

Construction and Measurement of an Indicator System for the Citizenization Capability of New-Generation Migrant Workers

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Abstract: In the rapid urbanization of the Global South, migrant workers have long faced the dilemma of semi-urbanization. China's urban-rural amphibious pattern and circular migration provide a particularly concrete manifestation of this issue. Based on Amartya Sen's capability approach, this study constructs an evaluation system for migrant workers' citizenization capability across three dimensions: employment transition, social interaction, and urban adaptation. The system contains 11 indicators. Using data from the Chinese General Social Survey for 2012-2021, this study applies the entropy-weighted technique for order preference by similarity to an ideal solution (TOPSIS) model and exploratory spatial data analysis. These methods measure the citizenization capability of new-generation migrant workers and examine its spatiotemporal evolution. The results show that: (1) over time, citizenization capability generally follows a fluctuating pattern of rising first, then declining, and then slowly rising again; (2) structurally, urban adaptation capability at the psychological level scores the highest, whereas employment transition capability at the economic foundation level scores the lowest; and (3) spatially, citizenization capability displays a stepwise declining pattern characterized by stronger performance in the east and weaker performance in the west. This study reveals the dual constraints imposed by institutional barriers and insufficient human capital on migrant workers' citizenization. It also proposes policy recommendations, including deepening hukou system reform and improving human capital, with the aim of providing decision-making references for advancing a people-centered new-type urbanization strategy and contributing Chinese experience to the global process of semi-urbanization.

Keywords: new-type urbanization strategy; new-generation migrant workers; citizenization capability; citizenization indicator system

1. Introduction

Rapid urbanization is one of the most profound transformations facing countries in the Global South in the 21st century (World Bank, 2009). In many developing countries in Asia, Africa, and Latin America, large numbers of agricultural residents have completed spatial urbanization. However, constraints in social capital, skill levels, and institutional barriers prevent them from becoming urban residents in a substantive sense. Semi-urbanization has become a key challenge to global sustainable development (Lerch et al., 2025). Accurately measuring the capability of agricultural migrants to integrate into cities is therefore not only a question of population migration, but also a key basis for assessing the quality of global urbanization (Lin & Chen, 2025).

Against this global background, China provides a representative empirical case. As the country with the largest scale, fastest pace, and longest duration of population migration in the world, China has gained substantial demographic dividends from urbanization, while also facing severe structural contradictions (Ma et al., 2024). By the end of 2023, China's distinctive urban-rural dual structure had produced a gap of about 17.9 percentage points between the urbanization rate of the resident population and that of the registered population. The phenomenon of separation between place of residence and household registration embodies the social integration dilemma faced by developing countries worldwide. This issue is especially salient for new-generation migrant workers, whose generational characteristics make them more inclined to pursue substantive social equity and identity recognition. Therefore, constructing a

scientific measurement system for the citizenization capability of China's new-generation migrant workers not only helps address China's real-world problems, but also provides an important reference paradigm for other developing countries facing similar urban-rural transition challenges (Gao & Zhu, 2022). However, existing academic discussions show substantial inconsistency in measuring citizenization or social integration. Previous studies have mostly emphasized macro-level institutional acceptance, such as hukou reform, or individual subjective willingness, such as the willingness to stay in cities, while neglecting the endogenous assessment of capability.

To fill this research gap, this study redefines and measures the citizenization capability of new-generation migrant workers based on Amartya Sen's capability approach. Unlike traditional single economic indicators, this study regards citizenization capability as a multidimensional system that encompasses employment transition, social interaction, and urban adaptation. Using micro-level data from the Chinese General Social Survey (CGSS) for 2012-2021, this study applies the entropy-weighted TOPSIS model and spatial analysis techniques to answer two core questions: How can an evaluation system for citizenization capability be constructed for the transition context of developing countries? What patterns characterize its spatiotemporal evolution? By answering these questions, this study aims to provide empirical evidence and policy implications for inclusive, people-centered urbanization in countries of the Global South from the perspective of individual capability.

2. Literature Review

2.1 *The Connotation of Migrant Workers' Citizenization Capability*

Academic attention to migrant workers' citizenization has deepened alongside China's profound transition from speed-oriented urbanization to quality-oriented urbanization. Early research, influenced by the Lewis dual-sector model and push-pull theory, equated citizenization with labor spatial transfer and occupational transition, implicitly assuming economic determinism. Scholars focused mainly on employment and income, arguing that stable urban jobs and basic living expenses constituted sufficient conditions for citizenization (Zhang, 2013). Citizenization capability was thus narrowly understood as urban survival capability, measured by single indicators such as wage levels and income gaps (Xu, 2008). However, with the spread of semi-urbanization, large numbers of migrant workers have achieved geographical mobility and occupational non-agriculturalization, yet remain in a long-term state of drifting in terms of social identity, access to public services, and psychological belonging. Purely economic indicators can no longer explain the complex realities of high income without integration or strong willingness to integrate but weak capability (Chen & Wang, 2015). This tension between theory and reality has prompted scholars to reconsider the limitations of traditional definitions and to seek a more inclusive and multidimensional theoretical framework.

In response to this theoretical dilemma, Amartya Sen's capability approach has been widely introduced as a theoretical foundation for reconsidering the connotation of citizenization. This approach challenges traditional welfare economics by arguing that the essence of development lies not merely in the accumulation of material wealth or the maximization of utility, but in expanding the substantive freedoms

people enjoy, namely the capability of individuals to achieve various valuable functionings (Sen, 1999). From this theoretical perspective, the concept of citizenization capability acquires a deeper meaning. It is no longer viewed as a passive process of survival adaptation, but as the comprehensive freedom through which individuals use their own endowments (Robeyns, 2003) and transform environmental conditions, such as institutions and social networks (Abel & Frohlich, 2012), to achieve identity transformation, rights acquisition, and psychological recognition in the shift from farmer to citizen (Preibisch et al., 2016). The theory emphasizes that resources are only means of development. The ultimate goal of citizenization lies in capabilities such as participating in urban social life, building broad social connections, gaining social respect, and developing psychological recognition (Bonfanti, 2014). Thus, contemporary research increasingly defines citizenization capability as a dynamic multidimensional system encompassing economic footing, social interaction, institutional acceptance, and psychological adaptation. It emphasizes the comprehensive quality through which individuals acquire resources, transform resources, and ultimately realize their own development in the urban field (Zhang, 2013). This not only broadens the scope of research, but also shifts attention from external institutional constraints to the agency of micro-level actors, that is, the possibility for migrant workers to change their life chances and achieve upward social mobility through their own efforts under given constraints.

It is worth noting that new-generation migrant workers, as the main body of the current agricultural migrant population, display new characteristics in the connotation of citizenization

capability. Unlike the older generation, who followed a circular migration pattern of earning money and returning home, new-generation migrant workers exhibit higher educational attainment, occupational expectations, and demands for material and spiritual enjoyment, alongside lower tolerance for hardship (Wang, 2012). Studies show that the driving force behind this group's citizenization has shifted from a low-level survival orientation to higher-level development-oriented and enjoyment-oriented needs (Li & Tian, 2011). They care about wages, career development, social mobility, and urban cultural acceptance (Huang et al., 2020). For this generation, citizenization capability extends beyond economic survival to encompass social interaction and psychological adaptation (Zhang, 2013; Yang, 2013). Scholars note that these workers face dual marginalization: difficulty integrating into cities while becoming detached from rural society (Yang, 2013). Research must therefore examine social capital accumulation, cultural identity construction, and psychological resilience.

2.2 Construction Logic and Measurement Methods for the Evaluation Indicator System of Migrant Workers' Citizenization Capability

After clarifying the multidimensional connotation of citizenization capability, how to quantify it scientifically becomes the core issue in empirical research. Existing literature shows that the measurement of citizenization capability has evolved from single-dimensional indicators to multidimensional indicator systems, and from subjective weighting to objective weighting (Alkire & Foster, 2011). In terms of indicator construction, early quantitative attempts mostly relied on macro-level statistical data and often selected single indicators such as the urbanization rate, the share of non-agricultural employment, per capita GDP, or wage levels to indirectly reflect the degree of citizenization (Xu, 2008; Liu & Cheng, 2008). This practice

conceals micro-level individual heterogeneity and makes it difficult to reveal capability deficits behind passive citizenization. With the deeper application of the capability approach, existing studies have tended to construct comprehensive evaluation models. For example, some scholars have developed a four-dimensional evaluation model that includes economic integration, social adaptation, cultural acceptance, and psychological identification, aiming to capture migrant workers' urban integration status comprehensively (Zhang, 2013). Other studies have started from the three dimensions of human capital, social capital, and institutional factors, incorporating years of schooling, vocational skills training, social network size, and insurance participation into the evaluation scope (Abel & Frohlich, 2012; Wang & Wang, 2020).

With the rapid development of the digital economy, some studies have sensitively captured the influence of technological change on migrant workers' citizenization and have attempted to incorporate digital literacy into indicator systems. Digital literacy is regarded as a new key capability for improving employment quality and urban adaptability. It covers the ability to use the Internet to obtain employment information, conduct social interaction, and access digital public services (Qi & Wu, 2024). However, existing indicator systems still have limitations. On the one hand, some indicators are too macro-level or theoretical to be directly obtained from large-scale micro-level social survey data, such as CGSS and CMDS, which reduces empirical operability (Fei & Huang, 2022). On the other hand, existing systems mostly emphasize descriptions of objective status, such as whether individuals own

housing or have social insurance (Cheng et al., 2025), while paying insufficient attention to subjective perceived capabilities such as perceptions of social fairness, expectations of class mobility, and identity recognition. They therefore fail to fully reflect the subjectivity and freedom of choice emphasized in the capability approach (Bonfanti, 2014). For new-generation migrant workers in particular, psychological urban identity often better reflects the essence of citizenization than mere material ownership. This is also an important direction for improving future indicator systems.

In terms of measurement and weighting methods, existing studies mainly fall into two approaches: subjective weighting and objective weighting. Subjective weighting methods, such as the analytic hierarchy process (AHP) and expert scoring methods such as Delphi, were widely used in early studies to determine indicator weights (Vaidya & Kumar, 2006). These methods can fully incorporate experts' theoretical experience and reflect differences in the theoretical importance of different dimensions. Their limitations are also clear: weight settings are strongly affected by researchers' subjective preferences, lack objective validation by data, and, when applied to large-sample and multi-variable complex data, may lead to biased evaluation results because of ambiguous human judgment. To overcome these limitations, more scholars have turned to objective weighting methods, such as principal component analysis (PCA), factor analysis, and the entropy method (Shannon, 1948). Objective weighting methods determine weights entirely based on the internal variation and information content of the original data. They can effectively avoid subjective arbitrariness and objectively reflect differences among

evaluation objects. Among them, the combined use of the entropy method and TOPSIS, namely Entropy-TOPSIS, has become a preferred approach in recent years (Zhu & Chen, 2020). This method first uses the entropy method to determine objective weights based on the information entropy of indicators. It then applies TOPSIS to calculate the Euclidean distance between each evaluation object and the positive ideal solution, or optimal state, as well as the negative ideal solution, or worst state (Hwang & Yoon, 1981), thereby deriving the comprehensive closeness coefficient. This combined method not only preserves the integrity of data information, but also clearly ranks the citizenization capability of different regions and groups. It is especially suitable for evaluating complex social systems with multiple dimensions and indicators, and thus provides a more scientific methodological basis for accurately identifying capability deficits among new-generation migrant workers.

2.3 Micro- and Macro-Level Mechanisms Affecting the Citizenization Capability of New-Generation Migrant Workers

The formation and evolution of the citizenization capability of new-generation migrant workers is a complex process shaped by multiple interacting factors. Existing studies mainly analyze the mechanisms that constrain or promote capability improvement from three levels: micro-level individual endowments, meso-level social networks, and the macro-level institutional environment.

At the micro level, human capital is widely recognized as the core endogenous variable that determines citizenization capability. Educational attainment, vocational skill level, and health status directly determine migrant workers' bargaining power and

employment stability in the urban labor market (Wang & Wang, 2020). Studies generally confirm that migrant workers with more years of schooling and formal vocational training tend to have stronger employment transition capability and higher income, and therefore possess a stronger material foundation for establishing themselves in cities (Wang & Wang, 2020; Zhao et al., 2022). In addition, with the penetration of the digital economy, digital literacy is becoming a new component of human capital. Empirical studies show that proficient use of digital technologies can significantly reduce information search costs, broaden employment channels, and improve the employment quality and social capital accumulation efficiency of new-generation migrant workers (He & Wang, 2023).

Beyond educational attainment and social interaction capability, physical and mental health is often an important consideration in migrant workers' urban integration. Studies indicate that migrant workers with left-behind experiences often show lower psychological resilience, poorer physical health, and lower trust in the external world (Fu et al., 2024). Implicit psychological trauma not only affects their mental health in adulthood, but also weakens urban identity through mediating effects, making them more likely to withdraw when facing the pressures of urban life (Fu et al., 2024). In addition, the effect of health status on citizenization capability involves a significant healthy migrant effect or salmon bias. Migrant workers in better health are more likely to remain in cities, while those with deteriorating health tend to return to rural areas. This may cause cross-sectional data to overestimate the average health

level of the city-staying group and conceal potential health vulnerability (Lu & Qin, 2014).

At the meso level, social capital plays a key role as both a lubricant and a bridge in the urban integration of new-generation migrant workers. Unlike the older generation of migrant workers, who mainly relied on strong ties based on kinship and native-place relations, new-generation migrant workers face an urgent need to build weak-tie networks based on occupational and interest-based relations (Li & Tian, 2011). Studies find that broad social interaction not only provides emotional support and alleviates the loneliness of living away from home, but also offers key job-search information and crisis assistance, thereby significantly improving social adaptation capability (Bonfanti, 2014). However, because of residential segregation, such as concentration in urban villages, and the closed nature of workplaces, many new-generation migrant workers' social circles remain confined to hometown networks and cannot truly enter mainstream urban social networks (Yang, 2013). Further studies indicate that the frequency of neighborhood interaction is positively related to social integration. Good community integration can effectively offset the negative effects of institutional exclusion and strengthen settlement intentions (Bonfanti, 2014).

At the macro level, the institutional environment remains the external ceiling that constrains the realization of citizenization capability. Although hukou system reform has continued to deepen, in megacities and super-large cities hukou status remains closely linked to core public services such as education, medical care, and housing

security, creating significant institutional exclusion (Yang, 2013; Liu & Shen, 2026). Institutional barriers not only increase the cost of citizenization for migrant workers, but also negatively affect their psychological expectations. Research shows that the segmentation of the social security system makes migrant workers extremely vulnerable to economic fluctuations and weakens employment stability, thereby suppressing their willingness and capability to stay in cities over the long term (Yang, 2013). Notably, some literature examines the role of non-governmental organizations (NGOs) in compensating for institutional deficiencies. It argues that migrant-worker NGOs, through a strategy of resistance through accommodation, have played a positive role in providing legal assistance and cultural education (Pasquali, 2023). To some extent, they have reshaped the practical forms of citizenship and improved migrant workers' collective bargaining capacity and social visibility (Jakimów, 2017). This suggests that improvement in the institutional environment depends not only on top-down policy reform, but also on participation by bottom-up social forces.

2.4 Literature Review Summary

Overall, existing studies have laid a solid foundation for research on migrant workers' citizenization in terms of conceptual definition, indicator system construction, and analysis of influencing factors. However, further expansion remains necessary. On the one hand, existing studies mostly focus on the willingness to stay in cities, the hukou system, or macro-level urbanization, while paying relatively insufficient attention to migrant workers' actual citizenization capability and its internal structure. On the other hand, studies that use micro-level survey data to

conduct long-term measurement and spatial-difference analysis of citizenization capability remain limited, making it difficult to fully reveal the evolutionary characteristics of migrant workers' citizenization capability across regions. Based on this, this study constructs an evaluation system for the citizenization capability of new-generation migrant workers from three dimensions: employment transition, social interaction, and urban adaptation. It then combines the entropy-weighted TOPSIS model with spatial analysis methods to examine temporal changes and regional differences, with the aim of providing empirical evidence for advancing people-centered new-type urbanization.

3. Theoretical Framework and Indicator System Construction

3.1 Construction Principles

The indicator system for the citizenization capability of new-generation migrant workers is the basis for comprehensive measurement. To ensure the rationality and objectivity of this study and to meet research needs, this study follows the following basic principles when constructing the indicator system for new-generation migrant workers' citizenization capability:

First, usability: indicators should reflect actual mobility patterns and be objective, usable, and quantifiable. Second, scientific validity: the system should reflect multiple capability dimensions, attend to hierarchical structures, and meet empirical testing needs. Third, comprehensiveness: the indicator system should cover individual endowments and urban adaptation jointly, avoid overlap, and ensure completeness for reliable empirical analysis.

3.2 Evaluation Dimensions and Indicator Selection

In this study, new-generation migrant workers are defined as laborers born after the 1980s who have moved to cities to engage in non-agricultural production for six months or longer, whose usual residence is in cities, and whose hukou registration remains in rural areas. According to Amartya Sen's capability approach, capability generally refers to people's feasible ability to live valuable lives according to their own wishes on the basis of freedom and equality. Focusing on new-generation migrant workers, this study clarifies the components of citizenization by considering the process through which farmers enter and integrate into cities, and conducts comprehensive measurement and analysis of their citizenization capability from the perspectives of employment transition, social relations, and urban adaptation.

Employment transition capability denotes the potential to obtain and maintain urban employment, including individual endowments, labor skills, and economic acquisition potential. Social interaction capability refers to integrating into urban life through interpersonal communication, encompassing social relations and status. Urban adaptation capability reflects recognition of urban life in terms of social identity, cultural psychology, and self-perception, including psychological satisfaction and social trust. These three dimensions constitute the measurement indicator system.

3.3 Indicator System for the Citizenization Capability of New-Generation Migrant Workers

Based on the capability components of new-generation migrant workers' citizenization, the construction principles of the indicator system, and data availability, this study constructs an indicator system from three aspects: employment transition

capability, social interaction capability, and urban adaptation capability. Drawing on relevant literature (Zhang, 2022) and the content of the CGSS questionnaire, the system consists of 3 first-level indicators, 8 second-level indicators, and 11 third-level indicators. Details are shown in Table 1.

Table 1 Indicator system for the citizenization capability of new-generation migrant workers

Primary	Secondary	Tertiary	Survey item	Coding
Employment transition	Individual endowments	Health status	Very unhealthy; relatively unhealthy; average; relatively healthy; very healthy	Very unhealthy/relatively unhealthy = 0; others = 1
		Educational attainment	No schooling; primary; junior high; senior high; university; graduate, etc.	Below junior high = 0; others = 1
		Employment status	Employed by others; self-employed; labor dispatch; casual work; freelance, etc.	Labor dispatch/casual/freelance = 0; others = 1
	Economic potential	Employment stability	Worked more than one hour for income last week	No work/unpaid leave = 0; others = 1
		Income level	Annual employment income	Monthly average income
		Social interaction frequency	Neighbor interaction: never; weekly; almost daily, etc.	Never interacts = 0; others = 1
Social interaction	Social communication	Language communication	Mandarin: cannot speak; poor; average; good; very good	Poor/cannot speak Mandarin = 0; others = 1
	Social status	Social class	Social position: 1-10 scale	Below 5 = 0; above 5 = 1
Urban adaptation	Social identity	Social fairness	Social fairness: very unfair; unfair; average; fair; very fair	Very unfair/unfair = 0; others = 1
	Social trust	Social trust	Most people can be trusted: strongly	Strongly/relatively disagree = 0; others = 1

Primary	Secondary	Tertiary	Survey item	Coding
			disagree to strongly agree	
	Life satisfaction	Life happiness	Life happiness: very unhappy to very happy	Very/relatively unhappy = 0; others = 1

4. Research Methods and Data Sources

4.1 Data Description

Considering data availability, the empirical analysis in this study uses data from the Chinese General Social Survey (CGSS). Launched in 2003, CGSS conducts continuous cross-sectional surveys of more than 10,000 households across more than 20 provinces, autonomous regions, and municipalities in mainland China. It collects multi-level information on communities, households, and individuals, summarizes trends in social change, and provides micro-level data for economic and social research. To ensure consistency across regional samples and comparability over time for each indicator, this study selects six waves of micro-level data from CGSS 2012, 2013, 2015, 2017, 2018, and 2021. Continuous cross-sectional samples can be used to analyze both the evolutionary trend of new-generation migrant workers' citizenization capability and differences in citizenization capability across regional samples, while avoiding potential sampling problems in single-year data.

According to the research purpose, the original CGSS data are processed as follows. The research object of this study is new-generation migrant workers. At present, the academic definition of new-generation migrant workers refers to migrant workers born in 1980 or later, whose usual residence is in cities, whose hukou registration is in rural areas, and who are engaged in non-agricultural industries.

Accordingly, samples born before 1980 are removed from the databases for each year, and only residents born after 1980 with rural hukou are retained as valid samples. In addition, abnormal income values and missing values in variables are removed. After screening, the final valid sample sizes are 1,126 in 2012, 1,312 in 2013, 1,351 in 2015, 1,874 in 2017, 1,913 in 2018, and 1,599 in 2021.

4.2 Indicator Weights and Measurement

4.2.1 Entropy Method

The entropy method is one of the most commonly used objective methods for determining weights and originates from information entropy theory. Its basic idea is to calculate the information entropy of each indicator and determine the weight according to the relative degree of variation in each indicator. Indicators with greater relative variation have a larger influence on the overall evaluation and therefore receive higher weights. The relationship between weight and entropy is inverse: the larger the entropy, the smaller the weight; the smaller the entropy, the larger the weight. The magnitude of entropy represents the degree of disorder in a system. Higher entropy indicates greater disorder and less extractable useful information. Thus, entropy and weight show an inverse relationship.

4.2.2 TOPSIS Method

The technique for order preference by similarity to an ideal solution, or TOPSIS, is a commonly used and effective evaluation method. Its advantage lies in its ability to fully exploit the value of data. At the same time, this method is not strictly limited by data distribution or sample size, has broader applicability, and is relatively simple to calculate. TOPSIS is a ranking method that obtains the optimal result by ranking

alternatives according to their distance from the ideal solution. Its basic idea is to calculate the distance between each evaluation object and the optimal and worst solutions. The optimal result is one in which the evaluation object is closer to the optimal solution and farther from the worst solution; otherwise, it is not optimal.

4.2.3 Establishment of the Entropy-TOPSIS Evaluation Model

First, indicator weights are calculated based on the entropy method.

① Construct the initial matrix X :

Suppose there are m evaluation samples, n evaluation indicators. Let x_{ij} ($i=1,2,\dots,m; j=1,2,\dots,n$) denote the observed value of the j -th evaluation indicator for the i -th evaluated sample. The original data matrix, namely the initial matrix X is then constructed as follows:

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix} \quad (4-1)$$

② Data standardization:

To eliminate the potential influence of dimensions on subsequent analytical results, the original data are standardized. The standardized data share the same dimension and can therefore remove this influence. The formulas are as follows:

Positive indicator:

$$x_{ij}^* = \frac{(\max x_{ij} - x_{ij})}{(\max x_{ij} - \min x_{ij})} \quad (4-2)$$

Negative indicator:

$$x_{ij}^* = \frac{(x_{ij} - \min x_{ij})}{(\max x_{ij} - \min x_{ij})} \quad (4-3)$$

③ Calculation of indicator proportions

The proportion of the i -th evaluated object in the j -th indicator is determined through calculation. The formula is as follows:

$$p_{ij} = \frac{x_{ij}}{\sum_{i=1}^m x_{ij}} \quad (4-4)$$

④ Calculation of entropy

This step calculates the entropy value of the j -th evaluation indicator, where $0 \leq e_{ij} \leq 1$. The formula is as follows:

$$e_j = -\frac{1}{\ln n} \sum_{i=1}^m p_{ij} \ln(p_{ij}) \quad (4-5)$$

⑤ Calculation of the variation coefficient

Let the variation coefficient be g_i , which indicates the differences among indicators. The larger the variation coefficient g_i , the more significant the role of the indicator in the comprehensive evaluation indicator system. It therefore provides a reliable basis for analyzing indicator weights. The formula is as follows:

$$g_i = 1 - e_i \quad (4-6)$$

⑥ Determination of indicator weights

Let the indicator weight be W_j , which denotes the weight corresponding to the j -th indicator. The formula is as follows:

$$w_j = \frac{g_j}{\sum_{j=1}^n g_j}, j = 1, 2, \dots, n \quad (4-7)$$

Second, a comprehensive evaluation system is established based on the TOPSIS method.

① Normalize the original data matrix. The normalization process is as follows:

$$R = [r_{ij}], \left(r_{ij} = x_{ij} / \sqrt{\sum_{i=1}^m x_{ij}^2} \right) \quad (4-8)$$

② Weight the normalized original data to obtain the weighted standardized matrix A . The process is as follows:

$$A = W_j * R = \begin{bmatrix} w_1 r_{11} & \cdots & w_j r_{1n} \\ \vdots & \ddots & \vdots \\ w_1 r_{m1} & \cdots & w_j r_{mn} \end{bmatrix} \quad (4-9)$$

③ Determine the optimal and worst solutions

The optimal solution v^+ and the worst solution v^- respectively refer to the sets of the best and worst values of each evaluation indicator. The scheme composed of the optimal values of all evaluation indicators is called the positive ideal solution, while the scheme composed of the worst values of all evaluation indicators is called the negative ideal solution.

④ Calculation of the distances from the optimal and worst solutions

Calculate the Euclidean distance between each evaluation indicator and the positive ideal solution, and also calculate the distance between each evaluation scheme and the negative ideal solution. The formula is as follows:

$$\begin{cases} S_i^+ = \sqrt{\sum_{j=1}^n (v_{ij} - v^+)^2} \\ S_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v^-)^2} \end{cases} \quad (4-10)$$

⑤ Calculation of closeness to the optimal solution

Calculate the relative closeness of each evaluation object to the ideal solution.

The formula is as follows:

$$C_i = \frac{s_i^-}{(s_i^+ + s_i^-)}, i = 1, 2, \dots, m \quad (4-11)$$

where $0 \leq C_i \leq 1$

Finally, this study uses the pivot table function in Excel to aggregate the household-level citizenization capability index into provincial-level mean values, and then conducts an in-depth analysis of the citizenization capability of new-generation migrant workers at the provincial level.

4.3 Spatial Analysis Methods

This study mainly uses the Getis-Ord General G index to analyze the spatial agglomeration characteristics of the citizenization capability of new-generation migrant workers. The calculation formula is as follows (Shi et al., 2022):

$$G = \frac{\sum_{i=1}^n \sum_{j \neq i}^n w_{ij} x_i x_j}{\sum_{i=1}^n \sum_{j \neq i}^n x_i x_j}$$

In the formula, x_i and x_j are the observed values for region i and region j respectively; n is the number of spatial units; and w_{ij} denotes the spatial weight matrix. Under the assumption of normal distribution, the statistical test formula for the G index is as follows:

$$Z(G) = [G - E(G)] / \sqrt{Var(G)}, \quad E(G) = W / [n(n-1)]$$

where $E(G)$ and $Var(G)$ are the expected value and variance of G , respectively.

When G is greater than $E(G)$ and the $Z(G)$ value is significant, it indicates that the citizenization capability of the new generation is spatially clustered in high-value areas. When G is smaller than $E(G)$ and the $Z(G)$ value is significant,

it indicates that the citizenization capability of the new generation is spatially clustered in low-value areas. When G approaches 0, it indicates that citizenization capability is randomly distributed in high-value areas.

Local autocorrelation analysis is mainly used to examine whether clustering exists between the observed value at a single spatial location and the observed values at neighboring spatial locations. Using Local Moran's I as the measurement statistic, the calculation formula is as follows (Anselin, 1995):

$$Local\ Moran's\ I = \frac{(X_i - \bar{X})}{S_i^2} \sum_{j=1, j \neq i}^n W_{ij} (X_j - \bar{X})$$

In the formula, S_i^2 represents the variance of the observed values. Local Moran's I can reflect local spatial characteristics such as spatial heterogeneity and instability in the distribution of spatial variables. Local Moran's I can be divided into four clustering patterns: high-high clustering (HH), low-low clustering (LL), high-low outlier (HL), and low-high outlier (LH).

5. Measurement Results and Analysis

5.1 Measurement Analysis of Different Dimensions of New-Generation Migrant Workers' Citizenization Capability

For the employment transition capability of new-generation migrant workers nationwide, the trend generally shows a pattern of first rising, then falling, and then rising again. The results are shown in Table 2. It reached its highest value in 2015, at 0.5420, indicating that new-generation migrant workers' employment transition capability reached its highest level in recent years in that year. It declined in 2017, but the decline was not severe. In the following years, the capability level continued to

grow steadily, although slowly, and by 2021 it had only barely returned to the 2013 level. Specifically, the employment transition capability of new-generation migrant workers in the eastern and central regions was higher than the national average, with the eastern region reaching the highest value of 0.5102. The western region was below the national average and had the lowest value, at 0.4636.

Table 2 Comparison of different dimensions of new-generation migrant workers' citizenization capability across regions

Dim.	Reg.	2012	2013	2015	2017	2018	2021	Mean
Emp. transition Capability	National	0.4440	0.4866	0.5420	0.4622	0.4736	0.4891	0.4829
	Eastern region	0.4602	0.5095	0.5920	0.4909	0.4995	0.5089	0.5102
	Central region	0.4629	0.4999	0.5138	0.4711	0.4561	0.4941	0.4830
	Western region	0.4176	0.4718	0.5225	0.4359	0.4669	0.4666	0.4636
Social interaction Capability	National	0.8210	0.8196	0.9243	0.5778	0.5788	0.5898	0.7186
	Eastern region	0.8106	0.8037	0.9312	0.5776	0.5683	0.5928	0.7140
	Central region	0.8470	0.8512	0.9271	0.6092	0.6061	0.6078	0.7414
	Western region	0.8246	0.8141	0.9174	0.5638	0.5808	0.5851	0.7143
Urban adaptation Capability	National	0.8270	0.7939	0.9650	0.7329	0.7889	0.8335	0.8235
	Eastern region	0.8491	0.7889	0.9702	0.7451	0.8034	0.8338	0.8317
	Central region	0.8388	0.7729	0.9577	0.7329	0.7501	0.8440	0.8161
	Western region	0.8012	0.8160	0.9673	0.7259	0.8032	0.8284	0.8237

For the social interaction capability of new-generation migrant workers nationwide, the trend generally shows a pattern of remaining stable at first, then rising, then declining, and finally stabilizing. The values in 2012 and 2013 were basically stable, both remaining around 0.8200, with only limited fluctuation. The value reached its highest level in 2015 (0.9243). This indicates that during these years migrant workers' social interaction capability had reached a high level: neighborhood interaction was frequent and close, and their ability to integrate into urban life was strong. The value declined sharply in 2017, marking an obvious turning point, falling

directly from a high level to a medium level (0.5778). In the following years, although the capability level grew steadily, the growth was slow and remained basically at a medium level around 0.5800. Specifically, over the six years, migrant workers' social interaction capability in the central region was higher than the national average (0.7414). The eastern and western regions were both below the national average, with the eastern region showing the lowest value (0.7140). A possible reason for the major turning point in 2017 is that increasingly tense employment conditions and growing economic pressure reduced social interaction capability. The subsequent stabilization may have been affected by the pandemic, which reduced interaction and therefore kept social interaction capability relatively stable.

For the urban adaptation capability of new-generation migrant workers nationwide, the trend generally follows a W-shaped pattern, that is, first declining, then rising, then declining again, and then rising once more. It reached its highest value in 2015 (0.9650), indicating that in that year migrant workers reached their highest level in recent years in terms of social fairness, trust, and life satisfaction. The values declined in both 2013 and 2017, but the former decline was slight while the latter was much more substantial, falling directly from the high level of 0.9650 to the lowest level in recent years (0.7889). In subsequent years, the capability level continued to grow steadily but slowly, and by 2021 it had only barely returned to the 2012 level. Specifically, migrant workers' urban adaptation capability in the eastern and western regions was higher than the national average, with the eastern region

reaching the highest value (0.8317). The central region was below the national average and had the lowest value (0.8161).

5.2 Measurement and Characteristic Analysis of New-Generation Migrant Workers' Citizenization Capability

5.2.1 Comprehensive Analysis at the Provincial Level

Judging from the trends across provinces in Table 3, the citizenization capability index of new-generation migrant workers in each province generally first rose, then declined in 2017, and subsequently increased steadily. From 2012 to 2015, the capability level of new-generation migrant workers' citizenization continued to rise, indicating that more new-generation migrant workers were gaining stronger capability to move toward citizenization. For example, in Shanxi Province, the citizenization capability index increased from 0.7658 to 0.8771, declined slightly in 2017, and then rose steadily in the following years. Overall, the level of citizenization capability had almost reached a relatively high level above 0.7000. The mean values show that differences in average levels were not large. Tianjin ranked first, with a citizenization capability value of 0.8126, while Jilin and Inner Mongolia ranked last, both at 0.7412. According to the rankings, Hebei, Fujian, Guangdong, Shaanxi, Gansu, Ningxia, and other places gradually moved from the second and third tiers into the first tier, showing relatively rapid improvements in citizenization capability. Inner Mongolia and some other places moved from the third tier into the second tier. A small number of provinces, such as Shandong, basically remained in the same tier, showing relatively stable levels of citizenization capability.

At the provincial level, all provinces show a gradual upward trend. The year 2017 was a turning point, when the citizenization capability of new-generation migrant workers declined substantially, followed by a steady upward trend. This observation confirms, at the provincial level, the national trend in the development of new-generation migrant workers' citizenization capability and provides strong evidence for examining the current status of this capability across provinces.

Table 3 Comprehensive measurement of the citizenization capability of new-generation migrant workers

Province	2012	2013	2015	2017	2018	2021	Mean
Beijing	0.7537	0.8197	0.9015	0.6849	0.7185	0.7642	0.7737
Tianjin	0.7960	0.8250	0.9104	0.7609	0.7709	-	0.8126
Hebei	0.7930	0.8044	0.8776	0.7056	0.7457	0.7281	0.7757
Shanxi	0.7658	0.8315	0.8771	0.7144	0.7055	0.7153	0.7683
Inner Mongolia	0.6447	0.7945	0.8754	0.6837	0.7172	0.7318	0.7412
Liaoning	0.7864	0.7897	0.8831	0.7145	0.7443	0.7042	0.7704
Jilin	0.7045	0.8167	0.8783	0.6356	0.6711	-	0.7412
Heilongjiang	0.7109	0.7980	0.8599	0.6917	0.6949	-	0.7511
Shanghai	0.7919	0.8075	0.9096	0.7291	0.7513	-	0.7979
Jiangsu	0.7682	0.8111	0.8880	0.6743	0.7357	0.7264	0.7673
Zhejiang	0.7129	0.8062	0.8940	0.7164	0.7280	0.7197	0.7629
Anhui	0.7570	0.8267	0.8761	0.7307	0.6808	0.7540	0.7709
Fujian	0.7036	0.8001	0.8815	0.7321	0.7596	0.7046	0.7636
Jiangxi	0.7660	0.8111	0.8722	0.6584	0.7137	0.7653	0.7644
Shandong	0.7194	0.8129	0.8870	0.7060	0.7425	0.7460	0.7690
Henan	0.7570	0.8312	0.8744	0.7500	0.7447	0.7410	0.7830
Hubei	0.7496	0.8080	0.8597	0.7043	0.7115	0.6934	0.7544
Hunan	0.7461	0.7985	0.8794	0.6863	0.6867	0.7298	0.7544
Guangdong	0.7842	0.8489	0.8794	0.6892	0.7545	-	0.7912
Guangxi	0.7302	0.8071	0.8797	0.6468	0.7103	0.7126	0.7478
Chongqing	0.7384	0.8109	0.8760	0.7408	0.6796	0.7319	0.7629

Province	2012	2013	2015	2017	2018	2021	Mean
g							
Sichuan	0.7815	0.8233	0.8831	0.7420	0.7476	-	0.7955
Guizhou	0.6858	0.7786	0.8837	0.6908	0.6892	-	0.7456
Yunnan	0.7745	0.7971	0.8751	0.6759	0.7602	-	0.7766
Shaanxi	0.7182	0.8151	0.8743	0.6598	0.7514	0.6681	0.7478
Gansu	0.7333	0.8193	0.8822	0.6799	0.7274	0.7489	0.7652
Qinghai	0.6811	0.7798	0.8687	0.7358	0.7777	-	0.7686
Ningxia	0.7011	0.7805	0.8739	0.6469	0.7152	0.7481	0.7443

5.2.2 Interregional Comparative Analysis

Using the above measurement method, the citizenization capability indices of new-generation migrant workers can also be obtained for China as a whole and for different regions. The results are shown in Table 4. Overall, the citizenization capability of new-generation migrant workers nationwide shows a rise-decline-rise pattern. The year 2017 was an important turning point. Before that, the index reached a high point of 0.8807, then dropped substantially because of saturation in urban absorption capacity. Subsequently, affected by factors such as the pandemic, it recovered steadily but slightly and remained around 0.7. By eastern, central, and western regions, the mean values of the citizenization index were 0.7755, 0.7659, and 0.7563, respectively. Regional differences were not obvious, and the trends were consistent with the national trend. The relatively low level in the western region may be due to a siphon effect, whereby large numbers of new-generation migrant workers flow to the eastern and central regions for employment, resulting in lower local human capital stocks and satisfaction.

Table 4 Measurement of the citizenization capability of new-generation migrant workers across regions

Reg.	2012	2013	2015	2017	2018	2021	Mean
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Reg.	2012	2013	2015	2017	2018	2021	Mean
National	0.7412	0.8090	0.8807	0.6995	0.7263	0.7281	0.7641
Eastern region	0.7581	0.8151	0.8921	0.7109	0.7452	0.7315	0.7755
Central region	0.7569	0.8178	0.8731	0.7073	0.7071	0.7331	0.7659
Western region	0.7189	0.8006	0.8772	0.6902	0.7276	0.7236	0.7563

5.3 Spatiotemporal Evolution Characteristics of New-Generation Migrant Workers' Citizenization Capability

5.3.1 Spatial Distribution Characteristics

Figure 1 depicts the spatiotemporal evolution of citizenization capability in 2012, 2015, 2018, and 2021, classified into five levels using the natural breaks method. In 2012, high-capability regions were concentrated in Liaoning, Hebei, Tianjin, Sichuan, Shanghai, and Guangdong, while low-capability regions included Inner Mongolia, Heilongjiang, Jilin, Qinghai, Ningxia, Shaanxi, Shandong, Guizhou, Zhejiang, and Fujian. By 2018, extreme levels appeared in Qinghai, Yunnan, Fujian, and Tianjin, with very light or light levels in Inner Mongolia, Heilongjiang, Jilin, Ningxia, Shanxi, Beijing, Chongqing, Hubei, Anhui, Guizhou, Hunan, Jiangxi, and Guangxi. In 2021 (with some missing data), Beijing and Jiangxi showed extreme levels, while Liaoning, Shanxi, Shaanxi, Hubei, Fujian, and Guangxi showed very light or light levels. Overall, high-capability regions shifted from eastern concentration toward central and western regions over time.

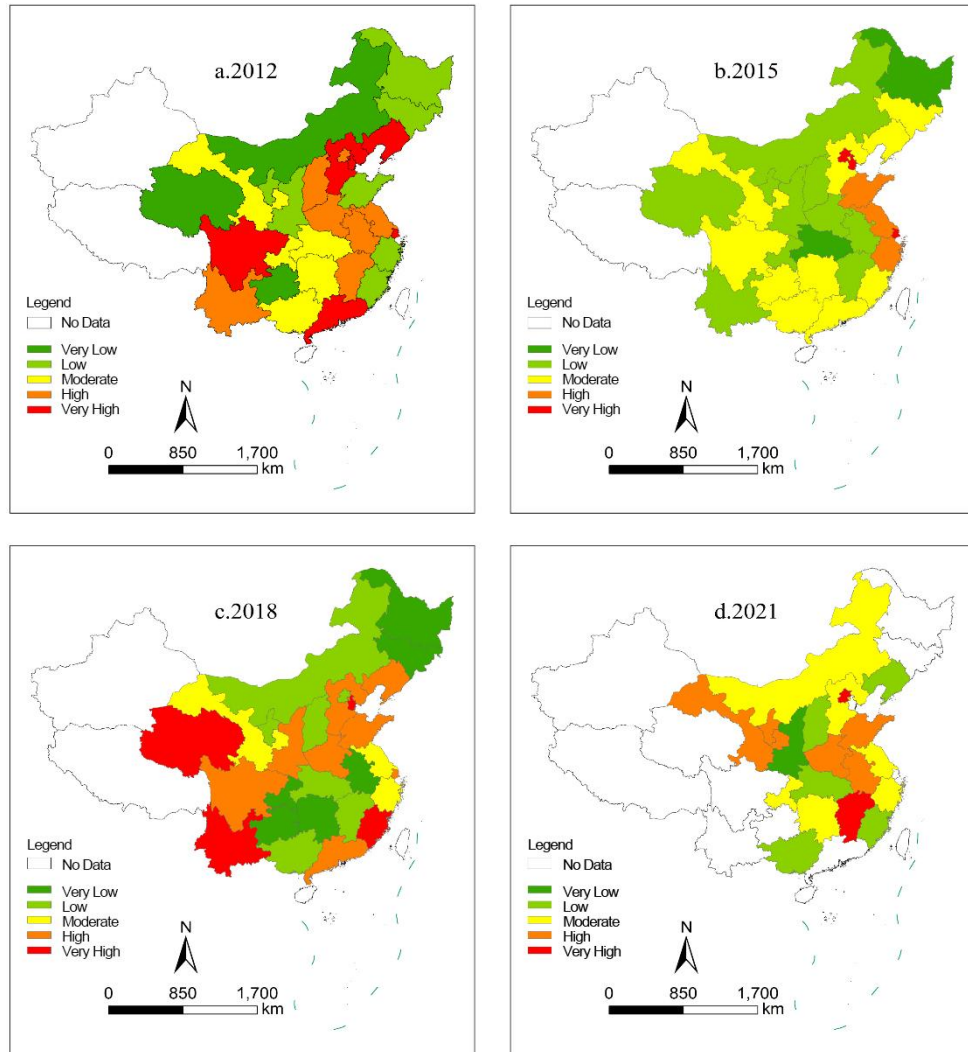


Figure 1 Spatial distribution map of the citizenization capability of new-generation migrant workers

5.3.2 Spatial Agglomeration Characteristics

Table 5 presents changes in the observed and expected values of the General G index for new-generation migrant workers' citizenization capability, as well as its variance, z-score, and p-value from 2012 to 2021. As shown in the table, during this period the observed value of General G increased from 0.163 in 2012 to 0.221 in 2021. However, the observed values of the General G index fluctuated only slightly during the period, and the overall trend was not obvious. The expected values (0.164 to 0.222) remained stable over the same period and showed no significant changes, indicating a

certain overall stability without an obvious trend. Over time, the z-score showed inconsistent changes, with both increases and decreases, reflecting some fluctuation. The p-value results show that, except for 2015, when the p-value barely reached the significance level, the other years were not significant. In sum, in the later stage of the study period, there was no significant spatial association in the level of new-generation migrant workers' citizenization capability among regions in China.

Table 5 General G index of the citizenization capability of new-generation migrant workers

Indicator	2012	2013	2015	2017	2018	2021
Observed General G	0.163	0.164	0.163	0.164	0.163	0.221
Expected General G	0.164	0.164	0.164	0.164	0.164	0.222
Variance	0.000	0.000	0.000	0.000	0.000	0.000
z-score	-0.576	0.717	-1.800	-0.430	-0.999	-0.722
p-value	0.565	0.473	0.072	0.667	0.318	0.470

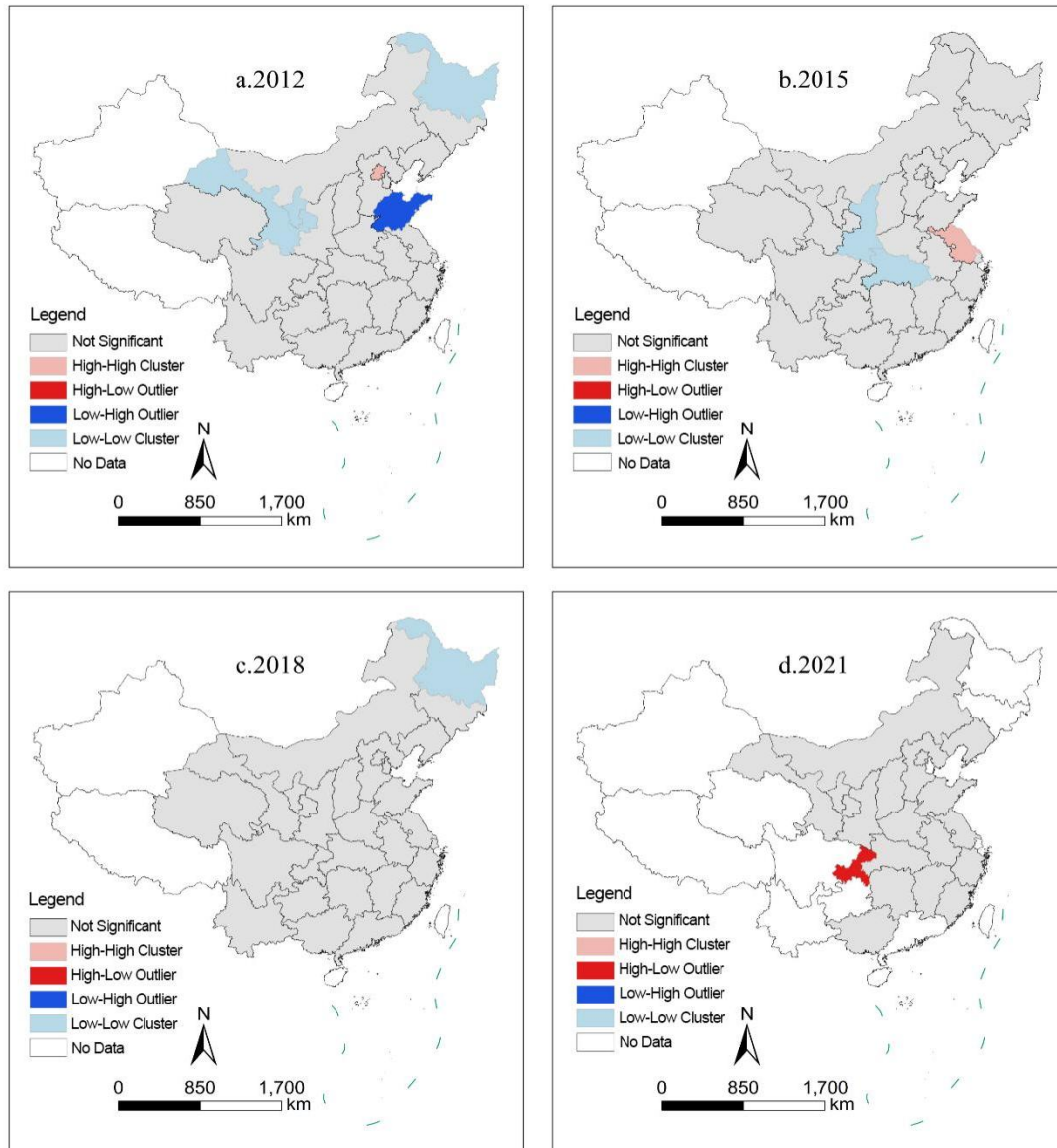


Figure 2 Local autocorrelation distribution map of the citizenization capability level of new-generation migrant workers

Further, ArcGIS is used to analyze the local autocorrelation characteristics of the citizenization capability level of new-generation migrant workers (Figure 2). The level of new-generation migrant workers' citizenization capability in China shows four types of characteristics: high-high clustering, low-low clustering, high-low outliers, and low-high outliers. In 2012, low-low clustering areas were distributed in Gansu and Ningxia; in 2015, low-low clustering areas were distributed in Shaanxi and Hubei. This means that in these specific geographic areas, the level of new-generation

migrant workers' citizenization capability was low and clustered together. In 2021, a high-low outlier appeared in Chongqing, indicating a clear gap between Chongqing and surrounding areas in the level of new-generation migrant workers' citizenization capability. Compared with 2012, the spatial clustering characteristics in 2018 changed significantly. No other clustering characteristics were observed, and only a low-low outlier appeared in Heilongjiang. In 2021, only a high-low outlier appeared in Chongqing.

6. Conclusions and Recommendations

6.1 Main Conclusions

Based on existing academic research and data availability, this study selects 11 indicators from three dimensions, namely employment transition capability, social interaction capability, and urban adaptation capability, to construct an evaluation indicator system for the citizenization capability of new-generation migrant workers. The entropy-weighted TOPSIS method is used to measure the overall level of migrant workers' citizenization capability, and the same method is applied to measure the capability levels of the three subdimensions: employment transition capability, social interaction capability, and urban adaptation capability. A comprehensive analysis of the measurement results is then conducted. The main findings are as follows:

(1) The overall level of the citizenization capability of new-generation migrant workers in China has reached a relatively high level. It peaked in 2015, declined rapidly in 2017, and then showed a slow growth trend in the following years. At the

provincial level, there are large differences in the level of citizenization capability among provinces.

(2) Across dimensions, new-generation migrant workers have the highest urban adaptation capability, followed by social interaction capability, while employment transition capability is the lowest. Across regions, the ranking of employment transition capability is: eastern region higher than central region, and central region higher than western region. The ranking of social interaction capability is: central region higher than western region, and western region higher than eastern region. The ranking of urban adaptation capability is: eastern region higher than western region, and western region higher than central region. The comprehensive citizenization capability of new-generation migrant workers ranks as follows: eastern region higher than central region, with the western region ranking last.

(3) Whether considering subdimensions or total capability, regional rankings differ across dimensions. Although the eastern region ranks relatively low in social interaction capability, its higher urban adaptation capability and employment transition capability mean that its overall citizenization capability for new-generation migrant workers still ranks first. In addition, employment transition capability and social interaction capability in the central region are higher than those in the western region. Although urban adaptation capability in the central region is lower than in the western region, the gap is not obvious. This determines that the overall citizenization capability of new-generation migrant workers in the central region is higher than that in the western region. It can therefore be concluded that in recent years, the level of

new-generation migrant workers' citizenization capability has declined from east to west, with the western region ranking last. This conclusion is broadly consistent with Zhang (2023). It indicates that the measurement method is feasible and that the measurement conclusions are credible.

6.2 Policy Recommendations

6.2.1 Deepening Hukou System Reform

At the current stage, the urban-rural dual hukou system is the main source of income inequality after new-generation migrant workers enter cities, and it also restricts the improvement of their citizenization capability. Relaxing settlement conditions, simplifying settlement procedures, and eliminating discriminatory policies against migrant workers can make it easier for them to obtain urban hukou and enjoy the same treatment as urban residents. Hukou system reform should be integrated with urban development planning to guide population mobility rationally and avoid excessive concentration or waste of resources. By encouraging the free cross-regional mobility of new-generation migrant workers, market allocation efficiency can be improved and regional income gaps can be narrowed. In addition, social integration policies should be strengthened. Such policies help migrant workers better adapt to urban life. The government should organize cultural exchange activities and provide language and cultural adaptation training. These measures promote mutual understanding and communication between migrant workers and urban residents, and strengthen their sense of social belonging.

6.2.2 Accelerating Urban-Rural Integration

Urban-rural integration does not simply mean promoting population movement into cities. Rather, it should focus on the capability deficits in the citizenization of new-generation migrant workers and improve their urban adaptation capability, social

interaction capability, and employment transition capability by region and by dimension. According to the measurement results above, the eastern region has a relatively high overall level of citizenization capability but insufficient social interaction capability; the central region has strong social interaction capability but still needs to improve urban adaptation capability; and the western region is relatively weak in employment transition capability and comprehensive citizenization capability. Therefore, differentiated policy arrangements should be proposed for the eastern, central, and western regions according to their different development foundations, focusing respectively on urban adaptation, social interaction, and employment transition.

First, in improving urban adaptation capability, policy should lower institutional barriers and strengthen urban public service capacity. In the eastern region, high living costs and settlement thresholds necessitate optimizing the points-based settlement and residence permit systems. Public services such as education, affordable housing, medical care, and social insurance should match the resident population size. Functional linkages among central urban areas, satellite cities, and surrounding counties should be strengthened through rail transit and cross-regional public service mechanisms to guide stable residence within metropolitan areas. In the central region, policy should improve the carrying capacity of medium-sized cities and county seats, filling infrastructure gaps in education, medical care, elderly care, housing, and public transportation. Counties undertaking industrial transfer should advance industrial parks, living communities, and public services simultaneously to avoid semi-urbanization. In the western region, priority should be given to closing public service gaps in county seats and prefecture-level cities, improving basic

education, healthcare, social security, and housing security. Cross-regional social security transfers, medical expense settlement, and school enrollment guarantees for accompanying children should be strengthened to foster stable urban life expectations.

Second, in improving social interaction capability, policy should strengthen social network supply and promote transition from acquaintance-based clustering to urban integration. In the eastern region, communities, trade unions, enterprises, and social organizations should establish integration platforms, increasing public cultural activities, occupational exchanges, legal assistance, and psychological counseling. Family-based and occupation-based group migration may be encouraged, but traditional strong ties should be transformed into bridging social networks through community activities, vocational training, and public service platforms. In the central region, family migration and stable settlement should be promoted, improving mechanisms for non-local population participation in community governance. Excessive reliance on kinship and native-place networks should be avoided by guiding migrant workers into open occupational and professional networks. In the western region, grassroots communities, industrial parks, and labor cooperation organizations should jointly build social support systems. Stable employment service stations and migrant worker service centers should be established to provide employment information, rights protection, and psychological support.

Third, in improving employment transition capability, policy should raise individual human capital and strengthen county-level employment absorption. In the eastern region, policy emphasis should shift from expanding job opportunities to improving employment quality. Skills training, vocational qualification certification, and continuing education systems should be established around advanced manufacturing, modern services, and the digital economy. Regulation of flexible

employment, platform employment, and labor dispatch should be strengthened to improve labor contract signing, social insurance coverage, and occupational safety. In the central region, employment transition improvement should be integrated with county-level industrial development. County-level industrial chains should be cultivated in agricultural product processing, equipment manufacturing, logistics, e-commerce, and cultural tourism. Order-based training, school-enterprise cooperation, and employment service stations should improve transition capability from agricultural to non-agricultural employment. In the western region, investment in vocational education, skills training, Mandarin training, and digital skills should be increased. Employment absorption capacity should be strengthened through specialty agriculture, deep processing, rural tourism, ecological industries, and county-level public service positions. For workers willing to return and start businesses, entrepreneurship training, financial support, and market-connection services should be provided.

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Ethical Approval: This article does not contain any studies with human participants performed by any of the authors. The study uses secondary, anonymized data from the Chinese General Social Survey (CGSS), which was originally collected by the National Survey Research Center at Renmin University of China with their own ethical approval procedures.

Informed Consent: This article does not contain any studies with human participants performed by any of the authors. Informed consent was obtained by the original data collector (CGSS) from all survey participants during the data collection process.

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