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Spatial Characteristics and Influencing Factors of Migration in Kanagawa, Japan

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ABSTRACT: In the context of "Tokyo centralization", population migration has become an important factor affecting Kanagawa's economic growth, living standards, and employment status. On the other hand, with the development of the declining birth rate and aging society, migration for any purpose has an impact on social development. The government has released many policies to attract people from other cities to Kanagawa. This study analyzes the factors influencing the spatial pattern of population migration in Kanagawa based on the current spatial characteristics of population migration in Kanagawa from 2016~2020 and previous population migration research theories. the influencing factors are analyzed empirically by selecting a total of 9 economic, social, and environmental indicators that may affect the spatial pattern of population migration in Kanagawa. The result showed that, when only the economic factor was considered, gross prefectural product, job opportunities, and consumer price index significantly influenced migration; When only environmental factors are considered, the number of pollution complaints successfully handled had a significant positive effect on population migration; When only the social environment is considered, the level of education becomes the main consideration for people. Furthermore, when the economic factors, environmental factors, and social factors are analyzed together, the gross prefectural domestic product, job opportunities, consumer price index, and the number of pollution complaints successfully handled all have an impact on migration in Kanagawa and the gross prefectural product is the common influencing factor.

Keywords: Kanagawa; Population migration; Spatial characteristics; Influencing factors

1. Introduction

Population migration is an important issue studied in the fields of geography and sociology, with obvious interdisciplinary implications and involving aspects of integrated regional economic and social development [1]. Population migration generally refers to the spatial movement of a population from one region to another and consequently to a long-term or permanent change of residence. At the same time, population migration is an important socio-economic phenomenon that shows a clear pattern [2].

Population migration has existed in the development of human society since the origin of human beings, and Ravenstein first focused on the process of population migration from the perspective of research [3] and then studies on theories, methods, and influencing factors of population migration have been continued, and their research has been enriched and improved. There are various influencing factors of population migration, but the main factors are mostly analyzed from social, economic, political, and environmental aspects [4]. With the accelerating economic globalization and regional urbanization, the scale of population migration and mobility is growing at the regional scale, and the emergence of this phenomenon has an important impact on the population redistribution and economic and social development of countries and regions. Therefore, the issue of population migration has attracted widespread attention from national academia and society [5].

In Japan, there are two tiers of local government: prefectures and the municipalities that make up each prefecture. Prefectures and municipalities are both local public organizations with equal standing that work together in local administration in accordance with a responsibility breakdown. Prefectures are local governments made up of municipalities that are in charge of overall regional management. Kanagawa prefecture is one of the 47 prefectures that make up Japan [6]. Kanagawa prefecture, located near Tokyo (Figure 1), has abundant historical and cultural traditions, such as the ancient capital of Kamakura and the castle town of Odawara, and a rich natural environment, including the coastline of Sagami Bay and the mountains of Tanzawa Daisen. The unique lifestyles that take advantage of abundant attractions attract people from Japan and abroad. Being the host city for the Rugby World Cup 2019™, the Tokyo 2020 Olympic and Paralympic Games Olympic Sailing Competition, this also created a large number of

employment opportunities, contributing to the migration of people and talent from other areas. In addition, promoting projects that make the most of the characteristics and resources of each region, such as the western part of the prefecture, the Miura Peninsula, and the Sagami Bay coastal area, promotes migration and settlement by communicating the unique lifestyles of these regions.

Kanagawa is one of the fastest-aging populations in Japan, and the total population is expected to peak around 2020 and then decline. Although the population of Kanagawa continues to grow for several more years, there are areas where the population is expected to increase, such as the Kawasaki-Yokohama area, and areas where the population has already begun to decline such as the western part of the prefecture and the Miura Peninsula. This situation is similar to the uneven distribution of population between rural and urban areas in Japan. Therefore, Kanagawa Prefecture can be seen as a microcosm of Japan, which has made the study of population migration in Kanagawa increasingly significant. This paper analyzes the spatial characteristics of population migration in Kanagawa based on theories related to population migration at home and abroad and previous research experiences. This basis analyzes the factors influencing the spatial pattern of population migration in Kanagawa.

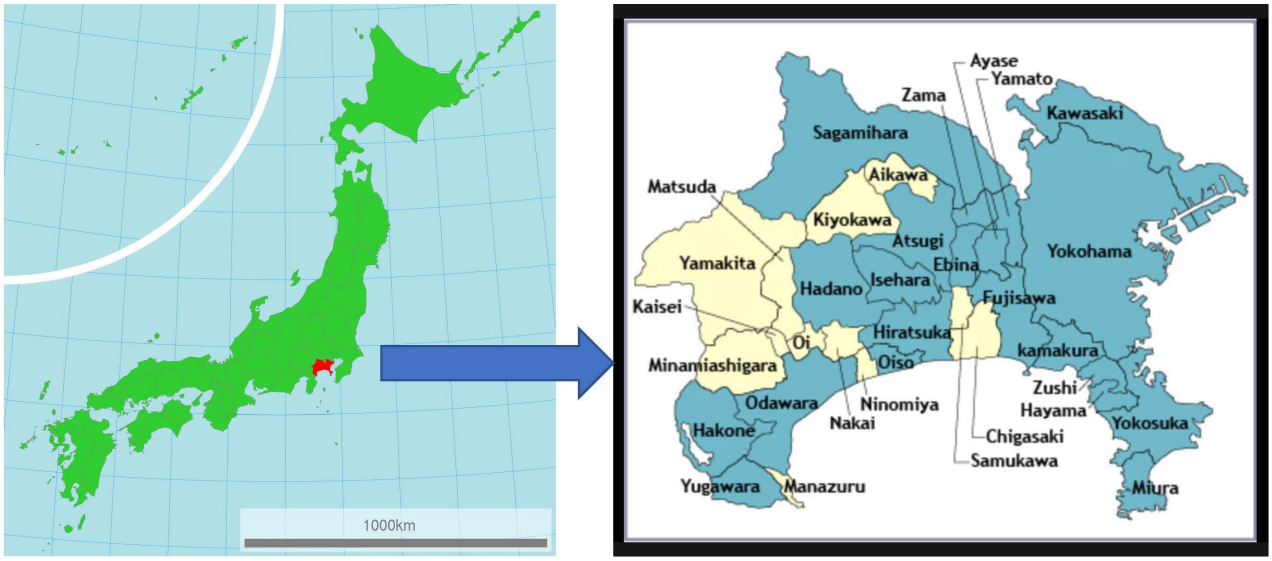

Figure 1. Research Location.

2. Research Significance and Methods

With the above background, this research addressed two key issues: (1) What are the spatial characteristics of population migration in Kanagawa during the recent past (2016–2020); and (2) What are the factors influencing the spatial pattern of population migration in Kanagawa during this period.

For the first question, there is a large literature focusing on the impact of population movement on cities as well as suburbs, and recent popular and academic work has drawn attention to the issue of population movement on urban shrinkage. The findings from the evolution of suburban shrinkage in the United States from 1980 to 2010 suggest that about a quarter of the suburbs are shrinking. The impact of shrinking suburbs on sustainable development is reflected [7]. This paper examines the characteristics and evolution of population movement in Kanagawa from 2016 to 2020, and the results show that population movement out of Kanagawa is characterized by "only superpower and multi-great power" and reflects the impact of COVID-19 on population movement.

For the second question, Hiroaki Ohashi and Nicholas A Phelps analyze the different types of growth/decline transitions in Tokyo's suburban cities during the pre-bubble growth and post-bubble contraction periods, identify the impoverishment of the outer suburbs, and emphasize the need for policymakers around the world to understand the specificity of outer suburban shrinkage. The process of suburban shrinkage, especially in peripheral areas, is considered to be the product of simultaneous socio-demographic, economic, political and administrative changes [8]. Therefore, the second question analyzed the economic, environmental and cultural factors that influence the population movement in Kanagawa, and the results show that from 2016 to 2020, the gross prefectural domestic product, job opportunities, consumer price index, and the number of pollution complaints successfully handled all have an impact on the migration in Kanagawa.

While reviewing a large amount of literature and data on population migration, most of the studies on inter-provincial population migration in Kanagawa have focused in the process of reviewing a large amount of literature and data on population migration, most of the studies on inter-provincial population migration in Kanagawa have stayed on the aspects of influencing factors, migration mechanisms, and effects on regional economic development, etc. In addition, not many studies have been conducted on population migration within Kanagawa, and the existing studies mainly focus on the effects of population migration within the region on regional economic development. There is hardly any systematic studies being conducted on Kanagawa's spatial

patterns of population migration the spatial patterns of population migration in Kanagawa. The following research methods and processes have been adopted.

Firstly, the paper summarizes the existing studies on the spatial distribution characteristics and spatial patterns of migration, introduces the objectives, methods, and main contents of this study based on relevant theoretical studies, defines the scope of this study, and explains the concepts related to this study.

Secondly, the spatial distribution characteristics of inter-provincial population migration in Kanagawa are analyzed in absolute and relative terms. The current patterns of population migration in Kanagawa are clarified.

Thirdly, an empirical analysis of the factors influencing the spatial pattern of population migration in Kanagawa is conducted to discuss the results of the empirical model and draw conclusions and propose countermeasures that can make population migration in Kanagawa more reasonable and practical based on the relevant findings.

Therefore, this paper analyzes the spatial characteristics of population migration in Kanagawa in terms of spatial distribution, migration distance, and migration scale by compiling and analyzing the data from the National Population Census and the Kanagawa Population Census analyzing the spatial distribution of population. With the development of the declining birth rate and aging society, migration for any purpose has an impact on social development. Through population migration, the economic and cultural exchanges between different regions can be enhanced, and the problems in socio-economic, environmental, and cultural aspects can be improved. Based on this, studying the spatial characteristics of population migration in Kanagawa is significant.

3. Subsection Review of Japan Population Migration Study

3.1. Population Migration in Japan

In Japan, the excessive concentration of population in metropolitan areas such as Tokyo, Nagoya, and Osaka have resulted in a distorted development of the country, especially the decline of rural areas. Although the total population began to decline after 2008 (128,084,000), the trend of concentration in metropolitan areas (more than half of the total population) is continuing. Since then, several policies have been implemented to revitalize rural areas. Despite these efforts, the population of rural areas continues to decline, especially among the young people who need to move out in order to maintain the population size.

Guixin [8] pointed out that population migration in the Tokyo metropolitan area: from “diffusion” to “concentration” as follows: (1) The “diffusion” of the population in the Tokyo metropolitan area is mainly manifested in two aspects: first, the rapid growth of population in the Tokyo metropolitan area and Kanagawa, Chiba, and Saitama prefectures relative to the Tokyo metropolitan area. Secondly, the population of the Tokyo metropolitan area, especially the central part of the metropolitan area, is decreasing. (2) After the mid-1990s, Kanagawa, Chiba, and Saitama prefectures maintained a certain level of net migration, but the trend of concentrated migration to the Tokyo metropolitan area became more pronounced. Moreover, the increase in net migration to Tokyo since the 1990s is mainly due to the steady decrease in the size of its out-migration population, which also indicates a clear tendency of stabilization of the in-migration of Tokyo during this period.

Kawai [9] examines recent population movements in the central cities and their urban wards of major metropolitan areas and the factors behind these movements, with a particular focus on Osaka City, the central city of the Kansai region, which has been experiencing a significant long-term outflow of population from the region. The following results were found, (1) The recent population growth in Osaka City and the Tokyo metropolitan area has been largely due to social growth but compared to the migration situation in the early 1990s, this is largely due to the halting of the population outflow rather than the population inflow. (2) Decrease in out-migration to the regional blocs where the cities are located contributes significantly to the improvement of net migration in each central city as a whole, and in Osaka City, in particular, the decrease in out-migration to Osaka Prefecture, where the distance traveled is shorter, is particularly large. (3) In Osaka City and the wards of Tokyo, there has been a marked social increase in the central wards of the city, and unlike the central cities, there has been a return to the center of the city due to the increase in population inflow. (4) The excess of new residents in Osaka’s central wards is largely due to the long-distance inflow of young people aged 15–24, mainly from the Chugoku and Shikoku regions, and the nearby and short-distance inflow from the city and the northern and eastern parts of the prefecture by a wide range of age groups, from young to middle-aged. (5) In addition to the massive supply of new housing, the reevaluation of the benefits of urban living based on the concentration of higher-order urban functions and the changes in the socio-economic environment that have promoted this trend have been major factors in the return of Osaka and Tokyo to urban centers, and others became clear.

3.2. Population Migration in Kanagawa, Japan

Foreign research on population migration is relatively broad, and its theoretical research is relatively mature and provides a reference for population migration research in Japan. Due to the availability and completeness of data, population migration in Japan is mainly focused on Japan as a whole and urban area such as Tokyo, and relatively little on population migration within provinces. In addition, not many studies have been conducted on the issue of Kanagawa population migration, the existing studies have mainly focused on the effects of Kanagawa population migration on regional characteristics, and no systematic studies have been conducted on the spatial patterns of Kanagawa population migration. In recent years, Kanagawa has seen an increase in

population migration. According to the 2021 Basic Resident Register Population Migration Report released by the Ministry of Internal Affairs and Communications on the 28th, the number of over-migrants, which is the number of in-migrants minus the number of out-migrants in Kanagawa Prefecture, increased by 2,270 from the previous year to 31,844. It was another top. It seems that the relocation from Tokyo is spreading due to the influence of COVID-19 [10].

Therefore, it is important to strengthen the study of population migration and macro-influencing factors in Kanagawa to better analyze the characteristics and influencing factors of population migration and to enrich the theory of population migration.

4. Variable Descriptions and Data Sources

This study selects several variables to study the factors influencing the spatial pattern of inter-provincial population migration in Kanagawa (Table 1), which helps to more rationally and scientifically formulate a population migration system that is conducive to Kanagawa's economic and development policy.

Table 1. Variable descriptions and data sources.

No.	Variable Type	Variable Category	Variable Name	Symbol	Variable description	Data source
1	**Dependent variable**		Population migration scale	Y	Inter-provincial population migration scale of Kanagawa	E-Stat
1	**Independent variables**	Economic factors	Gross Prefectural Product	G	Gross prefectural product by region	E-Stat
2			Job opportunities	UR	Employed population > 16 years old by region	E-Stat
3			Consumer price index (#1)	CP	Average consumer price index by regions (National average = 100)	Statistics Dashboard
4		Environmental factors	Garbage recycling rate (%)	GR	Waste recycling rate by region (%)	E-Stat
5			Number of pollution complaints handled	IN	Number of pollution complaints handled by region	E-Stat
6			Green Area (#2)	GS	Per capita park area (m^2)	The Ministry of Land Infrastructure, Transport, and Tourism
7		Social factors	Transportation conditions	D	Distance from Yokohama to the capital city or the out-migration province	Train Portal
8			Education level	E	Number of schools (#3) per capita by region	E-Stat
9			Medical level	M	Number of medical facilities per capita by region	E-Stat

#1: Consumer prices: 10 major categories: Food, housing, utilities, furniture, clothing, medical care, transportation, education recreation and miscellaneous expenses. http://www.stat.go.jp/data/kouri/kouzou/topics/topi871.htm;
#2: Green space: Includes specific district parks (country parks), contracted civic green spaces, and certified civic green spaces. https://www.mlit.go.jp/crd/park/joho/database/t_kouen/index.html
#3: Schools: The total number of kindergartens, elementary schools, secondary schools, upper secondary schools, universities and graduate school.

4.1 Variable Description

4.1.1. Dependent Variable

In this study, the indicator of the population migration scale of Kanagawa is used as the dependent variable. The population migration scale of Kanagawa is the number of people moving from Kanagawa to a province (region). This indicator is denoted by Y_S.

4.1.2. Independent Variables

In this study, considering the complexity of the population migration situation in Kanagawa, the availability of relevant data, and the current experience of population migration research at home and abroad, the indicators that may have an impact on the spatial selection of inter-provincial population migration in Kanagawa are selected as independent variables in economic, social, and natural terms, which as follows:

A. Economic factors

Economists believe that many factors affect population migration, such as the distance of population migration, differences in the level of economic development, population size, environment, and the level of development of science and technology, but to obtain greater economic gain is the general rule of spontaneous population migration. By conducting regression analysis, they

confirmed that regional differences in real per capita distributable income underlie population mobility [11]. The economic function of population movement is the equilibrium linkage of a population distribution to the regional distribution of living standards or regional differences in living standards. Later, it was examined the temporal causal relationship between interregional income inequality and interregional population movement using the Sims test. Joda points out that the development of population migration in Japan has generally been "synchronized" with economic growth and has been cyclical [12].

In this study, the following economic indicators are selected to study the influence of economic factors on population migration in Kanagawa.

$$\text{Gross Prefectural Income } (X_{1i}):\ X_{1i} = G_i \tag{1}$$

G_i is the gross prefectural income in the city i that people moved from Kanagawa into. The overall economic development level of a region can reflect the overall situation of the regional economy and represents the sum of all the values generated by a country or region within a certain time unit. Among them, the scale of gross prefectural income can reflect the overall strength of the regional economy and the speed of economic development and can reflect the impact of the size of a local economy on the migration of the local population.

$$\text{Job Opportunities } (X_{2i}):\ X_{2i} = UR_i \tag{2}$$

UR_i is the employed population over the age of 16 in the inter-provincial population migration area of Kanagawa. Push-pull theory suggests that workers' access to more and better employment opportunities is an important economic factor leading to population migration.

$$\text{Consumer Price Index } (X_{3i}):\ X_{3i} = UR_i \tag{3}$$

The Consumer Price Index measures changes in prices over time, including the prices of goods and services related to households purchased by households nationwide. The index used in this study includes 10 major categories, Food, housing, utilities, furniture, clothing, medical care, transportation and communication, education, recreation, and miscellaneous expenses.

B. Environmental factors

The awareness that non-monetary factors such as environmental factors are related to the causes of population movement between regions, in addition to monetary factors such as income disparity assumed by the classical model. Ito [13] used inter-prefectural population movement data for 1970, 1980, 1990, and 2000, including a variety of public policy indicators (34 types, including employment, human capital, various types of social infrastructure, transportation, public water and sewerage, parks, educational and learning facilities, residential areas, crime and traffic accidents, etc.). The analysis shows in addition to real personal income, urban social amenities were also found to affect the mobility of young people with junior high school, high school, and college degrees. Toma [14] estimated the effect of similarities in regional amenities such as natural parks, temperature, and precipitation on population movement patterns in each prefecture using an aggregate logit model, using inter-prefectural population movement panel data from 1997 to 2006. The results revealed that prefectural income, the ratio of job offers, the ratio of university graduates, the ratio of young people, the distance between regions, the cumulative number of migrants, the average temperature, and the number of days with precipitation significantly affect population movement between prefectures.

$$\text{Garbage Recycling Rate (\%) } (X_{4i}):\ X_{4i} = GR_i \tag{4}$$

The garbage recycling rate indicator is used to measure the level of ecological environment of the region i.

$$\text{The number of pollution complaints handled } (X_{5i}):\ X_{5i} = IN_i \tag{5}$$

Pollution complaints are a problem closely related to local residents and making them prompt and appropriate is extremely important for creating a better living environment. The number of pollution complaints is divided into the seven so-called typical pollution categories of air pollution, water pollution, soil pollution, noise, vibration, land subsidence, and offensive odor. The number of pollution complaints handled used in this study is used as a basis for responding to inquiries and complaints from nearby residents.

$$\text{Green area } (X_{6i}): X_{6i} = GR_i \tag{6}$$

Green spaces absorb carbon dioxide, purify the atmosphere, mitigate the heat island effect, and provide habitat and growth space for living organisms. Green spaces can contribute to the environmental sustainability of cities by continuously performing their environmental preservation function. The green space indicator used in this study includes specific district parks (country parks), contracted civic green spaces, and certified civic green spaces.

C. Social factors

The general common is that economic factors are the most fundamental factors influencing population migration, but in a complex social context, socio-cultural factors are also important factors to be considered in the process of population migration. In this study, the following two indicators of socio-cultural aspects related to population are selected to study the extent to which the spatial pattern of inter-provincial population migration in Kanagawa is influenced by socio-cultural factors.

$$\text{Transportation Conditions } (X_{7i}):\ X_{7i} = D_i \tag{7}$$

D_i is the distance from Yokohama to the capital city of the out-migrating province i. Distance is an important geographical factor in population migration, and the distance of migration affects the "migration cost" of the migrant to a large extent. The impact of distance on population migration is mainly manifested as hindering the migration of the population and reducing the number of the migrating population. Therefore, the spatial distance in this study refers to the shortest railroad distance between Yokohama and the capital city of each province.

$$\text{Education Level } (X_{8i}):\ X_{8i} = E_i \tag{8}$$

E_i is the number of schools per capita by region. The level of education in a region is an important factor in the level of literacy in a region and has an impact on regional population migration. In this paper, school is the total number of kindergartens, elementary schools, secondary schools, upper secondary schools, universities and graduate schools.

$$\text{Medical Level } (X_{9i}):\ X_{9i} = M_i \tag{9}$$

The level of medical care in a region has a significant impact on population migration. In this paper, the number of medical facilities per capita by region M_i is used to measure the level of medical care.

The indicators introduced in this empirical study are all relative data indicators for the following reasons: it is believed that the fundamental purpose of migration is to obtain higher benefits, and when there is a gap between the out-migrating place and the in-migrating place, the migrant is likely to obtain higher benefits. When the level of economic development of the in-migrating place is higher than that of the out-migrating place, the expected income of the migrant will be higher than the original income, and the expected outcome will determine whether and where the migrant will move to. The gap between the in-migrating and out-migrating places does not simply refer to the economic development gap, as long as there is a gap between the in-migrating and out-migrating places, the migrant will be driven to migrate. Therefore, population migration is subject to both the pull of the in-migrating place and the push of the out-migrating place.

4.2. Model Establishment

This study analyzes the factors influencing the spatial pattern of inter-provincial population migration in Kanagawa by constructing a multiple regression model. The degree of correlation between each factor and inter-provincial population migration in Kanagawa is analyzed visually through multiple data sets. Based on the above-selected variables, the article uses the census information, statistical yearbook information and data information obtained from the calculations, uses SPSS statistical software for data processing and discusses the data results of the regression model in the context of relevant research experience. The following is the basic form of the regression model in this study.

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \beta_6 X_{6i} + \beta_7 X_{7i} + \beta_8 X_{8i} + \beta_8 X_{8i} + \mu \tag{10}$$

Y_s is the scale of inter-provincial population migration in Kanagawa; X_{1i} is Per capita income; X_{2i} is job opportunities; X_{3i} is garbage recycling rate (%); X_{4i} is the implementation of the Noise Regulation Law rate (%); X_{5i} is transportation conditions; X_{6i} is education level; X_{7i} is medical level; β_0 is a constant term, β_j (j = 1, 2, 3, 4, 5) is the coefficient of each independent variable and μ is a random error term.

5. Results and Discussion

5.1. Analysis of Spatial Distribution Characteristics of Population Migration in Kanagawa

The total number of Kanagawa out-migrants is the highest in 2018, with 431,709 people moving out, which is much higher than in 2016 (Table 2). The number of out-migrants is on a decreasing trend starting in 2019, with the number of Kanagawa out-migrants decreasing to 424,743 by 2020. Overall, the growth rate of the Kanagawa out-migration population fluctuates from 2016 to 2020, with a tendency to increase year by year. The trend is increasing from 2016 to 2018, and gradually decreasing from 2019 to 2020. However, population emigration only accounts for 4.4% to 4.7% of the total population, which means that population emigration occurs relatively rarely.

Table 2. Kanagawa Out-Migration Data Sheet (2016~2020) (Data from [13–15]).

	Year	2016	2017	2018	2019	2020	2021
Out-Migration	Migration within Kanagawa	205,161	207,920	222,415	221,908	221,545	224,491
	Inter-Provincial Migration of Kanagawa	193,312	194,786	209,294	208,281	203,198	236,157
	Total	398,473	402,706	431,709	430,189	424,743	460,648
	Change over year rate	−3.4%	1.1%	7.2%	−0.4%	−1.3%	−0.8%

Table 3. Number of the population moving from Kanagawa to other 46 provinces from 2016~2020 (Data from [13–15]).

No.	Area	Year					No.	Area	Year				
		2016	2017	2013	2019	2020			2016	2017	2013	2019	2020
1	Tokyo	80493	81292	87979	88415	34795	24	Iwate	1191	1186	1200	1202	1088
2	Chiba	14303	15262	16276	16252	15392	25	Mie	1171	1246	1288	1215	1301
3	Saitama	13845	13888	15969	16114	15743	26	Kumamoto	1105	1083	1039	1113	1070
4	Shizuoka	7327	7631	8211	7972	7375	27	Yamagata	1030	982	963	915	833
5	Osaka	7195	6956	7594	7643	7657	23	Okayama	1028	984	1110	1054	1047
6	Aichi	6953	6920	7639	7591	7033	29	Yamaguchi	983	929	955	862	861
7	Hokkaido	5233	5339	5310	5446	5551	30	Ishikawa	920	972	984	832	906
3	Fukuoka	4873	4991	4922	5055	4995	31	Miyazaki	908	870	801	760	905
9	Ibaraki	4173	3933	4340	4199	4191	32	Akita	892	776	854	830	808
10	Hyogo	4064	3964	4290	4016	3334	33	Gifu	873	885	999	989	997
11	Mivagi	3320	3196	3052	3113	3056	34	Shiga	815	1011	1138	1072	975
12	Nagano	2702	2592	2340	2791	2366	35	Oita	743	643	740	708	722
13	Hiroshima	2550	2534	2630	2566	2520	36	Nara	742	736	755	740	661
14	Tochigi	2537	2699	3109	2997	2912	37	Toyama	696	694	699	750	723
15	Okinawa	2194	2223	2542	2422	2542	33	Ehime	664	631	715	744	655
16	Kyoto	2135	2149	2207	2167	2197	39	Kagawa	583	546	622	580	557
17	Niigata	2106	2066	2092	1989	2015	40	Kochi	419	379	381	383	342
13	Gunma	2053	2205	2522	2461	2572	41	Saga	411	432	496	472	405
19	Fukushima	1967	2033	2015	2000	2101	42	Shimane	343	337	332	318	361
20	Yamanashi	1650	1641	1863	1842	1923	43	Fukui	331	338	371	373	461
21	Aomori	1626	1747	1613	1557	1531	44	Tokushima	327	381	368	371	341
22	Nagasaki	1388	1424	1337	1242	1173	45	Wakayama	233	296	301	319	343
23	Kagoshima	1373	1466	1466	1528	1437	46	Tottori	279	243	265	246	315
	Max	80493	81292	87979	88415	84795							
	Min	279	243	265	246	315							
	Standard deviation	11919.2	12042.8	13052.8	13121.9	12591							

As can be seen from Table 3, the standard deviation of Kanagawa's inter-provincial out-migration population is very large, reaching 13,121.9 in 2019, indicating that the out-migration data are very discrete, and the population flow is very unbalanced. The difference between the maximum and minimum values is also large, with the maximum value around 80,000 and the minimum value only around 200, and the maximum and minimum values from 2016 to 2020 are all for Tokyo and Tottori prefectures, respectively. Also, Kanagawa's inter-provincial out-migration is mainly to Tokyo and substantially exceeds that of other provinces and cities, accounting for around 20% of the entire out-migration population. The second and third emigration provinces are Chiba and Saitama.

The migration characteristic is as follows: mainly around the cities of Kanagawa, extending to the coastal cities of Hokkaido in the east, and the western coastal cities such as Okinawa, Nagasaki, and Kagoshima, as well as some large cities such as Osaka and Fukuoka (Figure 2). In Figure 2, the areas marked in blue are the main relocation areas for Kanagawa emigrants. The darker the blue color, the more popular the area is with Kanagawa emigrants.

Due to the large difference in the total population of each province, the relative strength of cross-provincial population flow in Kanagawa cannot be fully reflected by using absolute numbers only, so this study introduces the "Outflow intensity index" to reflect the intensity characteristics of the flow. The following formula calculates the population out-migration intensity index (Table 4):

$$I_i = (M_i/M_x)/(P_i/P) \tag{11}$$

M_i: Population from Kanagawa to i province (city)
M_x: Inter-migration of Kanagawa
P_i: Population in i province (city)
P: National population
I_i: Outflow intensity index of Kanagawa's population to i province (region and city)

I_i reflects the relative proportion of Kanagawa's population flowing to i province (city). If $I_i > 1$, indicating that the proportion of Kanagawa's population flowing to i province (city) is higher than its proportion of its population in the country, and i province has a strong attraction to Kanagawa's population, the larger the value, the greater the attraction.

Figure 2. The map of the outmigration population of Kanagawa to major provinces. Source: Statistics Bureau, Ministry of Internal Affairs and Communications (2020). Made by authors. The darker shade shows a higher level of migration.

Table 4. Inter-provincial population migration intensity index in Kanagawa from 2016~2020.

No.	Area	Year					No.	Area	Year				
		2016	2017	2018	2019	2020			2016	2017	2018	2019	2020
1	Tokyo	1.88	1.86	1.86	1.86	1.79	24	Miyazaki	0.26	0.25	0.22	0.21	0.25
2	Chiba	0.76	0.77	0.76	0.76	0.75	25	Kyoto	0.26	0.26	0.25	0.25	0.25
3	Shizuoka	0.63	0.65	0.66	0.64	0.64	26	Osaka	0.26	0.25	0.25	0.25	0.26
4	Yamanashi	0.63	0.63	0.67	0.66	0.71	27	Ishikawa	0.25	0.27	0.25	0.23	0.24
5	Saitama	0.61	0.6	0.64	0.65	0.64	23	Hyogo	0.23	0.23	0.23	0.22	0.21
6	Okinawa	0.49	0.48	0.51	0.49	0.51	29	Yamaguchi	0.22	0.21	0.20	0.19	0.19
7	Ibaraki	0.46	0.43	0.44	0.43	0.43	30	Toyama	0.21	0.21	0.20	0.21	0.21
g	Miyagi	0.45	0.43	0.39	0.40	0.39	31	Mie	0.21	0.22	0.21	0.20	0.22
9	Nagano	0.41	0.39	0.40	0.40	0.42	32	Oita	0.20	0.18	0.19	0.18	0.19
10	Tochigi	0.41	0.43	0.47	0.45	0.45	33	Kumamoto	0.20	0.19	0.13	0.19	0.13
11	Aomori	0.40	0.43	0.37	0.37	0.37	34	Kagawa	0.19	0.13	0.19	0.13	0.17
12	Gunma	0.33	0.35	0.38	0.37	0.39	35	Kochi	0.19	0.17	0.16	0.16	0.15
13	Fukushima	0.33	0.34	0.32	0.32	0.34	36	Shiga	0.18	0.23	0.24	0.22	0.20
14	Nagasaki	0.32	0.33	0.29	0.28	0.27	37	Nara	0.17	0.17	0.17	0.16	0.15
15	Hokkaido	0.31	0.32	0.29	0.30	0.32	33	Okayama	0.17	0.16	0.17	0.16	0.16
16	Fukuoka	0.30	0.31	0.28	0.29	0.29	39	Shimane	0.16	0.15	0.14	0.14	0.16
17	Iwate	0.30	0.30	0.28	0.29	0.27	40	Saga	0.16	0.17	0.13	0.17	0.15
13	Aichi	0.30	0.29	0.30	0.30	0.28	41	Tottori	0.16	0.14	0.14	0.13	0.17
19	Yamagata	0.29	0.28	0.26	0.25	0.23	42	Ehime	0.15	0.15	0.15	0.16	0.15
20	Niigata	0.29	0.29	0.27	0.26	0.27	43	Tokushima	0.14	0.16	0.15	0.15	0.14
21	Hiroshima	0.29	0.28	0.28	0.27	0.27	44	Oifij	0.14	0.14	0,15	0.15	0.15
22	Akita	0.28	0.24	0.25	0.25	0.25	45	Fukui	0.13	0.14	0.14	0.14	0.13
23	Kagoshima	0.27	0.23	0.27	0.28	0.28	46	Wakayama	0.09	0.10	0.10	0.10	0.11

Only Tokyo's index is greater than 1, from 1.88 in 2016 to 1.79 in 2020, showing a gradually decreasing trend but still remaining high, indicating that Tokyo has a very strong but gradually decreasing attractiveness for Kanagawa. Kanagawa's inter-provincial population emigration intensity indicator is less than 0 in the remaining 45 provinces, with most of them between 0.5 and 0.1. It is noteworthy that Osaka and Aichi, which used to be the fifth and sixth provinces in terms of Kanagawa interprovincial migration, do not perform well in terms of the Kanagawa interprovincial migration intensity index, ranking 26th and 18th, respectively. What's more, Okinawa and Yamanashi, which were originally ranked 15th and 20th in terms of inter-provincial migration from Kanagawa, performed strongly in terms of Kanagawa inter-provincial migration intensity indicators, reaching 0.5 and 0.6, respectively, and ranked 4th and 6th, indicating that Okinawa and Yamanashi showed strong attractiveness to inter-provincial migration from Kanagawa. Also, after the COVID-19 outbreak in 2020, the intensity indicator of migration into Tokyo became smaller, while the intensity indicators of Yamanashi and Oginawa became significantly larger.

5.2. Analysis of Factors Influencing Spatial Pattern of Population Migration in Kanagawa

5.2.1.VIF Test of all Variables of Inter-Provincial Population Migration during 2016~2020

To clarify whether there is multicollinearity among the variables, this study validates the model by applying the variance inflation factor (VIF) test. VIF indicates the ratio of the variance of the estimated regression coefficients compared to the variance when no linear correlation is assumed among the independent variables. When the VIF is greater than 10, it indicates a serious problem of multicollinearity between the variables. As can be seen from Table 5, the VIF values of all variables do not exceed 10, which indicates that there is no serious problem of multicollinearity between the following main variables and can be studied in the next step.

Table 5. The VIF Test of all variables of the interprovincial population in Kanagawa during 2016~2020.

	Values of VIF Test					
	Variables	**2016**	**2017**	**2018**	**2019**	**2020**
Economic factors	Gross prefectural product	6.986	7.414	8.191	7.248	6.986
	Job opportunities	4.678	6.296	6.088	5.62	4.678
	Consumer price index	2.073	1.75	1.858	2.013	2.073
Environmental factors	Garbage recycling rate (%)	1.14	1.106	1.104	1.1	1.145
	Number of pollution complaints handled	5.509	6.588	6.89	5.78	5.509
	Green space	2.236	2.033	2.039	2.105	2.236
Social factors	Transportation conditions	1.882	1.935	1.901	1.942	1.882
	Education level	2.647	2.824	2.982	2.8	2.647
	Medical level	2.112	2.077	2.098	2.132	2.112

This study applies SPSS.26 statistical software to the model and selects the appropriate model for regression.

5.2.2. Analysis of the Results of Influencing Factors of Migration

This study applies SPSS.26 statistical software to the model proposed by the hypothesis and selects the appropriate model for regression. For model (3.10), this paper first applies regression analysis on the effect of economic factors, environmental factors, and social factors on inter-provincial population migration in Kanagawa, separately. The empirical results show that in 2016, in economic terms, Gross Prefectural Product (G) and Job opportunities (UR) are significant at the 1% level with regression coefficients of 1.209, and 0.374, respectively. From the environmental point of view, the number of pollution complaints handled (IN) has a significant effect on the migration, and the regression coefficient is 0.666 at the 1% level. From the social perspective, Education Level (E) influenced the migration tendency of the Kanagawa out-migration population with a regression coefficient of 0.403 at the 5% level (Table 6).

Combining all nine indicators of economic, environmental, and social factors in the model, the main influencing factors of population migration intensity are Gross Prefectural Product (G) and Job opportunities (UR), and both are significant at the 1% level, and their regression coefficients are 1.343 and 0.369 (Table 7).

Table 6. The regression result of the economic, environmental, and social influence factors separately included in the model (2016 data).

Economic Factors		**Environmental Factors**		**Social Factors**	
Gross Prefectural product	1.209 (13.043) ***	Garbage recycling rate (%)	0.014 (0.131)	Transportation	−0.148 (−0.838)
Job opportunities	0.374 (4.446) ***	Number of pollution complaints handled	0.666 (5.615) ***	Education level	0.403 (2.177) **
Consumer price index	0.063 (1.149)	Green space	0.104 (0.872)	Medical level	0.103 (0.524)

Numbers in parentheses are t-statistics, *, **, *** indicating that the t-statistics are significant at the 10%, 5%, and 1% levels, respectively.

Table 7. The regression result with all influencing factors included in the model (2016 data).

	Variables	**Unstandardized B**	**Coefficients Std. Error**	**Standardized Coefficients Beta**	**t**	**Sig.**	**Statistics VIF**
Economic factors	(Constant)	6.77×10^{-16}	0.05		0	1	
	Gross Prefectural Product	1.34	0.12	1.34	12	0	6.44
	Job Opportunities	0.37	0.11	−0.37	3.27	0.00	6.05
	Consumer price index	0.04	0.06	0.04	0.65	0.52	1.66
Environmental factors	Garbage recycling rate (%)	0.00	0.05	0.00	0.052	0.96	1.09
	Number of pollution complaints handled	−0.14	0.11	−0.14	−1.29	0.21	5.32
	Green space	0.05	0.07	0.05	0.73	0.47	1.98
Social factors	Transportation conditions	0.01	0.06	0.01	0.22	0.83	1.89
	Education level	0	0.08	0.05	0.64	0.53	2.84
	Medical level	0.00009749	0.07	0	0.00	1.00	2.09

Dependent Variable: Population migration scale.

The same regression model was applied to 2017~2020 and the main results are shown in Table 8 and Table 9. In Table 6, the result showed that, in terms of the factors influencing each factor level, the factors influencing inter-provincial population migration in Kanagawa province between 2016 and 2020 are relatively consistent but also changing. For the economic factors, the main influencing factors from 2016 to 2018 are Gross Prefectural Product and Job opportunities. From 2019 to 2020, Kanagawa's inter-provincial migration is influenced by three factors: Gross Prefectural Product, Job opportunities, and Consumer Prices Index; From the environmental perspective, the main influencing factor from 2016 to 2020 is the Number of pollution complaints handled, which indicates that the migrating population pays much attention to the quality of life in the place of migration, such as noise control. In terms of social factors, the main influencing factor between 2016 and 2020 is Education level, which indicates that the migrating population pays much attention to education level.

Putting all the factors in the model, the factors influencing inter-provincial population migration in Kanagawa province are relatively stable between 2016 and 2020. Between 2016 and 2019, Gross Prefectural Product and Job opportunities are the main influencing factors on population migration and the regression coefficient is positive. In 2020, Gross Prefectural Product and Consumer prices index are the main influencing factors on population migration with positive regression coefficients, indicating that the outflow population of Kanagawa in 2020 is mainly influenced by the general economic level and consumer prices of the place of migration; The number of pollution complaints handled in 2017, 2018 and 2020 is also the main influencing factor on population migration and the regression coefficient is positive. It indicates that the quality of life of residents is gradually becoming an important condition influencing population migration (Table 9).

In 2020, significant economic Influencing factorsInfluencing factors changed. The job opportunities are no longer significant, and the Consumer price index became a new influencing factor. According to the table below, the mean value of Job opportunities and the Consumer price index from 2016 to 2020 shows that the national average job opportunities were 17,908 in 2019 and has a substantial decline to 14139 in 2020. However, the mean value of the Consumer price index is stable over five years, thus having a larger impact on population migration and becoming the new influencing factor in 2020 (Table 10).

Table 8. The significant influencing factors after economic, environmental, and social factors included separately in the model (2016–2020).

		Variables	2016	2017	2018	2019	2020
Model 1	Economic factors	Gross Prefectural Product	(1.209)	(1.207)	(1.173)	(1.133)	(1.324)
		Job Opportunities	(0.666)	(0.686)	(0.697)	(0.665)	(0.676)
		Consumer price index				(0.117)	(0.245)
Model 2	Environmental factors	Garbage recycling rate (%)					
		Number of pollution complaints handled	(0.403)	(0.391)	(0.39)	(0.393)	(0.384)
		Green space					
Model 3	Social factors	Transportation conditions					
		Education level	(0.374)	(0.386)	(0.36)	(0.336)	(0.157)
		Medical level					

Table 9. Significant influencing factors after all factors included in the model (2016–2020).

		Variables	2016	2017	2018	2019	2020
Model 4	Economic factors	Gross Prefectural Product	(1.343)	(1.397)	(1.379)	(1.289)	(0.532)
		Job Opportunities	(0.369)	(0.367)	(0.324)	(0.314)	
		Consumer price index					(0.333)
	Environmental factors	Garbage recycling rate (%)					
		Number of pollution complaints handled		(0.201)	(0.222)		(0.271)
		Green space					
	Social factors	Transportation conditions					
		Education level					
		Medical level					

Table 10. Mean value of Job opportunities and Consumer price index in the model (2016–2020).

	Variables	2016	2017	2018	2019	2020
Economic factors	Gross Prefectural Product	11683995.9	11916565.1	12033755.4	11682226.2	11727055.6
	Job Opportunities	23169.6	21842.8	20169.0	17908.7	14139.3
	Consume price index	98.9	99.0	98.9	99.0	98.9
Environmental factors	Garbage recycling rate (%)					
	Number of pollution complaints handled	1583.0	1546.5	1521.0	1605.9	1838.9
	Green space					
Social factors	Transportation conditions					
	Education level	1014.3	999.7	985.4	972.4	958.2
	Medical level					

6. Conclusions

Based on the data information from the Japanese census from 2016 to 2020 and the theories about population migration in demography, this study investigates the migration out of Kanagawa province from the following aspects: first, it explores the temporal change pattern of migration out of Kanagawa province; second, it explores the spatial characteristics of the inter-provincial migration out of Kanagawa province; third is it analysis the changes in the factors influencing in the inter-provincial emigration of Kanagawa. The three are interrelated so as to further analyze the causes of the situation of Kanagawa's out-migration in depth. The main conclusions are as follows.

Firstly, the paper analyzes the population migration status from the time scale.

(a) According to the census information, we can conclude that the number of out-migrants from Kanagawa province between 2016 and 2020 is the largest in 2018, with the number of out-migrants much higher than in 2016 and 2017. The number of out-migrants from Kanagawa Province decreases by 2019 and continue to decline by 2020.

(b) The ranking of Kanagawa's population migration areas has been stable for five years. The main areas of migration are Tokyo, Chiba, and Saitama, where the annual migration population exceeds 12,000. The areas with an annual migration of 4,000 to 8,000 people are Shizuoka, Osaka, Aichi, Hokkaido, Fukuoka, Ibaraki, and Hyogo areas. Except for the above areas, the number of people migrating to other areas is relatively small and does not show significant changes.

Secondly, the paper analyzes the population migration status in terms of spatial characteristics.

(a) The overall migration is characterized as follows: mainly "geopolitical", moving around the provinces of Kanagawa, such as Tokyo, Chiba, Saitama, and Shizuoka. Extends to the coastal provinces of Hokkaido in the east, coastal cities in the west, such as Okinawa, Nagasaki, and Kagoshima, as well as some large cities, such as Osaka and Fukuoka.

(b) Analysis of population migration from the intensity of Kanagawa's inter-provincial population migration. Kanagawa's inter-provincial migration intensity is spatially characterized by "only superpower and multi-great power" geopolitically. "Only superpower" is Tokyo. Tokyo has an out-migration intensity index greater than 1, from 1.88 in 2016 to 1.79 in 2020, showing a decreasing trend, but still maintaining a high level, indicating that Tokyo's attractiveness to Kanagawa is strong, but gradually decreasing. The "multi-great power" are Chiba, Shizuoka, Yamanashi, and Saitama, with intensity ranging from 0.6 to 0.1.

Thirdly, the paper analyzes the influencing factors of population migration in Kanagawa.

Using SPSS statistical software, correlation and linear regression models were used to analyze the influencing factors.

Based on the result, it was found that, when only the economic factor was considered, gross prefectural product, job opportunities, and consumer price index significantly influenced migration. Among them, the main influencing factors from 2016 to 2018 are gross prefectural product and job opportunities. From 2019 to 2020, inter-provincial population migration in Kanagawa province is influenced by three factors, gross prefectural product, job opportunities, and consumer price index. This indicates that local economic development, personal development potential, and commodity price level are increasingly valued. When only environmental factors are considered, the number of pollution complaints successfully handled has a significant positive effect on population migration. This indicates that population migration in Kanagawa tends to be more towards areas with a higher quality of life and better government services. When only the social environment is considered, the level of education becomes the main consideration for people. It indicates that population migration in Kanagawa tends to go to areas with better education levels.

When the economic factors, environmental factors, and social factors are analyzed together, the gross prefectural domestic product, job opportunities, consumer price index, and the number of pollution complaints successfully handled all have an impact on the migration in Kanagawa. Among them, the gross prefectural product is the common influencing factor. From 2016 to 2019, gross prefectural product and job opportunities are the main influencing factors of population migration with positive regression coefficients.. In 2017, 2018, and 2020, the number of pollution complaints successfully solved is also the main influencing factor of population migration with a positive regression coefficient. This indicates that the quality of life and government service is becoming important factor influencing population migration. The indicators in social factors, transportation condition, education level, and the medical level do not have a significant effect on population migration in Kanagawa. This may be due to the convenient transportation and generally high level of education and medical care in Japan. The standard deviation of the level of education and medical care in each province was around 0.1, indicating an average development.

Last but not least, under COVID-19, economic factors remain the main factor in population movement, while among them the attractiveness of the economic and political center Tokyo has declined. The pandemic has disrupted and exacerbated past migration patterns, including migration and natural population change, in marked ways. The shift from physical to remote work in the service sector has affected the geography of work in urban and suburban areas. Considering the potential epidemic nature of this disease poses ongoing risks, shocks, and disruptions to communities around the world. Future research should focus on understanding the impact and outcomes of COVID-19 on population migration in Japanese cities across age classes.

Based on the above analysis, following conclusions and recommendations can be made to enhance better services, which will help migrants for better lives.

(1) Promote the good and rapid development of the regional economy

Make good use of the advantages of local resources in Kanagawa Province and combine them with technology to develop local special industries, such as tourism in Kanagawa Province; use the advantages of agriculture and land resources in Kanagawa Province to accelerate the development of agricultural modernization and improve the quality of rural industrial development.

(2) Develop regional resources, and increase job opportunities

Since its designation as a national strategic special zone, Kanagawa has been utilizing its industrial base and other regional resources to the maximum extent. In the future, the local pharmaceutical and medical device industries should be revitalized, and policy guidance for small and medium-sized enterprises should be increased. Continuously improve Kanagawa's comprehensive strength and attract more talents by increasing local job opportunities.

(3) Stabilize commodity price levels

Since 2021, most countries around the world have been challenged by severe inflation, and the Russian-Ukrainian conflict has led to a shock to the global oil and food supplies, which further adversely affects the global inflation situation. Currently, America is pushing the dollar to appreciate to fight inflation, and the rising dollar index means more countries' currencies depreciate, and inflation levels in many countries will continue to rise. If the price level rises, it will further disadvantage employment and consumption, thus widening the distribution gap. Therefore, price level stability is particularly important.

(4) Improve the quality of government services

Effectively use digital technologies such as cloud computing, blockchain, big data, artificial intelligence, etc. to improve the quality, level and effectiveness of public services and promote the development of high-quality public services. In practice, telemedicine services and education platforms built based on IoT, and big data technologies can not only effectively expand the radiation range of high-quality public services, but also break the barriers to access to public services arising from differences in economic development levels and governance resources between regions and urban and rural areas.

7. Limitation and Future Works

(1) Research depth

The article only analyzed the number of population migrations in Kanagawa but lacked the study of age group of the migrating population, which is one of the important characteristics of population migration. In the follow-up study, we should strengthen the study of the age group of population migration to analyze the characteristics of population migration in Kanagawa more comprehensively.

(2) Selection of influencing factors

The selection of influencing factors was mainly based on existing research results, and the selection of influencing factors may not be comprehensive. In the future, this study should be deepened in the context of Kanagawa's actual situation, conduct field research, and select micro-influencing factors for analysis to make the study more representative.

(3) Data collection

In terms of data collection, this study only used cross-sectional data for the five-year period from 2016 to 2020 to make a preliminary analysis of population migration patterns and influencing factors in Kanagawa Province from a macro perspective. It fails to gain insight into the changes in population migration from a longer period, which needs to be further deepened in future related studies.

(4) Single case study analysis

The current analysis is based on the single case study in one prefecture in Japan. It is always difficult to generalize the findings widely applicable to other prefectures or even outside Japan. The case study provides some insights on the urban-rural migration process, which is a new trend in Japan, and possibly in many other countries. It is important to have a more comparative analysis of different cases and try to understand the pull and push factors of the migration.

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Author Contributions

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Declaration of Competing Interest

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