards equilibrium, which reflects increasingly coordinated development. Furthermore, the converging trend of the deviation curves for the secondary and tertiary industries suggests a potential labor complementarity between them; specifically, the transfer of labor from the tertiary to the secondary industry has facilitated synergistic development across sectors.

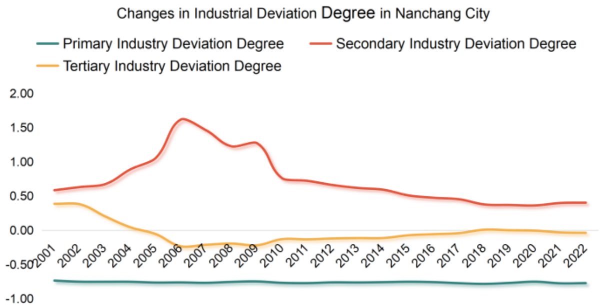

Fig. 1. Changes in Industrial Deviation of Nanchang City

3.2 Geographic Concentration in Nanchang

As shown in Figure 2, the economic geographic concentration in Nanchang stabilized after rising between 2001 and 2005, whereas the population geographic concentration has continued to climb since 2009. These diverging trends indicate that while Nanchang maintains a solid economic status within the province, its population agglomeration likely benefits from its function as the provincial administrative center. A comprehensive analysis of the trends in both economic and population geographic concentrations reveals a certain correlation between them.

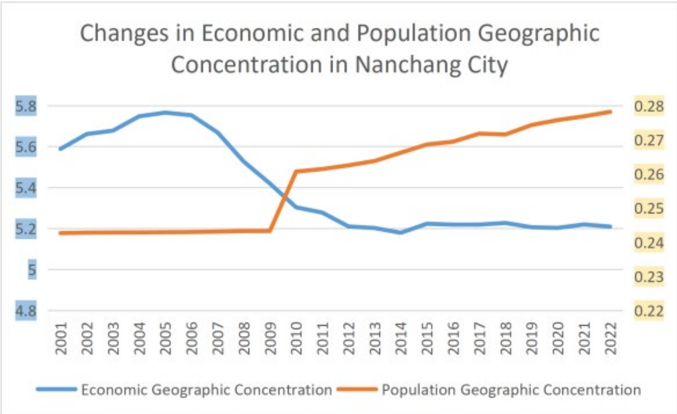

Fig. 2. Changes in Economic and Population Geographic Concentration in Nanchang

3.3 Main Influencing Factors of the Coupling Coordination between Economic Development and Population Structure in Nanchang

Factor analysis was employed to calculate the composite scores of economic development and population structure, followed by the application of grey relational analysis to bi-directionally measure the degree of mutual influence between the two systems and identify the key factors in each system that drive the development of the other. The ranking results of influencing factors by correlation degree show that the factors are ordered from highest to lowest as follows: X9 (0.85), X6 (0.725), X8 (0.717), X5 (0.673), X1 (0.642), X2 (0.626), X4 (0.579), X3 (0.48), X7 (0.478). The urbanization rate exhibits a strong association with economic growth, showing consistent trends with labor agglomeration and industrial structure transformation. The high relational degree of the proportion of employment in the primary industry corresponds to the pattern of surplus agricultural labor transfer, while the proportion of employment in the tertiary industry indicates a need for further quality improvement and expansion. The relational degree of the scale of higher education enrollment is moderate, which aligns with potential talent outflow or insufficient transformation of industry-academia-research outcomes; the relational degrees of the working-age population and the sex ratio are consistent with low labor utilization efficiency and structural imbalance. The pattern of the basic education indicator shows a lagging nature, while the low relational degree of the proportion of employment in the secondary industry corresponds to potential issues such as overcapacity and insufficient technological content in the industrial sector.

The ranking results of influencing factors by correlation degree show that the correlation degrees between Nanchang City's economic development factors and population structure system, from highest to lowest, are Y4 (0.905), Y9 (0.777), Y3 (0.735), Y2 (0.693), Y10 (0.68), Y8 (0.661), Y1 (0.659), Y7 (0.655), Y6 (0.614), Y5 (0.507), the differentiated associations of various economic factors with population structure are revealed. The proportion of the primary industry output value has the highest relational degree, showing a high degree of consistency with the urban-rural allocation of labor. The Engel coefficients of both urban and rural residents show a high relational degree, indicating that the pattern of consumption levels aligns with trends in fertility willingness and urban-rural differentiation. Fiscal revenue and GDP per capita exhibit a positive relational degree with population agglomeration and structural optimization, corresponding to improvements in public services and living standards. Economic scale indicators show a moderate relational degree, reflecting that Nanchang's capacity to attract population still needs improvement. Notably, the relational degree of the tertiary industry output value with population structure is higher than that of the secondary industry, but the overall relational degree is low, indicating that the synchronicity between industrial structure upgrading and population structure adjustment is not yet sufficient.

3.4 Analysis of the Temporal Evolution of Coupling Coordination between Economic Development and Population Structure in Nanchang

As shown in Figure 3, the coupling coordination degree between population structure and economic development in Nanchang jumped from "on the verge of imbalance" in 2001 to "good coordination" in 2022, experiencing five stages:

2001–2005 (On the verge of imbalance): The economic foundation was weak, with the industrial structure dominated by traditional manufacturing and agriculture. Low population quality and insufficient urbanization led to a poor match between labor and industry, and the demographic dividend was not released.

2006–2007 (Barely coordinated): The introduction of labor-intensive industries absorbed surplus rural labor and optimized the employment structure; increased investment in basic education initially improved labor skills, alleviating the disconnection between population and economy.

2008–2010 (Primary coordination): The "Four Trillion Plan" boosted infrastructure investment and accelerated economic growth; rapid urbanization accelerated the transfer of rural population to cities, expanding consumption and labor supply.

2011–2018 (Intermediate coordination): The rise of high-tech industries promoted economic diversification, and the implementation of talent introduction policies increased the proportion of high-skilled population, making innovation effects visible; the popularization of vocational and higher education further improved population quality.

2019–2022 (Good coordination): The digital economy became a new growth point, forming a virtuous cycle between industry and talent; "Industry-City Integration" optimized urban spatial layout and enhanced regional synergy; the resilience of the digital industry ensured the stability of coordinated development during the pandemic.

Through policy innovation, industrial upgrading, and population quality improvement, Nanchang has gradually achieved a high degree of coordination between economy and population structure. In the future, it needs to continue to make efforts in innovation-driven and inclusive development to consolidate the long-term coordinated trend.

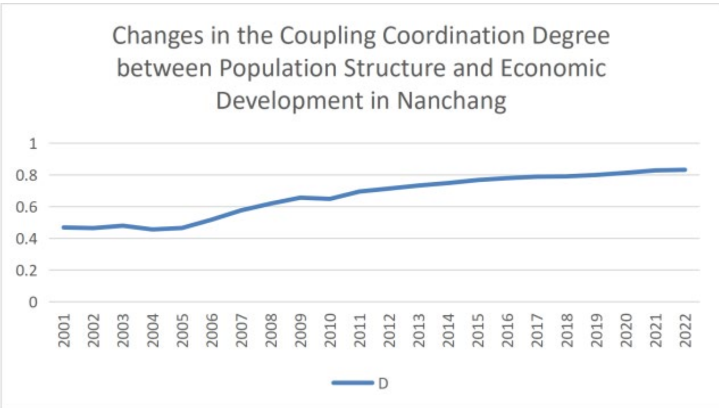

Fig. 3. Changes in the Coupling Coordination Degree between Population Structure and Economic Development in Nanchang

4 Conclusions and Policy Recommendations

4.1 Conclusions

Against the backdrop of the New Urbanization and the Rise of Central China strategies, the coupling coordination degree between population structure and economic development in Nanchang achieved a "step-wise" leap from 2001 to 2022. It went through five stages from "on the verge of imbalance" to "good coordination," reflecting the significant effectiveness of the synergy between policy guidance, industrial upgrading, and population optimization. The core findings are as follows: First, the industrial structure deviation shows that the primary industry has long been characterized by labor oversaturation, the secondary industry by labor shortage, and the tertiary industry is tending towards equilibrium. There is an urgent need to promote the transfer of surplus agricultural labor to the secondary industry to facilitate structural coordination. Second, economic geographic concentration declined after fluctuations, reflecting the diffusion of industries to new districts and surrounding areas; population geographic concentration steadily rose, highlighting the agglomeration effect of the provincial capital. Third, grey relational analysis indicates that the proportion of primary industry output value is the dominant driver of population structure, while the urbanization rate is the core engine of economic development, achieving mutual promotion by agglomerating labor and driving transformation.

4.2 Policy Recommendations

1.Optimize industrial structure and labor allocation

Establish "Agriculture-Manufacturing Skill Transition Centers" and subsidize manufacturing enterprises that absorb agricultural migrant labor; promote the alignment between universities and the service industry to improve the job matching rate.

Guide spatial synergy between industry and population

Establish "Advanced Manufacturing Reception Zones" in Xinjian District and Nanchang County, providing supporting relocation subsidies and "Industrial Worker Communities"; implement a "Home Purchase Points for Hukou" system for non-local residents purchasing homes in 2.high-density areas like Honggutan.

Deepen urbanization and consumption upgrading

Remove settlement restrictions for non-local populations who have been employed in advanced manufacturing and the digital economy for a specified number of years; construct "15-minute convenient consumption circles" in Jiulong Lake and Yaohu New City, and issue "Nanchang Consumption Vouchers" to promote upgrading.

3.Establish dynamic monitoring and talent retention mechanisms

Establish a quarterly release system for the "Population-Economy Coupling Coordination Degree Index," flexibly adjusting policy priorities based on the D value (e.g., D≥0.8); provide rental subsidies for graduates staying in Nanchang and establish talent funds to support leading talents.

References

1. He Xionglang, Li Junyi. Demographic Structure, Consumption Structure of Residents and Industrial Upgrading [J]. Regional Economic Review, 2023, (03): 90-100. DOI:10.14017/j.cnki.2095-5766.2023.0035.
2. Liu Chengkun, Lin Mingyu. Population Aging, Human Capital Accumulation, and High-quality Economic Development [J]. Inquiry into Economic Issues, 2020, (07):168-179.

3. SUN Qianqian. Analysis on the Spatiotemporal Heterogeneity Effect of Population Aging on Technological Innovation [J]. The Theory and Practice of Finance and Economics, 2021, 42(3):118-123.
4. Ruiqin Wang. The Research on the Influence of Chongqing's Population Structure on Economic Development [D]. Chongqing University, 2023. DOI:10.27670/d.cnki.gcqdu.2023.003006.
5. Chen Siyi, Tang Congcong. The causes and main economic impact of changes in the age structure of China's population: an empirical analysis based on micro perspective [J]. China Price Journal, 2024, (10):85-90.
6. Si Huaitao, Jiang Changliu. Population Structure, Scientific and Technological Innovation and High-quality Economic Development [J]. The World of Survey and Research, 2023, (01):61-69.
7. FU Jiao, HUANG Yin-zhou, TANG Ju. Coupling research of population changes and economic development in Gansu Province[J].China Population, Resources and Environment, 2018, 28(S1):49-53.
8. WANG Lei, DUAN Xuejun et al.. STUDY ON THE RELATIONSHIP BETWEEN POPULATION AND ECONOMIC SPATIAL DISTRIBUTION IN YANGTZE RIVER DELTA[J]. Economic Geography, 2009, 29(10):1619-1623.
9. YAN Dongsheng, HE Tian, CHEN Wen. Population Agglomeration, Economic Dispersion and Inconsistent Pattern: Evidence from the Yangtze River Delta [J]. Economic Geography, 2017, 37(09): 47-56. DOI:10.15957/j.cnki.jjdl.2017.09.006.
10. Wang Yang, Zhao Haizhu. Research on the Imbalance between Employment Structure and Industrial Structure[J]. Chinese Journal of Population Science, 2022, (02):74-85+127.