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The Impact of Labor Mobility on Urban-Rural Integration - A Case Study of Eastern China

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Abstract: ***Urban-rural integration is an important means to maintain steady and high-quality economic growth at this stage. In order to better promote urban-rural integration, narrow the urban-rural gap, and achieve common prosperity for all people, this paper uses the entropy method to scientifically measure the development level of urban-rural integration in counties and regions in the eastern region from 2000 to 2022. Based on the survey data of the "China County Statistical Yearbook" and the China Economic Database, a scientific indicator of labor mobility is constructed, and a general equilibrium model of urban-rural integration is constructed, and then its impact effect and mechanism on urban-rural integration in counties and regions are analyzed. This study found that: First, with the passage of time, the level of urban-rural integration has basically shown a general upward trend. Among them, the counties around the Beijing-Tianjin area, the Yangtze River Delta area and the Pearl River Delta area have a higher level of regional urban-rural integration; second, labor mobility significantly promotes the improvement of the level of urban-rural integration development; third, the role of labor mobility in promoting the level of urban-rural integration development is achieved through two "engines": human capital aggregation and labor participation rate improvement.***

Keywords: Urban-rural integration, Labor force mobility, Human capital concentration, Labor force participation rate.

1. Introduction

Urban-rural integration is an important symbol of China's modernization and a key measure to break the urban-rural dual structure, expand the space for high-quality development, and realize common prosperity for all people [1]. The CPC Central Committee attaches great importance to urban-rural integration and is committed to providing institutional guarantees for urban-rural integration. Since the reform and opening up, especially since the 18th CPC National Congress, the CPC has made a series of policies to promote urban-rural integration and build a new type of urbanization. In the report of the 19th CPC National Congress, the CPC clearly proposed to "establish and improve the institutional mechanisms and policy systems for urban-rural integration", and in 2019 proposed to build a national urban-rural integration development pilot zone. In the Central Document No. 1 of 2021, it was proposed to "accelerate the urban-rural integration development within the county", and in the report of the 20th CPC National Congress, it was pointed out that "adhering to urban-rural integration and unblocking the flow of urban and rural factors" is necessary. This shows that the CPC Central Committee attaches great importance to and has made important strategic arrangements to provide institutional guarantees for urban-rural integration. China's economy is facing the Lewis turning point and the demographic dividend is weakening. In order to maintain long-term sustainable growth, it is urgent to tap the potential for economic growth and form a more balanced development model. The meaning of the topic is to take counties and regions as important entry points, promote the integrated development of urban and rural economies, break the dual economic structure of urban and rural areas, achieve integrated development, and enhance the vitality of urban and rural economies on the basis of filling the gaps in rural economic development. However, today, factors such as unbalanced and unreasonable resource allocation, unsmooth factor flow, and poor driving effect of developed regions on underdeveloped regions still restrict the improvement of the level of urban-rural integrated development, the urban-rural income gap is still large, and the characteristics of the urban-rural dual structure are obvious.

Lewis (1954) pointed out that under the dual economic structure, the wage level of the industrial sector only needs to be slightly higher than that of the agricultural sector to attract agricultural labor to move to cities. China's rural areas are dominated by the primary industry, but the primary industry has low production efficiency and its income is also lower than that of the secondary and tertiary industries. The rural population still accounts for the majority of China's population. With the development of science and technology, the labor force required for agriculture has decreased, and there is a large amount of surplus labor in rural areas. With the increase in labor demand for industrialization and the attraction of higher incomes in cities after the reform and opening up, the phenomenon of migrant workers moving to cities for work has emerged in China. In addition, due to the restrictions of different regional policies and resources, the economic development level and people's living and income levels between regions are different, and the labor force is attracted by the income level and will also move between regions. Labor mobility is a typical feature of the entire dual economic development period since the reform and opening up. The characteristics of labor mobility at this stage are more obvious, mainly rural labor flowing into cities, supplemented by two-way labor flow between regions [2]. Labor mobility is a process of pursuing "city light", mainly from underdeveloped areas to developed areas, from rural areas to cities, in pursuit of more employment and entrepreneurship opportunities and better and more adequate basic public services that cities can provide. The flow of labor between urban and rural areas, counties, districts, and provinces has accelerated the rapid flow of labor factors, optimized the allocation efficiency of labor factors, improved the marginal productivity of capital, narrowed the income gap between urban and rural areas, and promoted the rapid growth of China's economy [3].

The eastern region involves multiple provinces and spans

north and south vertically. There are large differences in economic development levels, infrastructure construction and natural resources between counties and regions. Since the reform and opening up, some counties and regions in the eastern region surrounding the Beijing-Tianjin-Hebei region, the Yangtze River Delta and the Pearl River Delta have relied on policy inclinations, good geographical environment, perfect infrastructure and abundant natural resources. Industries have rapidly gathered and established multiple dense industrial parks. The economic development momentum is good, and it is an agglomeration area for labor mobility in China. In addition, some counties and regions in the eastern region are geographically remote, policy inclinations are not strong enough, infrastructure is not perfect, natural resources are not rich enough, economic development is relatively backward, labor mobility between urban and rural areas and between regions is weak, and it is difficult to attract high-quality labor. There are large differences in economic development levels, labor flow quantity and quality, and urban-rural integration development levels between counties and regions in the eastern region. Starting from counties and regions, the impact of labor mobility on the level of urban-rural integration development is studied, and the eastern region is a typical region. Starting from the eastern region where the development differences between counties and regions are large, studying the relationship between the level of urban-rural integration development and labor mobility is of reference significance for the formulation of China's policies.

The rest of this paper is structured as follows: the second part reviews the relevant literature on the study of urban-rural integration from the perspective of labor mobility, the third part is theoretical analysis and research hypotheses, the fourth part introduces the model and variables of this paper, the fifth part is benchmark regression analysis, the sixth part is mechanism testing, and finally the conclusions and suggestions of this paper are given.

2. Literature Review

Cities and villages are an organism. Only when they develop sustainably can they support each other (Liu Yansui, 2018) [4]. Realizing urban-rural integration is an inevitable requirement for China's economy to maintain long-term sustainable growth under the Lewis turning point. Narrowing the urban-rural gap, promoting balanced urban-rural development, and achieving equal quality of life for urban and rural residents are important goals of rural revitalization and urban-rural integration (He Renwei, 2018) [5]. How to promote urban-rural integration? Existing research mainly analyzes from the following aspects. First, from the institutional perspective, with the in-depth implementation of the rural revitalization strategy, the urban-rural relationship has entered a new stage of integrated development (Liu Chunfang et al., 2018; Ge Dazhuan et al., 2020;) [6-7]. Second, from the government perspective, under the new normal, actively promote the construction of a "good governance" government, reasonably adjust the game power between the government's "supporting hand" and "predatory hand", and promote the sustainable and healthy development of China's urban-rural integration (Zhang Kejun and Du Chan; 2019; Zhou Jianing et al., 2019) [8-9]. Third, from the perspective of factors, the lagging reform of urban and rural factor markets has led to the restriction of urban and rural factor mobility. The resulting mismatch of urban and rural factors has seriously restricted the improvement of the level of urban-rural integrated development (Liu Minghui and Lu Fei, 2019) [10]. Zhang Haipeng (2019) believes that it is necessary to accelerate the integration of urban and rural factor markets and overcome the weak links in urban-rural integrated development. Existing research on urban-rural integration mainly focuses on human capital deepening (Huang Xiaoming, 2014) [11], land market (Chen Kunqiu et al., 2019) [12], digital economy (Fang Xiaotong, 2023) [13], etc., but lacks research on urban-rural integration from the perspective of labor mobility.

Economists have long believed that the flow of labor from the low-productivity agricultural sector to the high-productivity non-agricultural sector is one of the important mechanisms of economic growth (Lewis, 1954). In terms of resource allocation, the rational flow of labor improves the efficiency of resource allocation, is conducive to the optimal allocation of resources, and thus drives economic growth (Wang Xiaolu et al., 2004; Fan Shide et al., 2011; Hou Xiaoting et al., 2023) [14-15]. In terms of labor productivity, since labor can flow freely, labor can be left over from agriculture and gradually transferred to non-agricultural industries in cities under the guidance of the urban-rural income gap, thereby improving labor productivity and promoting economic growth (Li Shi, 1999; Cai Fang, 2001) [16]. In terms of industrial upgrading, labor mobility induces enterprise transfer, forms industrial agglomeration, and industries compete with each other, thus promoting industrial upgrading (Fan Jianyong et al., 2004; Gao Bo et al., 2012) [17-18]. In short, under the new normal of economic development, labor mobility is still related to the continuation of the "Chinese miracle" (Cai Fang, 2013; Du Yang et al., 2014).

The report of the 20th CPC National Congress pointed out: "Adhere to the priority development of agriculture and rural areas, adhere to the integrated development of urban and rural areas, and smooth the flow of urban and rural factors." Will labor mobility promote the integrated development of urban and rural areas? Existing research related to urban-rural integration from the perspective of labor mainly focuses on the following perspectives. From the perspective of income gap, scholars generally believe that promoting the reverse flow of surplus urban labor to rural areas can narrow the income gap between urban and rural residents (Huang Dawei, 2013; Yu Yongze et al., 2019; Yin Zhichao et al., 2020; Jiang Fuxin et al., 2022) [19-21]. From the perspective of public services, Cai Fang (2018) described urbanization, which is manifested as the migration of rural residents to cities, as a process of chasing "city light". The city light here does not only refer to the more colorful cultural life in the city, but also to the better and more sufficient basic public services that the city can provide. From the perspective of total factor productivity, Du Yang et al. (2014) believed that labor mobility is conducive to expanding the size of the labor market and improving the total factor productivity of the urban economy. Although it has a negative impact on the capital output ratio and working hours, the net benefits brought by labor mobility are very considerable and are conducive to improving total factor productivity [22].

In summary, a large number of literatures have explored how to promote urban-rural integration from different aspects on the premise of explaining the connotation of urban-rural integration. In terms of labor mobility, economists generally agree that labor mobility will promote economic growth, and have analyzed the role of labor mobility from different angles. However, the research on the impact of labor mobility on urban-rural integration is not comprehensive enough, especially the research on counties and regions in the eastern region is even more lacking. Based on this, the marginal contribution of this paper is as follows: First, the paper starts with counties and regions in the eastern region, enriching the research results on the impact of labor mobility on urban-rural integration. Second, this paper uses the entropy weight method to scientifically construct a comprehensive indicator of urban-rural integration level, and reveals the internal mechanism of the impact of labor mobility on urban-rural integration. The study found that labor mobility promotes urban-rural integration through the aggregation of human capital and the increase of labor participation rate. Third, based on the differences in the degree of urban-rural integration and the conclusions drawn from the study, this paper puts forward some policy recommendations. It provides a new perspective and evidence for understanding the issue of urban-rural integration, and can provide a reference for policy formulation to promote high-quality economic development.

3. Theoretical Analysis and Research Hypothesis

According to the Todaro model (Todaro, 1969), the expected income gap between urban and rural areas is the main factor affecting the flow of rural labor. The larger the gap, the more people flow into cities. On the one hand, due to the influence of higher wages in cities, labor flows from rural areas to cities, which increases the personal income of rural residents, narrows the income gap between urban and rural areas, and increases the driving force for the development of rural economy. On the other hand, labor is liberated from sectors with relatively low production efficiency and flows into sectors with higher production efficiency. Compared with cities, the influx of cheap labor has increased the total factor productivity of cities. Specifically: First, the increase in personal income often leads to an increase in consumption. Economic people are often rational, and labor will automatically flow into cities with industrial clusters due to the attraction of high wages. High wages will make labor save while spending part of it on household expenses. The increase in rural household consumption and the increase in expenditure ratio are more conducive to the improvement of the level of urban-rural integration. Second, resources are often allocated preferentially in developed areas. The public services, education levels, and medical levels in developed areas are higher, and labor flowing into cities can also enjoy better resources in cities. Moreover, at this stage, most of the incoming labor force moves with their families, and the next generation of the incoming labor force can enjoy a better level of education, which can promote urban-rural integration in the long run. Third, cities often have better services and more advanced technologies. Due to the constraints of the household registration system, the labor force often cannot stay in the city forever. However, the advanced technology learned by the labor force in the city can be brought back to the countryside by the labor force, which will promote industrial upgrading and technological innovation in rural areas, meet the needs of rural residents, improve the production efficiency and public service level in rural areas, and reduce the urban-rural gap. Based on this, this paper proposes the theoretical hypothesis:

Theoretical hypothesis 1: Labor mobility helps promote urban-rural integration

Confucius said, “It is not the lack of wealth that is worrying, but the inequality of wealth.” Here, we want to emphasize “the inequality of wealth.” Adhering to this idea, we often say that we should both make the cake bigger and divide it well. It should be pointed out that there has long been institutional inequality in resource allocation. As mentioned earlier, resources are often allocated in more developed areas, which has greatly aggravated the opposition between the urban and rural dual structure. The flow of labor within the urban and rural areas and the concentration in areas with more developed resources and better infrastructure can help to remove the obstacles to resource allocation to a large extent. There has long been a wage gap between urban and rural residents in the economic system. The flow of labor can enable workers to quickly improve their skills and thus increase their personal income. In addition, by improving their personal skills, workers can also better build the countryside and narrow the urban-rural gap through the return of talents. There has long been an imbalance in social services in the social system, and the flow of labor and the concentration of human capital can enable workers in underdeveloped areas to enjoy better public services in developed areas, parents of workers in underdeveloped areas to enjoy better medical services in developed areas, and children of workers in underdeveloped areas to enjoy better educational resources in developed areas. Based on this, this paper proposes a mechanism hypothesis:

Mechanism hypothesis 1: Labor mobility promotes urban-rural integration through human capital aggregation

The economy has maintained steady growth, especially the expansion of non-agricultural industries in developed regions, which has created a strong demand for workers. At the same time, labor mobility can gather human capital. The expansion of non-agricultural industries in developed regions has increased the demand for workers, which will increase the per capita wage under the condition of a certain labor supply in developed regions. At this time, workers who were originally engaged in agricultural production in underdeveloped regions and met the skill requirements will automatically flow into developed regions driven by the profit-seeking instinct, thereby promoting the aggregation of human capital and increasing the labor participation rate in non-agricultural industries. Increasing the labor participation rate in non-agricultural industries will help increase workers’ personal income and narrow the wage gap between urban and rural workers. In addition, the aggregation of human capital and the increase in the labor participation rate will guide the flow of funds. The inflow of funds into non-agricultural industries will help create an atmosphere of innovation, thereby promoting the upgrading of industrial structure and infrastructure construction, improving production efficiency

and talent treatment, narrowing the urban-rural gap, and ultimately promoting urban-rural integrated development. Based on this, this paper proposes a mechanism hypothesis:

Mechanism hypothesis 2: Labor mobility promotes urban-rural integration by increasing labor force participation rate

4. Model and Variables

4.1 Data Sources

Since the level of urban-rural integration development is difficult to measure with a single variable, this paper selects 5 first-level indicators and 14 second-level indicators. The measurement indicators, core explanatory variables, control variables and mechanism variables of the level of urban-rural integration development used in this paper are all selected from the "China Statistical Yearbook", "China County Statistical Yearbook", "China Labor Statistical Yearbook", China Economic Database, Statistical Bulletins of Counties and Cities, and Guotai'an Database. Considering the availability and authenticity of the data, this article selects panel data of counties and regions in the eastern region from 2000 to 2022, and the survey sample covers 842 counties and regions. In order to make the data more convincing, some counties and regions that have been revoked in the selected years are also preserved. In order to maintain the integrity of the data, we use linear interpolation to fill missing values and outliers.

4.2 Explained Variables

The core explained variable of this paper is the situation of urban-rural integration. Urban-rural integration is a multi-dimensional, multi-level, and comprehensive concept. It is one-sided and unscientific to explain it only through a certain proxy variable. Therefore, based on the subdivision of urban-rural integration in the "14th Five-Year Plan New Urbanization Implementation Plan", this paper selects 5 first - level indicators and 14 second-level indicators based on authoritative literature, and constructs a comprehensive indicator to score the level of urban-rural integration development. The specific construction of the urban-rural integration development indicator constructed based on the literature review is shown in Table 1.

Table 1: Measurement indicators and weights of urban-rural integration

Target	First level indicator	Secondary indicators	Indicator calculation formula	Indicator properties
Urban-rural integration	Economic Integration	The proportion of added value of the primary industry	Value added of primary industry/ GDP/%	–
		The proportion of added value of the secondary industry	Value added of secondary industry/ GDP/%	+
		The proportion of added value of the tertiary industry	Added value of tertiary industry/ GDP/%	+
	Political integration	Per capita total social fixed asset investment	Total social fixed asset investment/registered population/ten thousand yuan	+
		Science expenditure share	General public budget expenditure_Science and technology/General public budget expenditure/ %	+
	Social Integration	Per capita real estate development investment value	Real estate development amount/registered population	+
		Proportion of crop planting area	Crop sowing area/land area/ %	–
		The proportion of employment in the secondary industry	Number of people employed in the secondary industry/registered population/ %	+
		The proportion of employment in the tertiary industry	Number of people employed in the tertiary industry/registered population/ %	+
	Life Integration	Per capita quota of social consumer goods	Total retail sales of consumer goods/permanent population/yuan	+
		Per capita disposable income difference	Per capita disposable income of urban residents/per capita disposable income of urban and rural residents/yuan	–
		Bed ratio of medical and health institutions	Number of beds/registered population	+
	Educational Integration	Teacher-Student Ratio	Number of students in ordinary primary schools/Number of teachers in ordinary primary schools	–
		Public library books per capita	Total collection of public libraries/registered population	+

The next more critical question is, based on the construction of indicators, how to quantitatively analyze the level of urban-rural integration? In terms of the existing indicator system measurement methods, the entropy weight method, which is an objective weighting method applied to the evaluation indicator system of multiple objects and multiple indicators, has two advantages. First, it is completely weighted based on the data variability, which is objective and credible, and meets the quantitative and objective scientific requirements of the economic urban-rural integration development index. Second, it can deeply reflect the distinguishing ability of indicators. By objectively weighting each indicator, it reflects the contribution of each component indicator, which is suitable for the needs of this paper to analyze the development of urban-rural integration in different dimensions [24]. Therefore, this paper adopts the entropy weight method to construct the urban-rural integration indicator system.

The selected provincial panel data are dimensionless processed using the extreme value method:

Positive indicators:

$$X'_{ij} = \frac{X_{ij} - minX_j}{maxX_j - minX_j} \quad (1)$$

Negative indicators:

$$X'_{ij} = \frac{maxX_j - X_{ij}}{maxX_j - minX_j} \quad (2)$$

To prevent the processed results from being zero and affecting subsequent calculations, all processed data are shifted by 0.01 units, that is, 0.01 is added to each processed data.

In the entropy weight calculation formula, i represents the year (i=2000, 2001... 2022); j represents each indicator (j=1, 2...14); $maxX_j$ represents the maximum value of the j-th data;

$\min X_j$ represents the minimum value of the j-th data; X_{ij} represents the data before processing; X'_{ij} represents the data after processing.

Calculate the weight of the indicator in the i-th year under the j-th indicator:

$$P_{ij} = \frac{X'_{ij}}{\sum_{i=1}^{14} X_{ij}} \quad (3)$$

Calculate the entropy weight of the jth indicator:

$$E_j = -\sum_{i=1}^{14}(p_{ij} \ln p_{ij}) \quad (4)$$

Calculate the weight of the jth indicator:

$$W_j = \frac{1-e_j}{\sum_{j=1}^{14}(1-e_j)} \quad (5)$$

Calculate the composite index:

$$s_j = \sum_j W_j P_{ij} \quad (6)$$

4.3 Core Explanatory Variables

The core explanatory variable of this paper is labor mobility (mig). The flow of labor in counties and regions is mainly between urban and rural areas and between regions. This paper defines the population living in a certain area for three months or more as the permanent population of the area, and the population registered in the local household registration management agency as the registered population of the area. The labor force that lives in a region for three months or more but does not obtain the household registration of the region is defined as the floating population of the region. The article uses "a certain county or region's permanent population and a certain county or region's registered population" as a proxy variable, and measures the amount of labor mobility by measuring the difference between the permanent population and the registered population in the region in a certain year, so as to study the impact of the explanatory variable on the explained variable.

4.4 Control Variables

In addition to the labor mobility factor, the level of urban-rural integration in counties and regions is also affected by multiple factors. In order to alleviate the endogeneity problem caused by omitted variables, this article refers to the relevant authoritative literature (Gan Li et al., 2018; Yin Zhichao, Zhang Cheng, 2019; Lugauer et al., 2019; Li Lin, 2024) and selects the following control variables: regional per capita GDP, regional per capita income, industrial upgrading, government intervention and population density. Specifically: (1) Regional per capita GDP (prgnp). The per capita GDP of counties and regions can reflect the economic development level of the region. Regions with high regional GDP and high economic development level can provide financial support for the integration of urban and rural areas in counties and regions, such as updating infrastructure. This article defines the regional per capita GDP as the year-end GDP of a county or region/the number of registered residents in the county or region; (2) Regional per capita income (pci). Part of the per capita income of residents will be used for savings, thereby providing capital support for the scale of capital formation in the region, thereby promoting the economic development of the region and promoting urban-rural integration. This paper classifies the eastern region according to counties and regions, and takes the average of the average income of urban residents and the average income of rural residents; (3) Industrial upgrading (IU). The industrial upgrading of counties and regions will promote the original local labor force to shift from low-productivity sectors to higher-productivity sectors, thereby narrowing the urban-rural income gap and promoting urban-rural integration. This paper uses (value added of the secondary industry + value added of the tertiary industry)/value added of the primary industry as a proxy variable to measure industrial upgrading. (4) Government intervention (GI). As the "visible hand" in economic operation, the government's intervention policy will affect the degree of urban-rural integration in counties and regions. This paper regards the proportion of a region's public budget expenditure to GDP as the degree of government intervention. (5) Population density (PD). Population density will affect the urbanization level of counties and regions, and thus affect the level of urban-rural integration. This paper measures population density by the number of registered population/land area.

4.5 Mechanism Variables

Human capital concentration (HCA): Labor mobility promotes economic development through human capital concentration, and drives a series of flows such as resources, factors, and public services, effectively promoting economic, social, and political integration between urban and rural areas. In pursuit of high income and better infrastructure, human capital gathers in a certain area. The concentration of labor will lead to an increase in the number of large-scale enterprises in the area. We define enterprises with an annual main business income of more than 20 million in a certain area as enterprises above designated size, and measure the concentration of human capital through enterprises above designated size in a certain county or region.

Labor force participation rate (LPR): Labor mobility can narrow the urban-rural gap and promote urban-rural integration by increasing the labor force participation rate, guiding the flow of funds, promoting industrial structure upgrading and infrastructure construction, and improving production efficiency and talent treatment. The increase in the labor force participation rate will lead to an increase in the output value of enterprises. This article measures the labor force participation rate by measuring the output value of the increase in the output value of enterprises in a county or region within one year.

4.6 Model Setting

In order to empirically examine the impact of labor mobility on the level of urban-rural integration development, this paper sets the following model:

$$URI_{it} = {}_{\alpha 0+}\beta_1 mig_{it} + \beta_2 X_i + \beta_3 A_J + U_i$$

Among them, i represents region, t represents year, URI is the level of urban-rural integration, the core explanatory variable represents mig_{it} the number of labor force flows X_i in the tth year in the ith region, represents a series of control variables, A_j represents time fixed effects and region fixed effects, U_i and represents the error term that is difficult to be observed.

5. Benchmark Regression Analysis

5.1 Benchmark Regression Results

The baseline regression results of the impact of labor mobility on the level of urban-rural integration development are shown in Table 2. Column (1) of Table 2 is the baseline regression result without adding control variables. It can be seen that the coefficient of labor mobility is significantly positive at the 1% significance level, which preliminarily confirms the theoretical hypothesis 1, that is, labor mobility will promote a significant improvement in the level of urban-rural integration. Columns (2)-(6) of Table 2 are the baseline regression results after adding control variables in turn. Labor mobility is still significantly positive at least at the 5% significance level. Therefore, the theoretical hypothesis 1 is preliminarily confirmed, that is, labor mobility will promote a significant improvement in the level of urban-rural integration.

5.2 Endogeneity Test

In the benchmark regression test, the article has tried to alleviate the impact of endogeneity as much as possible by using county and region fixed effects, time fixed effects, and finding other control variables that may affect urban-rural integration. However, there is still the possibility of omitted variables in the model. Based on this, this article introduces labor mobility lagged by one period as an instrumental variable and uses the two-stage least squares method for regression analysis. Specifically, on the one hand, the flow of labor to a certain region has inertia, and the number of labor mobility in the current period is highly correlated with the number of mobility in the lagged period, which meets the requirements of the two-stage least squares method for correlation. On the other hand, the number of labor mobility is lagged by one period and is uncorrelated with the random disturbance term of the current period, which meets the requirements of the two-stage least squares method for the uncorrelation of instrumental variables and random labor terms. As shown in the test in Table 3, after considering the endogeneity problem, the role of labor mobility in promoting urban-rural integration is still significantly positive at the 1% significance level. In addition, as shown in Table 3, the F statistic is much greater than 10, and the Cragg-DonaldWaldF statistic is greater than the stock-yogo critical value at the 10% significance level. The instrumental variables selected in the article are reasonable and explanatory. The endogeneity test also once again proves the correctness of theoretical hypothesis 1, that is, labor mobility will promote urban-rural integration.

Table 2: Benchmark regression results

variable	(1)	(2)	(3)	(4)	(5)	(6)
Labor mobility	0.431 ***	0.000656 **	0.000656 **	0.000656 **	0.000718 ***	0.000724 ***
	(2.75)	(2.55)	(2.55)	(2.55)	(2.81)	(2.83)
Regional GDP per capita		8.74e -09	7.18e-09	7.18e-09	5.01e-09	5.25e-09
		(0.79)	(0.65)	(0.59)	(0.45)	(0.48)
Regional per capita income			7.65e-06 ***	7.60e-06 ***	7.41e-06 ***	7.16e-06 ***
			(8.61)	(8.55)	(8.39)	(8.05)
Industrial Upgrading				9.87e -0 6	9.46e-06	7.01e-06
				(1.43)	(1.38)	(1.01)
Government intervention					- 0.19798 ***	-0.19804 ***
					(-15.11)	(-15.11)
Population density						6.4848 **
						(2.37)
Constant term	0.6561 ***	0.65526 ***	0.53994 ***	0.538818 ***	0.57385 ***	0.56867 ***
	(60.17)	(59.84)	(31.24)	(31.15)	(33.07)	(32.51)
County fixed effects	yes	yes	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes	yes	yes
N	19, 36 6	19, 36 6	19, 36 6	19, 36 6	19, 36 6	19, 36 6
R^2	0. 4	0. 4	0.42	0. 43	0. 59	0.62

Note: The statistics in brackets are t values, ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

Table 3: Endogeneity test

Variable	Two-stage least squares (2SLS)	
	Phase 1	Phase II
Labor mobility		0.0008053 ***
		(3.61)
Regional GDP per capita	-1.24e-08	1.38e-09
	(-0.50)	(0.14)
Regional per capita income	0.0000104 ***	6.14e-06 ***
	(5.31)	(7.87)
Industrial Upgrading	- 0.0000914 ***	4.75e-06
	(-6.08)	(0.79)
Government intervention	0.1056498 *	-0.6244863 ***
	(1.87)	(-27.60)
Population density	-35.38445 ***	6.357532 ***
	(-5.84)	(2.62)
Delayed labor mobility	1.003135 ***	
	(1790.58)	
F	3200000	
Cragg-DonaldWald F	3200000	
Kleibergen-Paaprk LM	18000	
Sample size	18524	18524
R^2	0.9943	0.442

Note: The statistics in brackets are t values, ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

5.3 Robustness Test

In order to verify the robustness of the above regression results, this paper adopts the following three methods to conduct robustness tests:

5.3.1 Change the measurement method of the explained variable

In order to verify the robustness of the regression results, this article replaces the entropy weight method with the global principal component analysis method to measure the level of development of urban-rural integration. The principal component analysis method can use fewer variables to explain most of the variation in the data. In the previous article, 5 first-level indicators and 14 second-level indicators were selected to measure the level of urban-rural integration. After testing, it was found that there was a high degree of correlation between these indicators, which met the prerequisite for using the principal component analysis method. The measurement method is as follows: First, the micro data is standardized according to formula 7, and the negative indicators are positively processed using formula 8;

$$N_{ij} = \frac{X_{ij}+\min(X_{ij})}{\max(X_{ij})-\min(X_{ij})} \quad (7)$$

$$N_{ij} = \frac{\max(X_{ij}) - X_{ij}}{\max(X_{ij})-\min(X_{ij})} \quad (8)$$

Secondly, the score of the kth principal component in the mth subsystem is calculated according to Formula F_{mk} 9;

$$F_k = \sum_{i=1}^{13} \gamma_{ki} N_{ij}, \text{ m=1, 2, 3, 4,} \quad 5\ (9)$$

Finally, the sum is performed according to formula 10:

$$R_m = \frac{\sum_{i=1}^{k} a_k F_k}{\sum_{i=1}^{k} a_k}, \text{ m=1, 2, 3, 4,} \quad 5\ (10)$$

Among them, i represents year, j represents region, m represents N_{ij} the index after standardization, X_{ij} represents the original value of the data, F_k represents the score value of the kth principal component, γ_{ki} represents the factor loading of the ith index on the kth principal component, and a_k is the variance contribution rate of the kth principal component.

The results of the regression analysis of the level of urban-rural integration and the explanatory variables obtained by principal component analysis under the control of year and region are shown in columns 1 and 2 of Table 4. Column 1 of Table 4 does not include control variables, while column 2 includes control variables. It can be seen that the core explanatory variables are still significantly positive at the 1% significance level, which once again confirms theoretical hypothesis 1 and that labor mobility will promote the improvement of the level of urban-rural integration.

5.3.2 Dynamic analysis of urban-rural integration

In order to re-test the authenticity of theoretical hypothesis 1, this paper adopts the dynamic generalized moment estimation (GMM) panel model and takes the lagged one-period of the level of urban-rural integration development as the instrumental variable of the model to conduct a robustness test. The premise for the GMM method to be valid is that all instrumental variables are valid and the residual sequence in the difference equation does not have second-order or higher-order autocorrelation, so it is necessary to conduct the Hansen test Arellano-Bond serial correlation test. From the test results, the value in the Hansen test is greater than 0.1, indicating that the instrumental variable selection of the model is effective, and the reported AR (2) value is also greater than 0.1, indicating that there is no second-order serial autocorrelation in the residuals of each model. From the regression estimation coefficient values in the last two columns of Table 4, on the whole, there is a positive correlation between the labor mobility of the lagged one period and the current labor mobility, and the regression coefficient value of urban-rural integration is still positively significant at the 1% significance level after the introduction of the lagged variables. From the dynamic panel regression coefficient value, the level of urban-rural integration development of the lagged one period is highly positive and significant, and there is still a highly significant positive correlation between labor mobility and urban-rural integration development after the introduction of the lagged variables. The results not only show that the level of urban-rural integrated development has a certain path dependence, and the development level of the previous year will affect the level of urban-rural integrated development in the current year, but also exclude the possible two-way causality and endogeneity problems between urban-rural integrated development and labor mobility to a certain extent, which once again proves that labor mobility does have a significant promoting effect on urban-rural integrated development, and proves the robustness of the conclusions of this article.

Table 4: Robustness test

variable	Static Panel		Dynamic Panel	
	Replace the explained variable		System GMM	
	(1)	(2)	(3)	(4)
L. Urban-rural integration			0.0014 **	0.0121 ***
			(6.03)	(2.47)
Labor mobility	0.0 04 ***	0.005 ***	0.000 ***	0.00026 ***
	(4.7 8)	(5.11)	(6.16)	(6.78)
Regional GDP per capita		0.0000		-0.000 ***
		(1.48)		(-3.00)
Regional per capita income		0.000 ***		0.000 ***
		(2.93)		(5.76)
Industrial Upgrading		0.0000		0.000 24 ***
		(0.46)		(3.22)
Government intervention		0.0 36 ***		-0.3137 ***
		(2.96)		(-19.72)
Population density		28.39 ***		9.9599 ***
		(3.74)		(9.42)
Fixed effects	yes	yes		
AR (1)	/	/	0.000	0.000
AR (2)	/	/	0.174	0.260
Hansen	/	/	0.122	0.19
R^2	0.3146	0.3158	/	/
N	1 9 366	1 9 366	19343	19343

Note: The null hypothesis of the Hansen test is that the instrumental variable is uncorrelated with the disturbance term, that is, there is no over-identification in the model; the null hypothesis of the AR (1) and AR (2) tests is that there is no first-order or second-order autocorrelation in the residuals. The values of the test part are the P values of the test results, and the statistics in brackets are t values. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

5.3.3 Data cleaning

In order to overcome the impact of extreme outliers on the test results and obtain more robust regression results, this paper performs bilateral shrinkage processing at the 1% level on the

level of urban-rural integration development, labor mobility, and various control variables. The shrinkage data is re-run with a baseline regression, and the specific regression results are reported in the first two columns of Table 5, which are consistent with the baseline regression results.

5.3.4 Decentralized processing

To further test the robustness of the benchmark regression results in the previous article, this article follows the approach of Balli and Sørensen (2013) [25] and decentralizes the core explanatory variable, labor mobility. The specific regression results are shown in columns (3) and (4) of Table 5. The results of the decentralized core explanatory variable "labor mobility" regression are consistent with those in the previous article.

Table 5: Decentralization and data cleaning

variable	Data cleaning		Decentralized processing	
	(1)	(2)	(3)	(4)
Labor mobility_W	0.00015 *** (3.39)	0.00026 *** (6.59)		
C_Labor Mobility			0.00015 *** (3.39)	0.00014 *** (3.30)
Control variables	No control	control	No control	control
City fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
N	19366	19366	19366	19366
R^2	0.7370	0.7953	0.7370	0.7562

Note: The statistics in brackets are t values, ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

6. Mechanism Test

$$URI_{it} = \alpha_{0+}\beta_1 mig_{it} + \beta_2 X_i + \beta_3 A_J + U_i$$

$$Med_{it} = \alpha_{0+}\gamma_1 mig_{it} + \gamma_2 X_i + \gamma_3 A_J + U_i$$

$$URI_{it} = \alpha_{0+}\theta_1 mig_{it} + \theta_2 Med_{it} + \theta_3 X_i + \theta_4 A_J + U_i$$

In the above, the subscript i represents the industry, t represents the year, and Med is the mediating variable, which represents the utilization of human capital aggregation and the increase in labor participation rate. The other variables are consistent with the $\beta_1$previous model. In order to ensure the robustness of the above mechanism test, when, γ_1, $\theta_1$and are all greater than zero and $\theta_2$meet the condition of being equal to zero or less than θ_1, it means that the above transmission mechanism exists, otherwise it does not exist. The specific regression results are shown in Table 5.

Table 5 reports the benchmark regression results of labor mobility and human capital agglomeration for subsequent mediation effect tests. Columns 1 and 2 in the table are the test results of the mediation mechanism of labor mobility using to improve human capital agglomeration. As can be seen from the table, labor mobility promotes human capital agglomeration at a confidence level of 1%. When the core explanatory variable labor mobility and the mediating variable are regressed comprehensively, the coefficients of the core explanatory variable and the mediating variable are significantly positive at the 1% level, and the coefficient value of the core explanatory variable labor mobility is significantly greater than the coefficient value of the mediating variable in the comprehensive regression. This confirms that the mechanism effect exists in the process of promoting the level of urban-rural integration development by utilizing human capital agglomeration, and proves the correctness of mechanism hypothesis 1, that is, labor mobility promotes urban-rural integration through human capital agglomeration. Columns 3 and 4 in Table 5 are the test results of the mediation mechanism of the improvement of labor participation rate. The results show that when the control variables and fixed effects are added, the labor mobility and the improvement of labor participation rate are significantly positive at the 1% level, indicating that labor mobility does help to improve the labor participation rate. When the two are included in the same model for comprehensive regression, the regression coefficient of labor mobility is 0.0008, and the regression coefficient of removing resource allocation barriers is 0.0003. Both are significantly positive, and the coefficient of the latter is significantly smaller than the former, indicating that the increase in labor participation rate does play a mediating role in the process of labor mobility promoting the improvement of the level of urban-rural integration development, which proves the correctness of mechanism hypothesis 2, that is, labor mobility effectively promotes the improvement of the level of urban-rural integration development through the increase in labor participation rate.

Table 6: Analysis of impact mechanisms

variable	Increase labor force participation rate		Removing barriers to resource allocation	
	HCA	Level of urban-rural integration	LPR	Level of urban-rural integration
Labor mobility	4.019 *** (24.74)	0.00123 * (1.35)	8287.46 *** (22.4)	0.0008 *** (2.91)
LR		0.0003 (0.8)		
TFP				0.0 0003 ** * (2.79)
Bootstrap test 95% Confidence Interval	[0.005731, 0.078284]		[0.200246, 0.2642144]	
Control variables	control	control	control	control
Industry fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
N	19366	19366	19366	19366
R^2	0.7630	0.3475	0.7364	0.7 102

Note: The statistics in brackets are t values, ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

For the robustness of the above mechanism test, this paper draws on the research of Pevzner et al. (2015) and Qu Jiaojiao et al. (2021) [26] and uses the path analysis method, 1000 coefficient product test method, and Bootstrap bootstrap sampling to test whether the three transmission mechanisms of labor mobility → human capital accumulation/increase in labor participation rate → improvement in the level of urban-rural integration development are significant. The specific test results are reported in row 8 of Table 5. The internal logic of the Bootstrap test is to determine whether the confidence interval of the indirect effect of the above transmission mechanism includes 0. If the 95% confidence interval of the indirect effect does not include 0, it means that the above transmission mechanism exists significantly. The test results in Table 6 show that the 95% confidence interval of the indirect effect of the Bootstrap test of the increase in

labor participation rate and the removal of resource allocation barriers does not include 0, indicating that the mediation effect is established, the indirect effect is significant, and the selection of the mediating variable is effective. This once again proves the correctness of the mechanism hypotheses 1 and 2 in the previous article, indicating that the use of the increase in labor participation rate and the removal of resource allocation barriers are indeed the key micro-mechanisms for labor mobility to affect the improvement of the level of urban-rural integration development.

7. Conclusion and Recommendations

Urban-rural integration is an important means to maintain steady and high-quality economic growth at this stage. In order to better promote urban-rural integration, narrow the urban-rural gap, and achieve common prosperity for all people, this paper uses the entropy method to scientifically measure the development level of urban-rural integration in counties and regions in the eastern region from 2000 to 2022. Based on the survey data of the "China County Statistical Yearbook" and the China Economic Database, a scientific indicator of labor mobility is constructed, and a general equilibrium model of urban-rural integration is constructed. The model includes multiple factors such as labor mobility, control variables and fixed effects, and then analyzes its impact on the county and regional urban-rural integration and its mechanism of action. This study found that: First, after using the entropy method to measure the level of urban-rural integration development, the article found that with the passage of time, the level of urban-rural integration has basically shown a general upward trend. Among them, the counties around the Beijing-Tianjin area, the Yangtze River Delta area and the Pearl River Delta area have a higher level of regional urban-rural integration development; Second, labor mobility significantly promotes the improvement of the level of urban-rural integration development. After conducting endogeneity tests and robustness tests, this conclusion still holds; Third, the role of labor mobility in promoting the level of urban-rural integration development is achieved through two "engines": human capital aggregation and labor participation rate improvement. Labor mobility promotes the gathering of human capital. In the process of pursuing the "light of the city", the labor force can enjoy more complete infrastructure services and learn more sophisticated production and living skills, so that they can return to their hometowns to drive rural development and promote urban-rural integration. In addition, labor mobility will promote the increase of labor participation rate, thus forming a scale effect, promoting the economic development of labor inflow and outflow areas, and driving the improvement of the level of urban-rural integration development.

Based on this, this paper puts forward the following policy recommendations:

First, we should give full play to the driving role of labor mobility in the level of urban-rural integration development according to local conditions. As time goes by, the level of urban-rural integration development shows a rising trend, but the level of urban-rural integration development in each region is different. In some regions, the driving role of labor mobility in improving the level of urban-rural integration development is relatively weak. The driving role of labor mobility in counties and regions around the Beijing-Tianjin area, the Yangtze River Delta area, and the Pearl River Delta area is relatively strong, while the driving role of labor mobility in areas with poor geographical locations and insufficient policy inclination is relatively weak. Based on this, we should give full play to the driving role of labor mobility in improving the level of urban-rural integration development according to local conditions. In areas with strong driving effects, it is necessary to improve the labor security system, based on local economic and technological advantages, attract the flow of high-quality labor within the region, and promote the development of rural areas through the flow of talents, skills training, high-quality talents, and talent return, so as to promote the flow of labor to drive rural development, thereby promoting urban-rural integration; in areas with weak driving effects, we need to strengthen the skills training of the labor force, create pilot projects for returning to hometowns to start businesses, establish and improve the talent introduction system and mechanism, attract the inflow of high-quality talents through high income and better quality guarantees, and provide talent support for rural revitalization and urban-rural integration.

Secondly, we should promote urbanization with citizenization as the core, and fully release the vitality of labor mobility in promoting the level of urban-rural integration. China's labor market has long been institutionally divided. There are many institutional barriers to the migration of labor and their families. For example, the coverage rate of various basic social insurance projects for the inflowing labor in cities is significantly lower than that of the urban registered population, and they basically cannot enjoy the minimum living security benefits. The children of migrant workers also face difficulties in receiving compulsory education and have no chance to obtain affordable housing. These institutional barriers have greatly reduced the role of labor inflow in promoting urban-rural integration. On the one hand, it is difficult for the labor force to maintain resource allocation on the supply side for a long time. On the other hand, it is also difficult for the labor force to drive consumption from the demand side. Under China's current conditions, labor mobility is greatly suppressed by this institutional repression. With the fluctuations of the macro-economy, the labor force is often hit by cyclical unemployment, and many people even have to return to their hometowns. Therefore, from a lifetime perspective, although the labor force is mobile, the labor participation rate in non-agricultural industries is still relatively low, and farmers can still tap greater employment potential. Based on this, we must promote urbanization with citizenization as the core to solve it. The government will establish a more complete social security system and accelerate the reform of the household registration system to alleviate institutional oppression, stabilize the inflow of labor, increase the supply of labor, alleviate the pressure of labor shortage, maintain the continuous flow of labor from low-productivity sectors to high-productivity sectors, and promote steady economic growth.

Finally, we should focus on promoting the accumulation of human capital and increasing the labor participation rate, and promote the improvement of the level of urban-rural

integration development in counties and regions. Migrant workers do not have urban household registration and cannot enjoy relevant social insurance and social assistance, especially they cannot expect to spend their old age in the city, so they actively withdraw from the urban labor market at a relatively low age, and the labor participation rate has not been fundamentally improved. Human capital accumulation and labor participation rate are the two engines for labor mobility to promote the improvement of the level of urban-rural integration development. Under the background of insufficient urban-rural integration development, we should improve the level of remuneration and skill training of enterprises, promote the advanced structure of human capital, cultivate high-quality human capital, and radiate agricultural scientific and technological innovation with the improvement of human capital innovation and skill level, so as to attract high-quality talents to return to rural areas; optimize the matching quality of human capital and employment positions, strengthen employment skills training and employment guidance for low-educated labor, so that labor of different ages and different technical levels can be matched to suitable positions, and fully guide the transfer of surplus rural labor; by improving the employment security system for women, we should reduce gender discrimination in the labor market from the perspective of women's rights and interests, protect women's employment rights and interests from the legal level, and increase women's labor participation rate, so as to promote the integration of urban and rural areas in counties and regions.

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