The 4th International Conference on Environmental Geoscience and Earth Ecology
DOI: 10.54254/2753-8818/2026.33337

Spatio-Temporal Evolution Patterns and Driving Mechanisms of Population Distribution in Jiangsu Province, China during 2017–2023

Shunhan Wang

College of Environment and Resources, Guangxi Normal University, Guilin, China
2174957074@qq.com

Abstract. Research on the spatiotemporal evolution of regional populations is the core foundation for accurately forecasting population dynamics, analyzing migration patterns, and optimizing regional coordinated development layouts. The spatiotemporal patterns, evolution and driving mechanisms of population distribution in Jiangsu Province(JS) are systematically analyzed in this study, as well as its driving mechanisms, based on population distribution data from 2017 to 2023 across all prefecture-level cities in JS, China. Spatial visualization analysis, spatial autocorrelation analysis, population center of gravity analysis, and standard deviation ellipse modeling were used in this study. The following insights were obtained: (1) JS's total population maintains a sustained growth trend; (2) Spatially, the population exhibits a "high south, low north" gradient pattern; (3) The population center is located in Taizhou City and continues to shift toward the southern JS. Analysis indicates that economic development level is the dominant driver of population mobility. In addition, industrial structure upgrading is the key force behind spatial population differentiation, policy and planning guidance serve as crucial regulatory variables for population distribution adjustments, location and transportation conditions provide foundational support for population circulation, and the development of regional central cities acts as a supplementary catalyst for localized population agglomeration. A scientific basis is provided by this study for the coordinated development of population, economy, society, resources, and environment in JS, while valuable references are also offered for population research in similar region

Keywords: population distribution, spatiotemporal evolution, spatial analysis, driving mechanisms, Jiangsu Province

1. Introduction

China's population development has moved into a new phase,one marked simultaneously by low fertility, falling birth rates, and population aging [1]. Under conditions of normalized population mobility and uneven spatial distribution [2], stronger adaptive capacity is requiblue in regional resource allocation, industrial configuration, and public service provision [3]. From the vantage point of national strategy, the implementation of initiatives such as Yangtze River Delta (YRD)

DOI: 10.54254/2753-8818/2026.33337

integration and coordinated regional development depends on accurate identification of the spatiotemporal patterns of demographic change [4,5], if the broader objective is to maintain balance among population, the economy, society, resources, and the environment [6]. China's demographic trajectory, in other words, has enteblue a new historical stage in which large-scale mobility and structural adjustment exert a direct influence on coordinated regional development [7]. Against this backdrop, close examination of regional population distribution becomes essential: it bears directly on population-development mismatches and, at the same time, constitutes a basic precondition for refining regional development strategy and improving governance effectiveness.

In recent years, both domestic and international scholarship has made extensive use of Geographic Information Systems (GIS) and related spatial-analytical approaches to investigate the spatial distribution of population and its evolution over time. At the international level, attention has often been directed to macro-scale spatiotemporal patterning. Thus, in the Colombo metropolitan area of Sri Lanka, Padma Weerakoon used GIS and spatial interpolation methods to carry out a geographic visualization analysis of urban density [8]. Earlier, Martin applied population surface modeling to identify typical neighborhoods in Southampton, United Kingdom, without relying on manual delineation [9]. Along a similar methodological line, though with finer-grained data inputs, Bhaduri et al. drew on the LandScan USA project to examine population distribution and temporal change through high-resolution geospatial and temporal modeling [10].

Within China, by contrast, research has been more heavily centeblue on the spatial distribution of regional populations and its socioeconomic effects. Zhu et al., for instance, investigated the multidimensional features and evolutionary trends of population attraction within China's urban agglomerations during 2010–2020; using data from the sixth and seventh national population censuses, that study examined three dimensions—intensity, scope, and spatial equilibrium [11]. Fan et al. calculated the geographic coordinates of China's economic and population centers for the 1952–2005 period and then analyzed their spatial coupling relationships, showing a marked association with disparities in regional development; on that basis, a "multi-stage inverted U-shaped" evolutionary pattern of regional disparity was proposed [12]. Also in Zhu et al., urban-rural counter-flow migration was divided into three types—overall migration, intra-provincial county-level migration, and inter-provincial migration—using the 2020 national census dataset. With Exploratory Spatial Data Analysis (ESDA) employed to clarify spatial patterns, and Multi-scale Geographically Weighted Regression (MGWR) introduced to detect multi-scale effects and spatial heterogeneity in the influencing factors, that work notably extended domestic inquiry into the evolution of population-flow spatial patterns. Taken together, these studies indicate—quite plainly—that spatial analysis and coupling approaches have become common tools in demographic research [13].

As a major coastal province in eastern China, JS occupies a consequential position in both coordinated regional development and the practical advancement of national strategies such as YRD integration. Densely populated and economically advanced, the province exhibits spatiotemporal population changes shaped by multiple, intertwined influences, including the level of economic development, industrial-structure upgrading, and policy orientation. Yet despite that practical importance, existing studies have tended to focus on specific periods or limited localities, leaving a shortage of systematic research on the spatiotemporal evolution and driving mechanisms of JS's population distribution during 2017–2023. The present study therefore aims to map, in a more systematic manner, the spatiotemporal dynamics of JS's population distribution, to clarify its spatial correlation characteristics, and to examine how key factors—economic development, industrial structure, and transportation accessibility among them—affect population distribution.

DOI: 10.54254/2753-8818/2026.33337

2. Research area overview, data, and methods

2.1. Study area overview

JS is one of China's most populous and economically advanced provinces. It is in the eastern coastal region and is at the center of the YRD. In 2023, its permanent resident population was 85.26 million, making it one of the highest in the country for net population inflow [14]. There are three main areas in the province: Southern JS, Central JS, and Northern JS. These areas have very different levels of development: Southern JS, which is based on advanced manufacturing and modern services, has a strong economy and can absorb a lot of people, with a steady net population inflow trend. Central JS has a balanced industrial structure and receives industrial transfers from Southern JS, with relatively stable population flows. Northern JS, which is based on agriculture and traditional industries, has seen steady economic growth in recent years thanks to regional revitalization policies, but still has a net population outflow area [15]. The YRD Integration and other national strategies are being put into action more and more, which has made it easier for industries to work together and for people to move between regions in the province. The "high south, low north" economic pattern and the fact that people are moving from Southern JS to Northern JS [16] are the main things that this study looks at.

2.2. Data sources

The population data for this study comes from the JS Provincial Bureau of Statistics' yearly statistical yearbooks. These yearbooks have data on the permanent resident population of all JS cities and regions from 2017 to 2023. We can use this basic information to look into how the population in JS has changed over time and space. The National Geographic Information Public Service Platform gave us the vector data for the prefecture-level administrative divisions in Jiangsu. This dataset has information about the borders of all the cities in Jiangsu that are at the prefecture level. It is a good place to start using GIS for spatial analysis. The JS Statistical Yearbook provided JS with socioeconomic data, such as GDP and the industrial structure of each city. These numbers show how well the economy is doing and what kinds of businesses are in each prefecture-level city in JS. They are very useful for figuring out the driving mechanisms behind population distribution.

2.3. Research methods

(1) Analysis of spatial visualization. To render visible the temporal shifts and geographical patterning of the population in JS, population density distribution maps together with population change maps were constructed. By design, the density maps depict the degree of population concentration across different areas, thereby making the spatial clustering of residents readily identifiable. Population change maps, by contrast, trace population growth and decline across cities over the study period, with the most pronounced increases and decreases standing out clearly in the mapped results. Taken together, these visualizations provide a direct, readily interpretable account of how the population distribution in JS has evolved across both time and space (a useful descriptive point of departure for subsequent analysis).

(2) Spatial autocorrelation analysis. For the province-wide population distribution, the Global Moran's I index was used to evaluate the overall pattern of spatial clustering. The expression for Global Moran's I is given as:

DOI: 10.54254/2753-8818/2026.33337

$$I=\frac{N}{W}\cdot\frac{\sum_{i=1}^{N}\sum_{j=1}^{N}w_{ij}(x_i-\bar{x})(x_j-\bar{x})}{\sum_{i=1}^{N}(x_i-\bar{x})^2} \quad (1)$$

where "N " denotes the number of prefecture-level cities in JS, " x_i " and " x_j " represent the population densities of the " i "th and " j "th cities respectively, " $\bar{x}$ " is the average population density across all prefecture-level cities, and " w_{ij} " is an element in the spatial weight matrix indicating the spatial relationship between the " i "th and " j "th cities, typically based on geographic adjacency or distance. " W " is the sum of all spatial weights, i.e., " $W=\sum_{i=1}^{N}\sum_{j=1}^{N}w_{ij}$ ".

Additionally, the Local Moran's Index (LISA) was employed to identify local hotspots (high-high clustering), coldspots (low-low clustering), and spatial outliers. The LISA formula is expressed as:

$$I_i=\frac{x_i-\bar{x}}{S^2}\sum_{j=1}^{N}w_{ij}(x_j-\bar{x}) \quad (2)$$

where x_i is the population density of the i prefecture-level city, $\bar{x}$ is the average population density of all prefecture-level cities, w_{ij} is an element in the spatial weight matrix representing the spatial relationship between the i th and j th prefecture-level cities, and S^2 is the variance of population density, i.e., $S^2=\frac{1}{N}\sum_{i=1}^{N}(x_i-\bar{x})^2$.

(3) Models of the population center of gravity and the standard deviation ellipse. Calculating the annual population center coordinates and plotting migration trajectories shows how the overall direction of population distribution has changed over time. The direction and velocity of movement in the population center delineate the dominant migration trajectories and their relative intensity across the study area. To track changes in spatial distribution over time and by directional orientation, the standard deviation ellipse model is employed. The ellipse itself captures the configuration, orientation, and spatial extent of the population distribution. Through close inspection of shifts in the standard deviation ellipse, the evolving tendencies of population distribution, together with its primary axes of expansion, can be identified. On that basis, the present study combines both models to clarify, in a more fully specified manner, the spatiotemporal evolutionary characteristics of population distribution in JS, thereby providing supporting evidence for subsequent analysis of the mechanisms that drive population distribution.

3. Analysis of spatiotemporal pattern evolution characteristics

3.1. Spatiotemporal characteristics of population changes

The total population of JS grew in phases from 2017 to 2023, going from 84.235 million in 2017 to 85.26 million in 2023 (Figure 1). This trend shows not only how quickly the province's economy grew and how its industries changed during the study period, but it also shows how closely population growth and economic development are related.

DOI: 10.54254/2753-8818/2026.33337

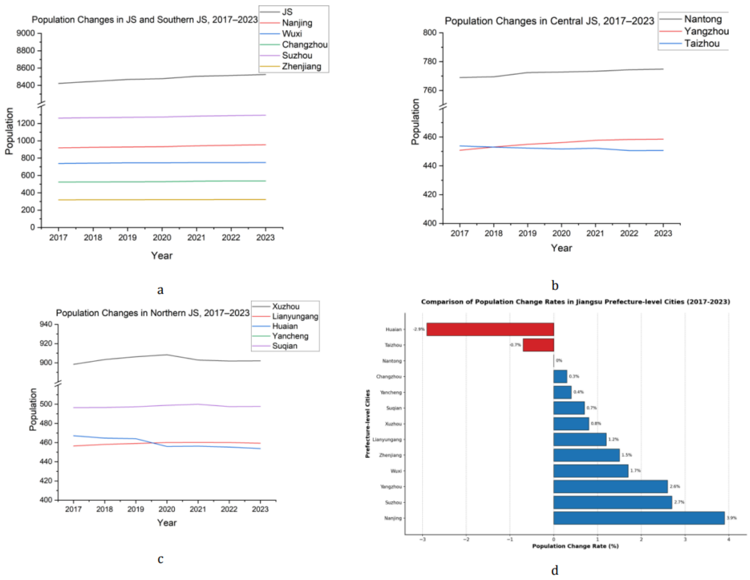

Figure 1. Population changes in JS municipalities, 2017–2023

Marked regional asymmetries were evident in city-level population change across Jiangsu Province. In southern Jiangsu, Nanjing, Suzhou, and Wuxi registered comparatively rapid population expansion. From 2017 to 2023, Nanjing's population increased from 8.192 million to 9.547 million; over the same interval, Suzhou rose from 12.619 million to 12.958 million, and Wuxi from 7.3076 million to 7.495 million. Closely associated with this growth pattern are the area's elevated level of urbanization, its comparatively mature infrastructure base, and an industrial structure that has been more effectively optimized, all of which strengthen its capacity to draw in population.

By contrast, in central Jiangsu, cities such as Yangzhou and Zhenjiang exhibited relatively stable population growth. Yangzhou's population moved upward from 4.5002 million in 2017 to 4.585 million in 2023, whereas Zhenjiang increased from 3.1863 million to 3.226 million. Underlying this stability is a combination of steady regional economic development, industrial upgrading toward high-technology sectors, and the pull generated by comparatively strong educational resources and favorable living conditions (factors that, taken together, tend to support demographic continuity rather than abrupt fluctuation).

More uneven, however, were population trends in northern Jiangsu. Suqian's population reached a peak of 4.998 million in 2020 and then declined gradually to 4.9775 million by 2023. In Yancheng, the population fell from 6.8096 million in 2017 to 6.689 million in 2023, while in Taizhou it decreased from 4.537 million to 4.507 million over the same period. This pattern is closely connected to the slower pace of economic growth in northern Jiangsu relative to the national level. There, traditional agriculture and heavy industry continue to occupy a dominant position, a sectoral configuration that reduces the region's attractiveness to population inflows.

3.2. Spatial pattern evolution characteristics

The population density map (Figure 2) shows that JS has a lot of spatial heterogeneity in population distribution, with a clear north-south gradient pattern where the population density is higher in the south and lower in the north [17]. The southern part of JS has a lot of people living there because it has a strong economy, a lot of high-tech industries and services, and a good location. This has led to

DOI: 10.54254/2753-8818/2026.33337

the formation of high-density population clusters. Cities like Suzhou, Wuxi, and Nanjing not only have strong economies, but they also have strong competition for public services like healthcare and education, which makes them even more appealing to people. Northern JS (including cities like Xuzhou, Lianyungang, and Huai'an) is behind in economic growth. Agriculture and heavy manufacturing are the main industries there. Because it has a weaker population magnetism, it has a lower population density. Even though the economy and industry have gotten better recently, the population density is still much lower than it is in Southern JS. Central JS has a population density that is between that of Southern and Northern JS. It also has moderate economic and industrial growth, which means that its population aggregation capabilities are relatively balanced [12]. From 2017 to 2023, this "high south, low north" gradient pattern stayed pretty stable. This shows that the economy in JS is growing unevenly and that people move and settle in different regions in complicated ways.

3.3. Spatial agglomeration analysis

The results of the spatial autocorrelation analysis (Table 1) show that the global Moran's I index for JS's population distribution is 0.023804, which is much higher than the expected index of -0.083333. This means that population distribution is not random; instead, it shows strong spatial dependence and clustering patterns. For example, densely populated areas are usually next to other densely populated areas, and sparsely populated areas tend to group together. This pattern of clustering stayed the same throughout the study period.

The Local Isotopic Scale Analysis (LISA) results show that hotspots are mostly areas where the economy is growing quickly and the population is growing quickly, while coldspots are mostly areas where the economy is growing slowly and the population is shrinking. This gives us a way to find areas where population growth is driving development and areas where policy changes are needed to keep development balanced. In terms of changes in agglomeration intensity over time, southern JS shows a steady rise in population agglomeration intensity. This is closely related to its fast economic growth and improvement of its industrial structure. Central JS has a stable agglomeration intensity, which shows that it can attract and keep people in a balanced way. Northern JS has changing levels of agglomeration intensity, which are linked to changes in the economy and the types of industries in the area.

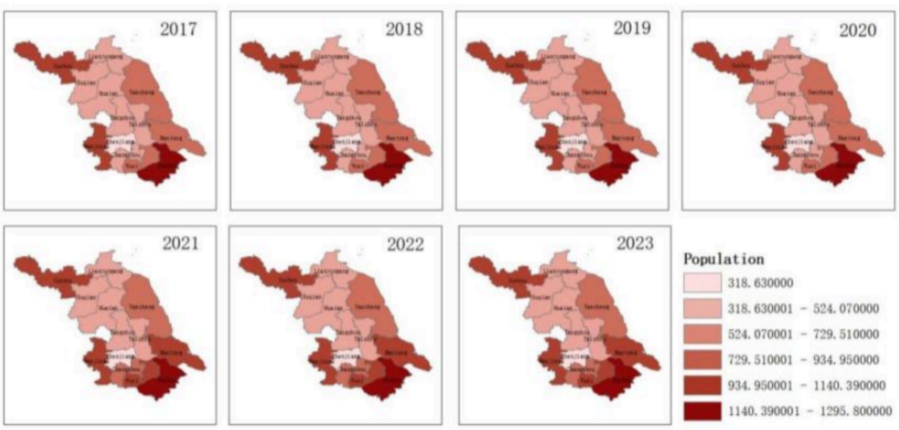

Figure 2. Population density map of JS, 2017–2023

DOI: 10.54254/2753-8818/2026.33337

Table 1. Statistical results of global Moran's I for population distribution in JS

Statistical Indicator	Value
Moran's I Index	0.023804
Expected Index	-0.083333
Variance	0.023150
Z Score	0.704141
p-value	0.481345

3.4. Identification of spatial correlation patterns

3.4.1. Identification of spatial correlation patterns

According to the LISA clustering analysis (Figure 3), the southern JS region is a hotspot for where people live, with a lot of stability in where people live.This area has a strong economy that is mostly made up of high-tech industries and services. It attracts a lot of immigrants, especially young, highly skilled people. Its well-developed infrastructure and many public services, such as good healthcare, education, and transportation, make it even more attractive to people. The results of LISA clustering show that the intensity of population concentration is steadily rising and that the patterns of population distribution are very stable. This suggests that this trend will continue.

Northern JS is a cold spot for population distribution, with low levels of population agglomeration intensity [13]. This area is behind in economic growth because agriculture and traditional manufacturing make up most of its industrial base. It has a weak population attraction and big problems with people leaving, especially young workers moving to Southern JS. This has made the problems with population distribution even worse. The results of LISA clustering show that the intensity of population agglomeration stays low.

Some places, like the city of Xuzhou, have strange patterns of population distribution. Xuzhou is a central city in northern Jiangsu with a relatively high level of economic development and a diverse industrial base. However, its population density is lower than expected because of its location, history, and the fact that southern Jiangsu is more developed economically. The results of LISA clustering show that population distribution patterns are unstable and change over time [18]. This is closely related to how the region develops, what policies it follows, and how it interacts with nearby cities.

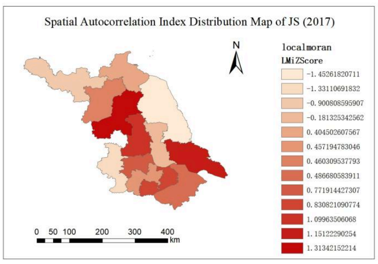

Figure 3. Distribution map of JS's population spatial autocorrelation index in 2017

DOI: 10.54254/2753-8818/2026.33337

3.4.2. Distribution direction and pattern evolution

The migration trajectory of the population center (Figure 4) reveals a pronounced southward shift in JS from 2017 to 2023, aligning with the "high south, low north" population distribution pattern. This trend primarily stems from sustained population inflows driven by Southern JS's advanced economic development, optimized industrial structure, and robust infrastructure, coupled with accelerated urbanization and the implementation of regional development strategies.

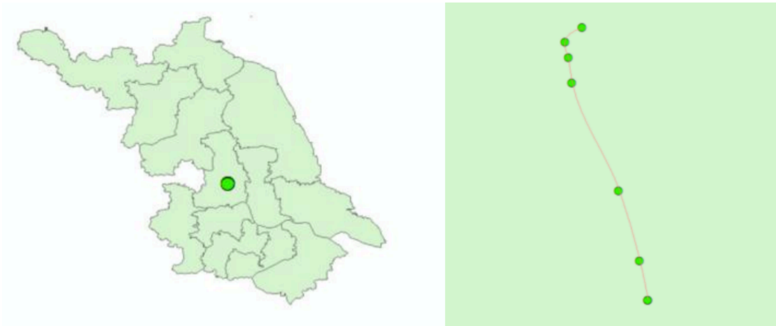

Figure 4. Migration trajectory of JS's population center (2017–2023, northeast of Jiangyan district, Taizhou city, near Zhen'tong town/Shen'gao town)

The results of the standard deviation ellipse analysis (Table 2, Figure 5) show that the ellipse rotation angle stayed stable at about 137.6° from 2017 to 2023. This confirms that the main direction of population distribution in JS always went from northwest to southeast. This fits very well with the main population gradient pattern of "Southern JS-Northern JS." In 2023, the rotation angle went up a little bit, which means that the population concentration intensity in the southeast went up a little bit. The standard deviation on the X-axis went up from 0.8567 to 0.8582, which means that the population spread out a little more from east to west. This shows a trend toward a more even distribution of people between the east and west, which is caused by population growth in central JS areas like Nantong and Taizhou. The standard deviation of the Y-axis went down from 1.9210 to 1.9186, which means that the population spread from north to south has gotten a little smaller. This shows that the north-south population gradient is getting stronger because some northern JS cities (like Huai'an and Lianyungang) are losing people and southern JS cities (like Suzhou and Nanjing) are still getting more people. In 2023, the population center moved from (119.5612, 32.6119) to (119.5638, 32.6012), which was a small move to the southeast. This fits with the pattern of population flow, which is "concentration in southern JS and contraction in northern JS." This shows how people are moving to the more economically developed southeastern coastal areas.

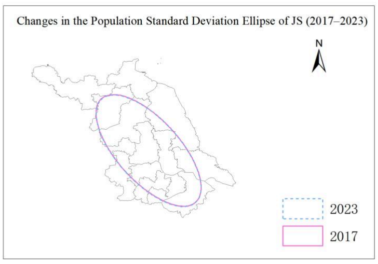

Figure 5. Changes in population standard deviation ellipse of JS, 2017–2023

DOI: 10.54254/2753-8818/2026.33337

Table 2. Changes in parameters of population standard deviation ellipse in JS, 2017–2023

Parameter	2017	2023	Trend
Ellipse Center Coordinates (CenterX, CenterY)	(119.5612, 32.6119)	(119.5638, 32.6012)	Center shifted slightly southeast
X-axis standard deviation (XStdDist)	0.8567	0.8582	Slightly increased (slight expansion of east-west dispersion)
Y-axis standard deviation (YStdDist)	1.9210	1.9186	Slight decrease (slight contraction in north-south dispersion)
Rotation angle (Rotation, °)	137.5902	137.6281	Slight clockwise rotation (main direction shifted more southward)

4. Discussion on driving mechanisms

Existing research indicates that the formation of population migration and distribution patterns results from the combined effects of multiple factors, including economic conditions, policies, location, and urban development. Gradient differences in regional economic development represent the core driving force behind population mobility [19]. National and local policy planning further reshapes spatial population patterns by guiding industrial layout and infrastructure development [20]. Meanwhile, locational transportation conditions and the radiating capacity of regional central cities play crucial regulatory roles in population aggregation and dispersion [21]. Integrating JS's population evolution characteristics from 2017 to 2023, this study comprehensively analyzes the formation mechanisms of population distribution patterns from four dimensions: economic drivers, policy guidance, locational conditions, and internal radiation.

4.1. The core driving role of economic development level

A spatial analysis was conducted using population and GDP data from 2017 to 2023 across prefecture-level cities in JS.the results indicate (Table 3) that the global Moran's I values for GDP change rate and population change rate are -0.1117 and 0.0537, respectively, with z-scores of -0.1798 and 0.8862. Both p-values exceed 0.05, suggesting that at the provincial scale, neither GDP growth nor population change exhibits significant global spatial correlation. Regional economic and demographic linkages are more evident at the local prefecture-level city scale.

Table 3. Global spatial autocorrelation results for GDP change rate and population change rate in JS

Analysis Field	Moran's I Index	z Score	p-value	Spatial Pattern
GDP Change Rate	-0.1117	-0.1798	0.8573	Random Distribution (No Significant Agglomeration)
Population Change Rate	0.0537	0.8862	0.3755	Random distribution (no significant clustering)

Local Autocorrelation Analysis of GDP reveals (Figure 6a) that only Xuzhou and its surrounding areas exhibit High-Low anomalies—where Xuzhou's GDP growth is high but neighboring cities' GDP growth is low. This reflects Xuzhou's economic polarization effect as a central city in northern JS, where its growth has failed to effectively drive coordinated development among surrounding cities.

Population-GDP coupling analysis results (Figure 6b) reveal that the Southern JS cities in high-coupling zones (e.g., Suzhou, Nanjing) exhibit "high population inflow-high GDP growth" patterns

DOI: 10.54254/2753-8818/2026.33337

(e.g., 4.46, 3.56), indicating significant driving effects of economic growth on population influx, with prominent traction from industrial upgrading and job opportunity concentration;In the low-coupling zone, some cities in northern JS (e.g., Huai'an, Lianyungang) exhibit a "population outflow-high GDP growth" pattern (e.g., -3.50, -1.52), reflecting that their economic growth primarily relies on investment or resource-based industries, failing to effectively create jobs to attract population; Central JS and Yangtze River cities in the stable coupling zone (e.g., Taizhou, Yangzhou) exhibit "stable population-moderate GDP growth" patterns (e.g., 0.48, 1.47), indicating a relatively balanced state between population and economic development.

In summary, the economic drivers of population change in JS exhibit distinct spatial heterogeneity: Southern JS forms a positive feedback loop between economic growth and population inflow, where high GDP growth continuously attracts population concentration through industrial upgrading and job creation; Northern JS shows insufficient population-driven effects in economic growth, with industrial structure disparities leading to a low-coupling pattern of "high growth, low attraction"; At the regional level, the spatial correlation between population and GDP is insignificant, with driving forces primarily manifested in local industrial and employment structure differences.

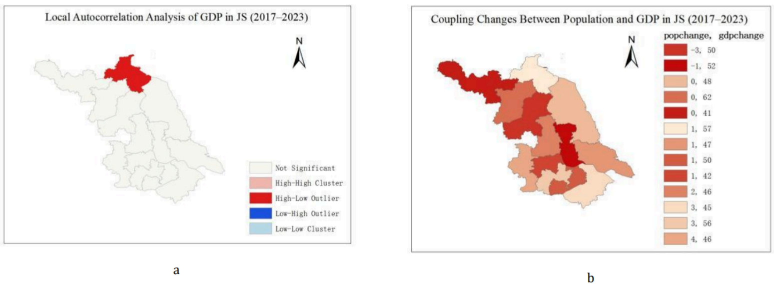

Figure 6. (a) Local autocorrelation of JS GDP, 2017–2023; (b) Coupling changes between population and GDP in JS, 2017–2023

4.2. Regulatory role of policy and planning guidance

The implementation of major policies exerts a significant regulatory effect on population distribution patterns. The advancement of the YRD Integration Strategy has contributed not only to more coordinated regional economic growth, but also to cross-regional population mobility and settlement [22]. Along the coast, the Coastal Development Strategy has lowered mobility barriers to coastal cities through port expansion and through the development of ocean-oriented industries and logistics services. In turn, policy-led industrial restructuring, coupled with infrastructure build-out, has generated both the incentives and the enabling conditions for migration, thereby further reshaping the population distribution pattern of JS [20].

4.3. The fundamental support role of location and transportation conditions

With respect to population mobility, locational conditions and transport accessibility remain decisive. GIS-based spatial overlay analysis indicates that proximity to major transport corridors and to core metropolitan centers such as Shanghai exerts a marked effect on population attraction [21]. In southern JS, adjacency to Shanghai—together with an extensive high-speed rail system and expressway network—facilitates both the movement of people and the spatial concentration of firms, a configuration that, in turn, further strengthens the area's attractiveness to migrants (or, more

DOI: 10.54254/2753-8818/2026.33337

precisely, to mobile populations within the regional system). By contrast, in parts of northern JS, constrained transport conditions and relative distance from major economic centers weaken the capacity to attract population inflows.

4.4. Internal radiation effects of regional centers

Regional centers such as Xuzhou and Nantong attract population inflows through their own developmental momentum, and this, in turn, exerts a marked influence on the regional distribution of population. Slower than the growth trajectories recorded in the principal cities of southern JS, their economic expansion remains nevertheless sufficient for these cities to function as regional hubs for commerce, culture, and political activity, thereby drawing residents from surrounding localities. Alongside this, development-oriented initiatives—including improvements in medical services, the expansion of educational resources, and the optimization of industrial structures—further strengthen their attractiveness to population concentration. Within the region, localized clustering is thus encouraged, serving as an important complement to the province-wide spatial pattern of population distribution [23].

Taken together, the spatiotemporal evolution of population distribution in JS reflects the joint action of several forces: levels of economic development, policy and planning guidance, locational and transport conditions, and the growth of regional central cities. Interwoven rather than operating in isolation, these factors collectively shape the current population distribution pattern and the direction of its ongoing evolution.

5. Conclusion

This study reveals that JS's population distribution presented distinct spatiotemporal evolution characteristics from 2017 to 2023, featuring a spatial pattern of agglomeration in Southern JS and contraction in Northern JS with weak overall agglomeration yet pronounced local correlations, and the primary population flow direction maintained a northwest-to-southeast orientation with a slight southeastward shift [24]; economically, development level is the core driver of population migration, with Southern JS's industrial upgrading and employment opportunities continuously attracting population inflows while some Northern JS cities fail to translate economic growth into effective population attraction, a pattern further reinforced by policy planning, locational transportation conditions, the YRD integration strategy, high-speed rail network expansion and Shanghai's spillover effects. To promote coordinated spatial development of population, economy, society, resources and environment in JS, three recommendations are proposed: driving industrial transformation in Northern JS by fostering distinctive industries and improving public services to boost population attraction and ease outflow pressure, optimizing population carrying capacity in Southern JS by building affordable housing and public facilities alongside industrial upgrading to mitigate over-concentration pressures, and strengthening the balanced layout of regional transportation networks in Northern JS to enhance accessibility and facilitate cross-regional flows of population and production factors. This study uses spatial autocorrelation and standard deviation ellipse models to systematically reveal the evolutionary patterns and driving mechanisms of JS's population distribution, providing solid spatial evidence for regional population regulation, yet it is limited to the prefecture-level city scale—making it hard to capture county-level and smaller-scale population flow details and insufficiently exploring individual migration behavioral mechanisms; future research can integrate multi-source big data such as mobile phone signaling and POI data to conduct more refined spatiotemporal population simulations, further uncover micro-level driving

DOI: 10.54254/2753-8818/2026.33337

mechanisms, and provide more precise decision support for JS's new urbanization and coordinated regional development.

References

[1] Zhai, Z., Jin, G. China's Negative Population Growth: Characteristics, Challenges, and Responses [J]. Population Research, 2023, 47(2): 11-20 (in Chinese with English Abstract).

[2] National Bureau of Statistics. Bulletin of the Seventh National Population Census (No. 2) [R]. Beijing: National Bureau of Statistics, 2021.

[3] Research Team of the Development Research Center of the State Council, Ma J, Li J, et al. Understanding the Fundamental Patterns of Population Evolution to Promote Long-Term Balanced Population Development in China [J]. Management World, 2022, 38(1): 1-19.

[4] Central Committee of the Communist Party of China, State Council. Outline of the Yangtze River Delta Regional Integration Development Plan [Z]. 2019.

[5] Yan D, Yang J. Evolution and Influencing Factors of Population and Economic Spatial Patterns in the Yangtze River Delta [J]. Population Research, 2017, 36(7): 820-831.

[6] Yu X, Zhai Z, Yang F, Li J, Mu G. Why Build a "Population-Balanced Society"? [J]. Population Research, 2010, 34(3): 40-52.

[7] Ding J, Chang L, Chen Y, Huang X. Population Mobility Analysis Paradigms and Identification of Interprovincial Migration Components in China [J]. Acta Geographica Sinica, 2024, 79(8): 1883-1897.

[8] Weerakoon, P. (2013). Geovisualization of urban densities using GIS: Case Study in Colombo Metropolitan Area, Sri Lanka.

[9] Martin, D. (1998). Automatic neighborhood identification from population surfaces. Computers, Environment and Urban Systems, 22(2), 107-120.

[10] Bhaduri, B., Bright, E., Coleman, P. et al. LandScan USA: a high-resolution geospatial and temporal modeling approach for population distribution and dynamics. GeoJournal 69, 103–117 (2007).

[11] Zhu, Y., Liu, T. Multi-dimensional population attractiveness and its characteristic changes of mega-city regions in China [J]. Geographical Research, 2025, 44(6): 1691-1708

[12] Fan, J., Tao, A., Lü C. Coupling Trends Between China's Economic and Population Centers and Their Impact on Regional Development [J]. Progress in Geography, 2010, 29(1): 87-95.

[13] Zhu, Y., Yang, Q., Luo, W., et al. Spatial Patterns and Influencing Factors of China's Urban-Rural Population Counterflow [J]. Geographical Science, 2025, 45(7): 1485-1499.

[14] Jiangsu Provincial Bureau of Statistics, Jiangsu Survey Team of the National Bureau of Statistics. Statistical Bulletin on Jiangsu Province's National Economic and Social Development in 2023 [R]. Nanjing: Jiangsu Provincial Bureau of Statistics, 2024.

[15] Wu L, Zhao Y, Wu K. Spatial Coupling Evolution and Mechanism Analysis of Population Structure and Economic Center of Gravity: A Case Study of Jiangsu Province [J]. Exploration of Economic Issues, 2017(12): 11.

[16] Tang S, Zhou J, Deng Y, Xu Q. Spatiotemporal Differentiation and Influencing Factors of Migrant Population Distribution in Cities, Towns, and Villages in Jiangsu Province. Acta Geographica Sinica, 2022, 77(12): 3055-3071

[17] Che B, Qiu F. Spatial Pattern Evolution of Population Distribution in Jiangsu Province at the Town Level [J]. Geographical Research, 2015, 35(11): 1381-1387

[18] Liu, N. Q., Wu, W. P., Liu, S., et al. (2017). Spatiotemporal evolution and influencing factors of population spatial distribution in the Yangtze River Delta urban agglomeration. Urban Observation, 2017(5): 14. DOI: 10.3969/j.issn.1674-7178.2017.05.001.

[19] Wei, Y. H. D., & Ye, X. (2009). Beyond convergence: Space, scale, and regional inequality in China. Tijdschrift voor Economische en Sociale Geografie, 100(1), 59-80.

[20] Yang Y, 2018. ". . IMF Working Papers 2018/276, International Monetary Fund.

[21] Yao, Z., Ye, K., Xiao, L., Wang, X. (2021). Radiation Effect of Urban Agglomeration's Transportation Network: Evidence from Chengdu–Chongqing Urban Agglomeration, China. Land, 10(5), 520.

[22] Guo Y, Zeng G, Chen P, Wan Y. Changes of economic development disparities in the Yangtze River Delta and policy effect analysis from the perspective of Yangtze River Delta integration expansion [J]. PROGRESS IN GEOGRAPHY, 2024, 43(9): 1681-1695

[23] Zhang L, He X X, Jia Z L. Industrial agglomeration, public services and city size: Evidence from 286 cities in China [J]. Land Use Policy, 2023, 131: 106758.

DOI: 10.54254/2753-8818/2026.33337

[24] Tang S, Zhou J, Xu Q, Lin L, Deng Y. Population distribution evolution and influencing factors of city-town-rural area in Jiangsu Province from 2010 to 2020 [J]. PROGRESS IN GEOGRAPHY, 2024, 43(5): 993-1007