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Research Article

Evolution Characteristics and Regional Roles' Influencing Factors of Interprovincial Population Mobility Network in China

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This paper analyses the evolutionary characteristics of the interprovincial population mobility network structure in China and explores the roles of provinces from 2010 to 2015. By constructing the interprovincial population mobility network, we examine the provinces' functions during periods of population mobility through population mobility diversity, population mobility, and population mobility intermediation. The results show that the coverage and tightness of the interprovincial population mobility network were influenced by national economic development, increasing steadily from 2010 to 2014 and then suddenly falling in 2015. The regions that played essential roles in the province's mobility diversity and intermediation showed a dispersion trend. In contrast, areas that played a vital role in the inflows or outflows were relatively concentrated and stable. Additionally, this work further explores how economic factors, e.g., GDP, residents' consumption levels, total population, unemployment rate, and consumer price index, are used as independent variables to analyse the provinces' roles in the interprovincial population mobility network. The analysis shows that the inflow or outflow volumes are easily affected by the five indices. These five indices are significantly related to network role indicators to different extents.

1. Introduction

Population flow and regional development are interactive processes [1]. During migration, material, information, capital, and technology also flow among regions [2]. In the case of unbalanced regional development and a heterogenous population distribution in China, a vast number of people move among different areas every year. As mentioned in the Report on the Development of China's Floating Population [3], there was a floating population of 230 million in China in 2010 that reached 244 million by 2017. This accounted for nearly 18 percent of the total population in China. Most were migrant workers, and similar cases are common in emerging economies such as India and Brazil. In these countries, the regional development paces are asynchronous, leading to a mismatch of population and wage levels in different areas. In detail, there are always surplus labourers and lower wages in underdeveloped regions. In contrast, in developed areas, labour is scarce, and salaries are high. Thus, such a significant imbalance prompts migration. Naturally, with population mobility, resources, information, capital, and technology will also spill over and reallocate among regions. In the long run, with gradual changes in regional socioeconomic factors, the interregional population mobility features and the roles of migration areas will correspondingly transform. As the largest emerging country, China has an extraordinary household registration regime, which greatly supports population movement statistics. Therefore, analysing China's interprovincial population movement features and evolution trends, exploring the roles the provinces play in migration, and excavating the underlying impact factors could provide references for emerging economies when making population mobility policies.

Previous research on population flow mainly focuses on how people move among different countries, such as

immigration [4–7], travel abroad [8], or refugee migration [9, 10]. Additionally, they also focus on how residents float around the country. Inside a country, travel is a short-term pattern of population mobility; thus, some research studies primarily explore tourism impacts on local economies and the environment [11, 12]. Additionally, some unique festivals will temporally motivate people to move, such as New Year's Festivals in Asia and Christmas in Western countries. Given the large scale and seasonal effects, scholars mainly explore how this type of population mobility affects transportation and consumption in the short run [13]. Finally, many labourers migrate to other areas permanently for jobs [14].

In recent years, based on the fifth and sixth censuses in China, some scholars have explored the features of interprovincial population floating [15, 16]. They analysed the relationship between population mobility and related socioeconomic indicators, such as the urban-rural income gap [17, 18], regional economic growth [19–21], epidemic diffusion [22, 23], and market potential and anticipated revenue [18]. However, due to the lack of continuity in data, it is hard to demonstrate how population mobility evolves and how evolution gradually influences economic development [24]. Therefore, some research has introduced network theory, building population mobility models among different provinces and exploring the rules and evolutionary features of interprovincial population floating in a precise and systematic way. In addition, some scholars describe the features of population mobility through network theory. Jiang explored daily population hovering features among 334 cities in China using Baidu Migration Big Data [2]. Ye et al. [25] found that a significant rich-club phenomenon occurred in Chinese population movements during the 2015 Spring Festival. Zhang et al. [26] used Tencent location big data to explore population movement characteristics among 234 cities in China. However, previous research has mainly focused on temporal changes in migration, especially patterns on holidays, and has not explored gradual trends and influencing factors.

In terms of residential movement among the different provinces, economic development, marketization, spatial distance, and information can influence its pattern. Therefore, this paper explored the role played by each province in the population flow from a global perspective, inferring how their roles are influenced by the factors mentioned above. We built five interprovincial population mobility networks and explored each province's functions during migration from the diversity of population flow, the amount of flow, and the intermediary of migration. In addition, by introducing the panel regression model, we examined how the gross regional production, total population, household purchase level, unemployment rate, and consumer price index impact the different roles that the provinces played in migration. Moreover, due to quantification uncertainty and protracted nature of the household registration system's reform, this paper mainly considers the total population without deeply analysing the impacts of the reform on urban and rural populations.

2. Data and Methodology

2.1. Data. We downloaded the dataset describing the interprovincial population movement from the National Earth System Science Data Center at the National Science & Technology Infrastructure of China (http://www.geodata.cn). This dataset contains the population inflow and outflow of 31 provinces, municipalities, and autonomous regions. It also includes the outflow of population from Hong Kong, Taipei, and Macau to the other provinces in mainland China.

Additionally, we downloaded the gross provincial production, household consumption level, total population, unemployment rate, and consumer price index for each province from the National Bureau of Statistics (http://data.stats.gov.cn/).

The entirety of the data spans from 2010 to 2015.

2.2. Methodology

2.2.1. Networks of Population Moving Interprovincially. We applied a node to represent each province for the network construction, with the directed edges depicting the migrant and the edges' weights measuring mobility. We exhibit the migrant structures from 2010 to 2015 in Figure 1.

In this figure, the size of the node reflects the population inflow and outflow. A larger node corresponds to a greater number of migrants. The direction of the edge describes the citizens' movement direction, and the thickness of the edges reflects the amount of the population flow between these areas. Additionally, we used the same colour to mark provinces with close population mobility relationships. Since there are only outflow data from Hong Kong, Taipei, and Macau, we did not explore the factors influencing these three areas' roles in the network.

Furthermore, we calculated the network density, the average shortest path for exploring the interprovincial population structure, and its evolutionary features. Specifically, network density measures the level of coverage of interprovincial population movements, and the average shortest path length reflects the closeness among the provinces:

$$D = \frac{1}{u} \sum_{i,j \in N, i \neq j} e_{ij}\left(p_{ij}\right), \tag{1}$$

where D is the network density, u is the largest possible number of edges in the population flow network, and e_{ij} is the weight of the edge between node i and node j. If p_{ij} (the population flow between province i and j) is larger than zero, it equals 1; otherwise, it equals 0:

$$L_t = < L_{ij} > = \text{Average}\left(\sum_{ij \in N, i \neq j} \text{Min}\left(\text{Path}\left(i \longrightarrow j\right)\right)\right), \tag{2}$$

where $\langle L_{ij} \rangle$ is the average shortest length path between node i and node j [27].

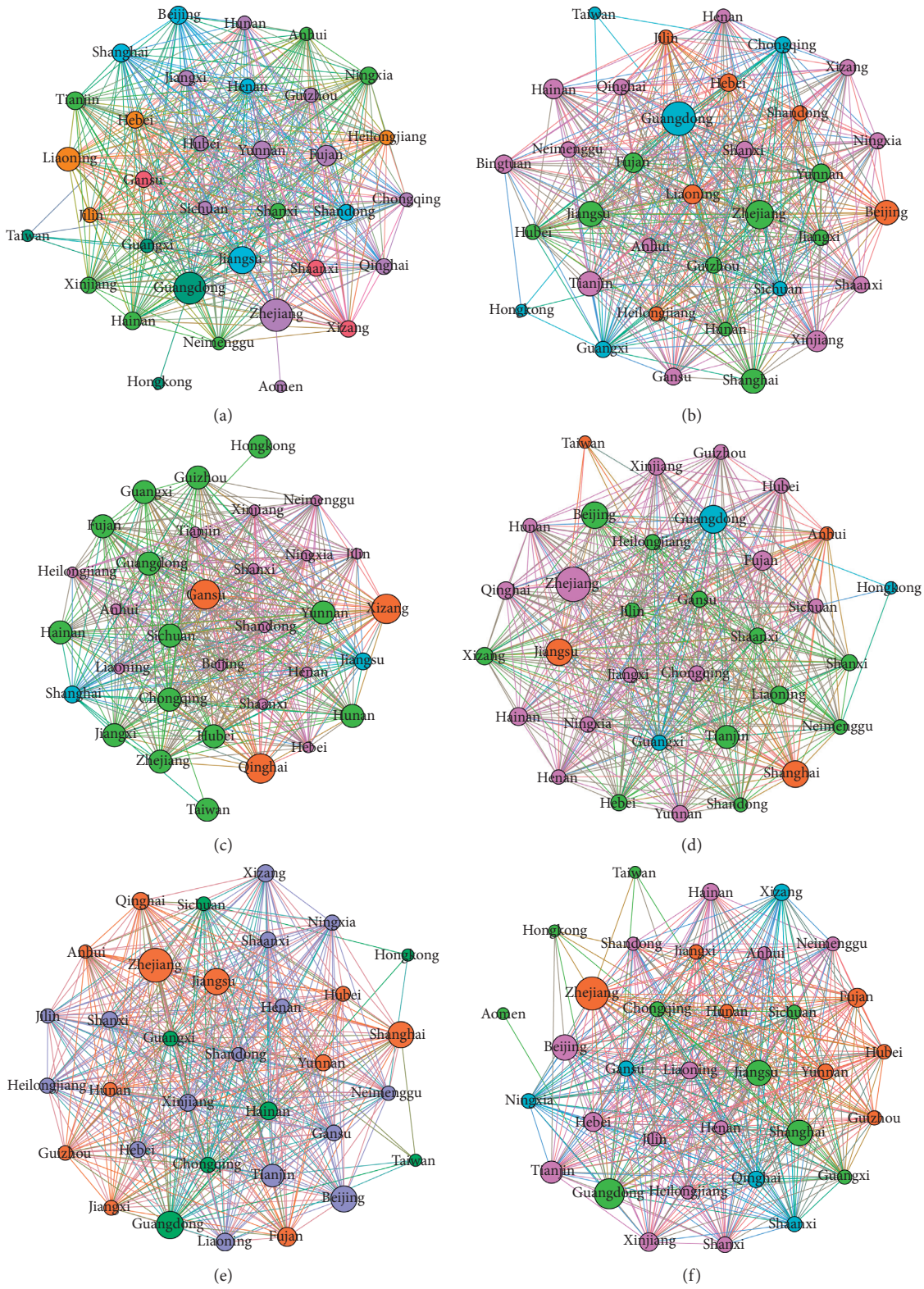

Figure 1: China's interprovincial population flow network from 2010 to 2015. (a) 2010. (b) 2011. (c) 2012. (d) 2013. (e) 2014. (f) 2015.

Population mobility reflects the mutual influence of economic development among the provinces. The average shortest length in the network measures the least number of provinces that need to be crossed to get from one province to another. Therefore, the value of L_t could exhibit closeness among the provinces.

2.2.2. The Roles of the Provinces in the Network. In network theory, there are several indices used to measure the roles of the nodes. This paper selected in-degree, out-degree, in-strength, out-strength, and betweenness centrality to explore the diversity of population movement, gross population mobility, and population flow medium.

In this paper, in-degree (as shown in function (3)) was applied to represent the inflow population diversity, which measures how many provinces have population migrating to a particular province. The out-degree (as shown in function (4)) was used to explain the outflow population diversity, which measures the number of provinces to which the people migrate from a specific province. In function 5, the in-strength calculates the total number of people who move to a particular province. Correspondingly, in function (6), the out-strength estimates the population that moves from a specific province. In addition, to depict the medium of population flow (i.e., some areas play the role of bridges during migration), we introduced betweenness centrality, as shown in function (7) [28]:

$$d_i^{\text{in}} = \sum_{k=1}^{m} e(p_{ki}), \tag{3}$$

where d_i^{in} is the in-degree of the node, i.e., the diversity of the inflow population.

When $p_{ki} > 0$, $e(p_{ki})$ equals 1; otherwise, $e(p_{ki})$ equals 0:

$$d_i^{\text{out}} = \sum_{k=1}^{m} e(p_{ki}), \tag{4}$$

where d_i^{out} is the out-degree of the node, i.e., the diversity of the outflow population. As shown above, when $p_{ki} > 0$, $e(p_{ki})$ equals 1; otherwise, $e(p_{ki})$ equals 0:

$$wd_i^{\text{in}} = \sum_{k=1}^{m} p_{ki}, \tag{5}$$

where wd_i^{in} is the in-strength of the node, i.e., the total number of inflow populations:

$$wd_i^{\text{out}} = \sum_{k=1}^{m} p_{ki}, \tag{6}$$

where wd_i^{out} is the out-strength of the node, i.e., the total number of outflow populations:

$$C(i) = \frac{\sum_{s \neq i \neq t} \sigma_{st}(i)/\sigma_{st}}{(N-1)(N-2)}, \tag{7}$$

where $C(i)$ is the betweenness centrality of the node, i.e., the medium of population mobility. The variable σ_{st} is the number of shortest paths between node$_s$ and node$_t$, $\sigma_{st}(i)$ is the number of shortest paths across node$_i$ between node$_s$ and node$_t$, and N is the number of nodes in the population migration network.

2.2.3. Factors Influencing the Roles of Provinces in the Population Migration Network. Since interprovincial population migration will be impacted by several factors, such as regional economic development, demographics, and employment, we further explore which factors influence interprovincial population migration and the magnitude of their impacts.

(1) Regional Economic Development. Uneven economic development among provinces is the core driving factor that accounts for population movement. Rapid economic growth could provide more employment and raise the income level (hence, coastal areas such as Guangdong, Zhejiang, and Shanghai have always been significant regions for attracting people). Therefore, we selected gross regional production to represent regional economic development, the household consumption level to exhibit the average living cost of the local citizen, and the consumer price index (CPI) to measure the gaps between labour wage levels and real purchasing power.

(2) Demographics. When economic development is comparable and employment opportunities are limited, competitiveness in heavily populated areas is higher than that in other areas, and the labour wage per capita is relatively lower. Therefore, in some provinces with a large population, people will be inclined to leave for other provinces with better economic performances. Consequently, we select the total number of people to reflect the demographic factor.

(3) Employment. To some extent, demographics could reflect the total number of working forces provided by a region. However, the employment rate could reflect the relationship between the province's available employment positions and the number of working-age people willing to work.

This paper selected gross regional production, household purchase level, total population, unemployment rate, and customer price index as explanatory variables above all. To explore how these variables influence the interprovincial population flow, we selected inflow population diversity, outflow population diversity, the total number of inflow populations, the total number of outflow populations, and the medium of population mobility as the explained variables. We then establish a panel regression model of these variables to explore how these factors influence population mobility across provinces.

During the analysis, we algorithmize the model as in the following function:

$$\ln \overset{i}{Y}t = \beta 0 + \beta 1 \ \ln \ X1t + \beta_2 \ln \ X2t + \beta_3 \ln \ X3 + \beta_4 \ln \ X4t + \beta_5 \ln \ X5t + \beta_6 \ln \ et, \tag{8}$$

where $\overset{i}{Y}_t$ represents the value of the ith role of a province in year t and $X1_t \sim X5_t$, respectively, represent the gross regional production, household consumption level, total population, unemployment rate, and consumer price index of each area.

3. Results

3.1. Evolutionary Features of Interprovincial Population Mobility. As shown in Figure 2, from 2010 to 2015, except for Hong Kong, Taipei, and Macau, the other 31 provinces or autonomous regions all have inflow and outflow migrants. Additionally, from 2010 to 2014, the coverage of the bilateral population flowing among these areas increased year by year and then dropped in 2015, which exactly corresponded to China's economic development. China's economy grew rapidly from 2011–2014. However, influenced by the weak behaviour of the global economy in 2015, China's economy entered a new normal, caused by a significant drop in exports and excess domestic production capacity. We additionally noticed that the bilateral population flow tightness among the provinces exhibited a similar trend. Although there was a slight upswing in 2015, the tightness during the six years was below 1.2, which means that the population could migrate from one province to another through 1.2 provinces on average. This shows that, except for Hong Kong, Taipei, and Macau, there are frequent population flows among the 31 provinces in mainland China. Another profile indicates that mainland China's economic development is quite active, and the provincial economy performs unevenly and has significant structural differences. Influenced by the slowdown of the economy in 2015, the population flow's activeness correspondingly declined.

3.2. Roles of Provinces in the Interprovincial Population Mobility Network. Based on the five indices in Section 1.2.2, we analysed the provincial role in interprovincial population mobility from 2010 to 2015 and ranked the values. We present the top 5 provinces for each year in Tables 1–5.

According to the in-degree and out-degree of each node in the network, we can obtain the source and flow direction of population mobility, reflecting the diversity of population mobility. The outflow of population from each province is widely scattered throughout the country, while the provinces with the most inflow are mainly concentrated in the more developed coastal provinces. Regarding the diversity of population mobility, we can notice from Tables 1 and 2 that compared to the inflow population, the outflows are more dispersive. During 2010–2015, Guangdong and Shanghai exhibited significant diversity in inflow population, and they persistently ranked in the top 5. This means that these two provinces received migrants from all the other areas in mainland China. In addition, Jiangsu, Sichuan, Hebei, Zhejiang, Henan, Shaanxi, Gansu, Fujian, Jiangxi, Shandong, Hunan, Hubei, and Anhui have prominent advantages in the diversity of the outflow population.

By further analysing the out-strength and in-strength of each node in the network, we can obtain the number of inflow and outflow populations for each province. Tables 3 and 4 show that the top 5 provinces with the highest annual amounts of inflow and outflow populations counted. Regarding the population mobility amount, all the provinces behave more stably than the diversity of mobility. Notably, the five eastern developed regions, including Zhejiang, Guangdong, Jiangsu, Shanghai, and Tianjin, attracted the most migrants in 2011–2015. Therefore, regional economic development is the core factor influencing the population to move in. Furthermore, the five major central provinces, i.e., Sichuan, Anhui, Henan, Hunan, and Hubei, sent the most people to other areas. Correspondingly, these five provinces are the ones with larger populations and weaker economic performances. This shows that the main factors affecting population mobility remain to be the level of regional economic development, employment opportunities, and personal income.

Furthermore, Table 5 shows that all the provinces' values change significantly for the medium population flow. Notably, Guangdong has consistently performed as the most potent in medium population flow for the five years. Combined with Guangdong's results in Tables 1–4, we find that Guangdong has received a mass of labourers from the other provinces but sent less to the others during the economic development period. There is a consensus that Guangdong performed as a substantial economic growth engine. While attracting migrants, Guangdong also channelled labour to the other areas through investment. After 2013, Jiangsu and Zhejiang exhibited increasingly prominent medium roles, playing a similar function to Guangdong. Hainan and Chongqing—famous places to live and travel in China—have also played a more vital medium role.

3.3. Factors Influencing the Roles of the Province in the Population Mobility Network. As mentioned above, each province plays a different and distinct position in the population mobility network. Regions that have significant diversity and intermediation roles are scattered, distributed and change over time. Population flow amounts are mainly concentrated in certain crucial provinces, and the distribution is stable over time. We further analysed how regional economic and social factors influence these provinces' roles based on these significant population mobility features.

Therefore, we selected the network indices we obtained in Section 3.2 as explanatory variables, i.e., population inflow and outflow diversity, the number of population inflows and outflows, and mobility intermediation. We determined the gross regional production, household consumption level, total population, unemployment rate, and consumer price index as explained variables to build five panel regression models.

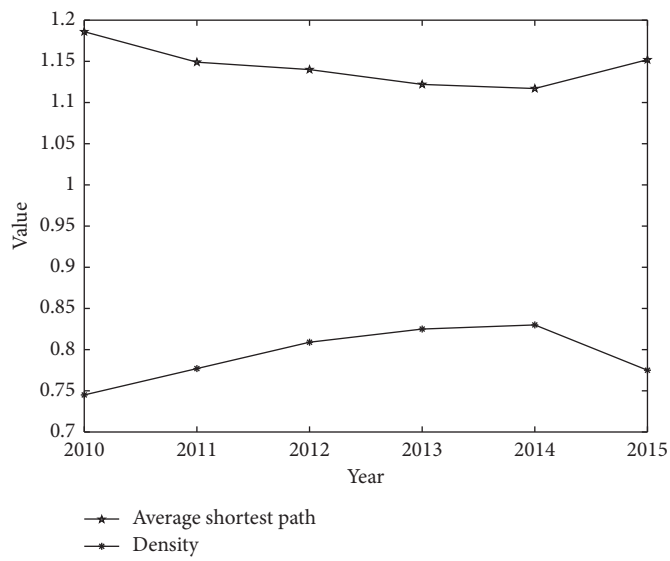

Figure 2: Coverage and tightness of the interprovincial population mobility network.

Table 1: The top 5 provinces for population inflow diversity in 2010–2015.

	2010	2011	2012	2013	2014	2015
Guangdong	32	32	30	31	31	32
Jiangsu	30			31	30	30
Liaoning	29				30	30
Shanghai	29	29	31	29	31	30
Sichuan	29	29			30	
Hainan	29			29	30	
Tibet Autonomous Region	29				30	
Beijing		30	30	29		
Tianjin		30		29	30	30
Guangxi Zhuang Autonomous Region		29		29	30	
Chongqing			30		30	30
Qinghai			30			
Shanxi				30		
Zhejiang				30	31	31
Hebei				29		
Shaanxi				29		
Gansu				29		
Fujian						30

Thus, to ascertain the model's robustness and validity, we tested the variables before regression. First, we explored the correlations between these variables. As shown in Table 6, the correlation coefficients between the five explanatory variables are relatively small. Second, we applied the variance inflation factor to check the multicollinearity of the five explanatory variables. The results show that the largest variance inflation factor was VIF = 7.80, indicating that they all passed the test. Third, we introduced the ADF test (augmented Dickey–Fuller test) to examine the variables' stationarity, with the results showing that they are second-order stationary. Fourth, we conducted a cointegration test of these variables and found that they have long-term cointegration relationships.

The panel regression results (shown in Table 7) found that the household purchase level has a significant positive correlation with inflow population diversity. The standardized correlation coefficient is 0.531, which indicates that the household purchase level is the primary factor influencing the population's inflow diversity. Consistent with common sense, high local purchasing implies that the income level overwhelms the purchasing power, and people who live in other areas will be keen to migrate here. In contrast, the unemployment rate was negatively correlated with the inflow population diversity. In most cases, a high unemployment rate means an unstable external living environment, and the people outside this area will be reluctant to move here.

The population's outflow diversity is positively correlated with the total population, household purchasing level, and unemployment rate. This shows that the combined effects of these factors will induce people to migrate to other

Table 2: The top 5 provinces for population outflow diversity in 2010–2015.

	2010	2011	2012	2013	2014	2015
Guangdong	30			30	30	
Jiangsu	30	31	30	30	30	30
Sichuan	30	31	30	30	30	30
Hebei	30	31	30	30	30	30
Zhejiang	30	31	30	30	30	30
Henan	30	31	30	30	30	30
Shaanxi	30	31	30	30	30	30
Gansu	30	31	30	30	30	30
Shanxi	30	31	30	30	30	
Fujian	30	31	30	30	30	30
Jiangxi	30	31	30	30	30	30
Shandong	30	31	30	30	30	30
Hunan	30	31	30	30	30	30
Heilongjiang	30		30	30	30	30
Hubei	30	31	30	30	30	30
Anhui	30	31	30	30	30	30
Guizhou	30		30		30	
Chongqing		31	30	30	30	30
Yunnan		31		30	30	30
Qinghai			30	30		
Jilin			30	30	30	30
Guangxi				30		
Liaoning				30	30	30
Inner Mongolia				30		

Table 3: The top 5 provinces for inflow populations in 2010–2015.

	2010	2011	2012	2013	2014	2015
Zhejiang	6517	5291	8883	12493	12473	12461
Guangdong	6363	7086	8445	8547	8706	10693
Jiangsu	4859	4271	5383	8122	8050	7851
Liaoning	3826					
Fujian	2795					
Tianjin	2000	4000				
Shanghai	2000	4000	14993	7974	7999	7995
Beijing	2000	4000	5994	8000	7997	7999

Table 4: The top 5 provinces for outflow populations in 2010–2015.

	2010	2011	2012	2013	2014	2015
Sichuan	6718	7798	9695	11207	10876	11667
Anhui	6559	6660	11113	12029	11923	11656
Henan	5699	7256	8667	10809	10353	10879
Hunan	3725	4404	5350	6227	6273	6380
Jiangxi	3284					
Hubei		4146	4989	5861		5820
Shandong					5774	

provinces (even to underdeveloped regions) to find working opportunities and lower their living costs. Among these factors, the total population is the major one, of which the standardized coefficient is 1.165.

In addition, the amount of population mobility has significant positive correlations with gross regional production, household purchase level, and consumer price index. Despite the costly living standard exhibited by the consumption level and price index, the results show that the advanced economy still attracted people to migrate. For example, Guangdong, Shanghai, and Beijing have always been places where young people dream to live. Additionally, the negative correlations between unemployment and population outflow show that the unemployment rate plays a vital role in population inflow. Moreover, the total population is positively correlated with the outflow population

Table 5: The top 5 provinces for population mobility intermediation in 2010–2015.

	2010	2011	2012	2013	2014	2015
Guangdong	45.50	26.17	32.94	33.59	16.31	43.05
Yunnan	32.62					
Sichuan	14.30	6.24		3.19	14.59	
Jiangsu	9.95			33.59	6.48	9.53
Jiangxi	8.47	13.48				
Guangxi		19.48				
Chongqing		16.00	23.55			
Shanghai			13.51			
Qinghai			5.17			
Shanxi			4.69	3.59		
Zhejiang				3.59	9.71	13.82
Inner Mongolia					9.31	
Henan						8.24
Guizhou						7.44

and is the most significant influencing factor (with the standardized coefficient reaching 0.914).

For the population mobility intermediation, the results show that gross regional production is a significant negative factor. This shows that developed areas are more likely to act as population mobility destinations than intermediation destinations. In contrast, the household purchase level, total population, and consumer price index are positively correlated with mobility intermediation. This shows that the more people there are and the higher the province's living cost, the more likely this area will become an intermediary in population mobility. Notably, the total population mostly influenced the intermediary function of the province regarding population flow.

From the above analysis, we can see that the total population, unemployment rate, and consumption level are the most important factors affecting interprovincial population flow. They not only affect the diversity of population mobility but also affect the amount of population mobility. However, they are different in the direction of influence; the regional GDP, consumption level, total population, and consumer price index determine the regional economic growth to a large extent. The higher the GDP and the consumption level of a province, the more likely it is to be a destination for migrants.

4. Discussion and Conclusion

According to China's population statistics, this paper introduced network theory to explore interprovincial population mobility during 2010–2015 from different perspectives. Specifically, this paper analysed the evolutionary features of the topological structure of interprovincial population mobility and provincial roles during the flow of population, extracting the factors that influence their functions. This paper systematically reveals the regular pattern and evolution characteristics of interprovincial population mobility from the network perspective and analyses the influence intensity of each influencing factor by constructing a panel regression model between the main influencing factors and network indicators.

First, based on the coverage of the population mobility relationship (graph density) and the closeness of the population mobility relationship (average shortest path), we explored the evolutionary features of China's interprovincial population mobility network structure from 2010 to 2015. From 2010 to 2014, we found that the population flow across the province gradually increased but then dropped in 2015. This indicates that active and imbalanced regional economic development facilitated frequent population mobility across provinces. Especially in 2015, with structure regulation, China proposed a new normal for developing the economy. Thus, the overall topological feature of population mobility exhibits a different pattern. This conclusion reflects that the characteristics of employment-based population mobility are different from those of tourism or holiday populations. From the existing literature, China's tourism and holiday population flow has been increasing annually in recent years [20, 29].

Second, we explored each province's roles in population mobility from three perspectives, i.e., diversity (in-degree and out-degree), amount (in-strength and out-strength), and the intermediary of population mobility. We obtain some different population flow characteristics from other studies that only consider holiday population mobility [13] and tourism [2]. The results showed that the provinces that have advantages in the diversity of population mobility change over time. The population's outflow diversity especially exhibits a more distinct scattered distribution of the provinces than the inflow. Regarding the population flow, people who lived in the midwestern regions were more inclined to migrate out to the other areas, and eastern provinces were more likely to act as hosts. Similarly, the provinces that play significant intermediary roles in population flows also change over time. However, Guangdong, Zhejiang, and Jiangsu performed extraordinarily compared to the others. In particular, Guangdong has always played an essential intermediate role in migration. Some provinces famous for travel or living environments (such as Hainan, Chongqing, and Guangxi) also act as vital intermediaries during population flows.

Third, to explore the factors that impact the different provincial functions related to population flows, we built five

Table 6: Correlation coefficient between variables.

	Inflow diversity	Outflow diversity	Inflow population	Outflow population	Intermediary of flow	Gross regional production	Household purchasing level	Total population	Unemployment rate	CPI
Gross regional production	0.2955	0.3707	0.4625	0.3045	0.4603	1.0000	—	—	—	—
Household purchasing level	0.4491	−0.1089	0.7339	−0.1973	0.1836	0.4556	1.0000	—	—	—
Total population	0.0715	0.5628	0.0719	0.6128	0.4032	0.6222	0.0251	1.0000	—	—
Unemployment rate	−0.4119	0.2624	−0.4016	0.1889	−0.1590	−0.1465	−0.2626	0.0559	1.0000	—
CPI	−0.1239	−0.0645	−0.1421	−0.2305	0.0133	−0.2249	−0.2821	−0.1209	0.0774	1.000

Table 7: Estimation of panel regression models by the least squares method (standardized coefficients and t).

	Inflow diversity	Outflow diversity	Inflow population	Outflow population	Intermediary of flow
Gross regional production	0.4552182 (1.043562)	−0.5892163 (−1.744970)	0.200232* (2.150312)	−0.1485215 (−0.583230)	−1.318329*** (−3.13820575)
Household purchasing level	0.53137612** (2.587326)	0.3262172** (2.043505)	0.719328*** (6.704840)	−0.2124816** (−1.762216)	0.826172*** (4.161051)
Total population	0.3486712 (0.963121)	1.1652187*** (4.701748)	−0.035481 (−0.121224)	0.91399212*** (4.328284)	1.4913473*** (4.282643)
Unemployment rate	−0.2813984*** (−4.074657)	0.1724173*** (3.201550)	0.093291* (1.662168)	0.15321229*** (3.787326)	−0.047103 (−0.700281)
CPI	0.0243217 (0.346621)	0.1721269 (1.300935)	0.200232* (2.150312)	−0.18733215*** (−4.546379)	0.252485*** (3.714374)

Note: the value in the bracket is the t-value, * means $p < 0.1$; ** means $p < 0.05$; *** means $p < 0.01$.

panel regression models by separately setting the gross regional production, household purchase level, total population, unemployment rate, and consumer price index as explanatory variables and the five network indices as the explained variables. Although some studies have analysed the influencing factors of population mobility in China, most of them use cross-sectional data on population mobility [22, 25]; thus, it is difficult to analyse the influence, direction, and intensity of different factors on population mobility by time-series data. The results show that the total population, unemployment rate, and household purchase level are significant factors influencing the diversity of people inflows. People who live in regions with more people, higher unemployment rates, and higher purchase levels are more inclined to migrate to underdeveloped areas. Thus, the outflows of the people take an air of diversity. Additionally, the five factors all exert significant impacts on the total amount of population flow. Therefore, to ascertain the population's stable and orderly flow, local governments should regulate the policy based on each factor's strength of influence. Specifically, the gross regional production, household purchase level, and consumer price index significantly influenced provinces' population inflows. The total population is the most significant factor in inducing people to move out to other regions. In addition, some provinces are more likely to act as population flow destinations with advantages in their gross regional product, household purchase level, total population, and consumer price proportional to the province's intermediary values.

This work analysed how the population migrated across China's provinces and explored the external factors that influence provincial functions during periods of population flow. In this research, we mainly selected indicators extensively applied in socioeconomic research as external factors. In future works, we will broadly focus on many more factors that might influence provincial migration roles and that will help propose more worthwhile policies.

Data Availability

In this paper, we downloaded the dataset describing the interprovincial population movement from the National Earth System Science Data Center, National Science & Technology Infrastructure of China (http://www.geodata.cn).

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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