A Geographical Study on Urban Migration in the Kanto Region

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CHAPTER I

INTRODUCTION

I-1 Previous studies and the purpose of this study

Urban migration is defined as the movements including in-migration into the city, out-migration out of the city, and intra-urban migration within the city (Lewis,1982,p.118). This study uses this definition.

The origin of studies on urban migration is the Ravenstein's classical studies of migration laws at the end of the 19th century the same as many other migration studies be. In terms of in- and out-migrations of city, he proposed the relationships between city and migration as follows:

① Migrants proceeding long distances generally go by preference to one of the great centers of commerce and industry;

② Migration proceeds step by step to the greater center;

③ Large towns grow more by migration than by natural increase;

④ The natives of towns are less migratory than those of rural areas (Ravenstein, 1885・1889).

In the context of migration studies, whether explicitly or implicitly, these four propositions have been verified by many researchers for a long time.

As compared with this, it was late that the study of intra-urban migration became active: for example, in Europe and America, increase of such studies has started from the latter half of the 1960's (Kishimoto,1978,pp.187-190). At the present time, in- and out-migrations of city and intra-urban migration are both the main subject of migration study with the consequence of enormous number of studies related to the urban migration defined by Lewis (1982).

Up to this time on the geographical branches, generally to say, it has made a distinction between the short-distance movement within city and the other movement traveled longer distance: the former is separated from migration and named as local mobility or residential mobility. This distinction is applied not only to the terminology but also to the methodology related to the spatial scale as mentioned below.

The analytical approaches on migration studies are divided into two parts of macro- and micro-level approaches. On the macro approaches, the subject of analysis is not to the individual itself but to the group of individual and its mean value: in addition to say, this methodology intends to link the spatial pattern of migration with that of the other regional attribute by means of the objective method such as multivariate analysis (Woods,1982,pp.131-157).

In terms of spatial scale, in- and out-migrations belong to the inter-regional level which corresponds to the inter<u>shi-cho-son</u>(cities-towns-villages) migration in Japan. On the macro analysis of this scale, there are many verifications applied regression analysis based on the so-called "Lory model family" (Lewis,1982,pp.99-125). From the widespread application of regression analysis, it would appear that out-migration depends more on the size and structure of population than on the level of economic opportunity in the origin city, and that in-migration is closely related to the size and condition of labor market in the destination city (Morikawa,1975; Flowerdew and Salt,1979). Also, only in terms of in- and out-migrations of city, Ishimizu (1979) investigated the spatial pattern of urban migration and its causes. As a result of correlation and regression analyses, he exemplified a hypothesis that the urban migration was a function of both population potentials and urban population within the given group of cities.

In the scale of intra-urban migration, restrictions of the data reduce to the small number of analyses based on the macro approaches as compared with the in- and out-migrations. In these analyses, additionally to identifying the spatial pattern of mobility rates within the city, attempts have also been made to establish the interrelationships between mobility rates and other features of the urban environment, such as socio-economic, demographic and housing characteristics (Moore,1969・1971; Kato,1980; Cadwallader,1981・1982; Murayama,1985). Of these characteristics, it would be very different from the macro level of migration phenomena that housing variables indicate some high level of percentage of the variance explained as independent variables.

However, in the scale of intra-urban migration, the central approach on migration studies is rather micro one in which analyses are conducted to the normative migration behavior extracted from the whole on the assumption that individual's decision-making process exists. There are representative studies on this context: for example, in the beginning, a series of studies by Wolpert (1964・1965・1966) proposed the concept of place utility; Brown and Longbrake (1970) exemplified the importance of socio-economic differences between the areas within the city; Clark and Cadwallader (1973) estimated various kinds of stress promoting migration behavior; and Speare (1974) clarified the relationship between migration behavior and migration decision-making by means of an index of residential satisfaction.

As mentioned above, it is the central approach for in- and out-migrations of city to utilize analyses based on the macro approach; as opposed to this, on studies of intra-urban migration, the micro level of methodology has been adopted more than the macro one. However, in a direction of the migration studies of late years, it has been recognized firmly that it is an important theme to explain the different scale of migrations with unification by means of macro or micro approaches (Woods,1982,pp.131-157; Cadwallader,1986; Courgeau,1989). There is the background of this orientation: that is, the social fluctuation explained by the mobility transition theory is applicable to European and American countries and also Japan as mentioned as follows.

Concretely to say, there are five kinds of forms on the internal migration: intra-rural migration, inter-rural migration, rural-urban migration, inter-urban migration and intra-urban migration. And these are put in order in parallel with the historical modernization process of socio-economic development and urbanization. With shifting from the pre-modern traditional society to the advanced society, the form of migration transfers from the rural-urban dominance to the inter-urban or intra-urban basis (Zelinsky,1971). In Japan, it is the tendency of late years that migration has been reiterating reciprocally between concentration to large cities and dispersion from those (Kuroda,1976; Hama,1990,pp.119-123; Murayama,1990a). Along with this, it is also pointed out that inter- and intra-urban migrations have taken the seat of main current of the internal migration (Ishikawa,1978,p.433). Therefore, in the case of having a intention to understand the dynamic feature of city by means of migration phenomena, it would be a valuable theme for the advanced society of modern Japan to elucidate the synthetic migration phenomena including not only in- and out-migrations between city and its external area but also intra-urban migration (Skeldon,1990,pp.115-120).

In order to reply this theme, it is necessary to analyze the three kinds of migration phenomena constituting urban migration collectively: in the concrete, three kinds of methodology would be presented for the analysis as follows.

The first method is to analyze the urban migration with the macro approaches. Though previous researchers have devoted themselves to the accumulation of studies separated between the in- and out-migrations of city and the intra-urban migration, in this place, these migrations are analyzed collectively with the application of multivariate analysis. By means of this method, it could be done for a broader unit area including a lot of cities to clarify the areal difference of migration phenomena among the cities and to extract the spatial pattern of urban migration from the difference.

The above mentioned spatial pattern of migration means the configuration of spatial distribution based on the attribute variable values of migration and it differs from the pattern of migration flows: in this study, the pattern of such configuration is named as the distribution pattern of migration.

The second method is to analyze the urban migration with the micro approaches. By shifting the viewpoint from population group to specified individual, it is capable to understand the matter of concrete migration behavior individually. For instance, the researcher is able to question the individual migrant directly about the migration form and migrant attribute: single or family; age and sex; occupation, school career, housing and the other socio-economic status: and also about the reason to migrate. Additionally, from the viewpoint of individual level, it would be explained in connection with the life-cycle of human life for in- and out-migrations and intra-urban migration, each having a different spatial scale, but both to be a part of the locus named as life-path from a birth point to a death point (Ohzeki and Takahashi, 1984; Ohzeki et al., 1985).

And the third method is to develop a new approach combining the macro and micro ones and thereby to extract the distribution pattern of urban migration for a broader unit area simultaneously with description of the individual migration behavior. In terms of this method, Cadwallader (1989a・1989b・1992, pp.3-38) has presented a conceptual framework combining those two approaches and also quantified causal relations between the explanatory variables to migration by means of the structure equation in a series of his studies.

In those three methods, the first and the second are not in antinomy but characterized in common by converging to the unified explanation of migration phenomena with different spatial scales complementarily: it means the solution by the third method. But, up to the present, the third method would not be developed sufficiently to produce the operational model clarifying the interrelation actually between the in- and out-migrations of city and the intra-urban migration and elucidating the areal difference of cities based on the interrelationship. The principal reason why it doesn't is that there is insufficient information for construction of the model in order to clarify the urban migration even with the first and second methods. For instance, it needs more accumulation of the exemplified study concerning volume of urban migration, mobility, migrant's attribute, relationship between migration and socio-economic attribute of city and so on.

In this study, in consideration of the present condition of migration statistics, the first method is selected from the above mentioned three methods for reasons of replying to the theme of explaining the different spatial scale of migrations with unification.

In Japan, by reference to the results of internal migration of the Population Census of Japan, it is capable to collect the statistical data tabulated for broader area which is necessary to analyze urban migration with the macro approach. Also, the employment of those data makes it practicable to input a lot of attribute variables of migration into the analysis and particularly it is important that the analysis is practicable based on the national statistical data of in- and out-migrations of city and intra-urban migration collecting at a time and at the same accuracy. The lack of statistical data preparing such conditions is the most fundamental factor which has made a difficulty in comparison between the in- and out-migrations of city and the intra-urban migration and which has obstructed the accumulation of previous studies based on the first method.

Also, the results of internal migration of the census contribute to the dynamic analysis of urban migration because of its publication at the plural years. As mentioned above, from the viewpoint of mobility transition theory, the mobility of in- and out-migrations including rural-urban migration is to decrease relatively as compared with the mobility of intra-urban migration with modernization of society. In comparison with the temporal scale of that theory, the years of statistical data which can utilize in Japan are restricted after the year of 1970 when the country was in the period of high economic growth. Therefore, there is a certain limit of consideration from the viewpoint of dynamic feature but it is practicable to confirm the temporal stability of distribution pattern at least.

Additionally, in this study, the relationship between migration and socio-economic attribute of city is employed as another viewpoint of considering the distribution pattern of urban migration. In Japan, though there is plenty of accumulation of the urban dimension studies originated by Yasuda (1959) and the quantitative regional structure studies, only a few studies have employed the attribute of migration and therefore it is insufficient to clarify the role of that attribute on explaining the characteristic of city. Accordingly, the distribution pattern of urban migration derived from the analysis by the first method mentioned above would be interpreted from a viewpoint of explaining the characteristics of city through elucidating the spatial covariation between the migratory attribute and the socio-economic attribute which has been employed in previous studies.

The above has mentioned to an outline of previous studies on the relationship between migration and city and the spatial scale of migration and its related analytical approaches. Also, it has mentioned to the problem unsolved in previous studies and the viewpoint of this study to that. Based on the above consideration, the purpose of this study is set up as follows. The purpose of this study is to extract the distribution pattern of urban migration based on the difference of migration phenomena between the cities within the advanced society of urbanization in Japan and to consider the pattern based on the temporal stability and the spatial covariation between the migratory attribute and the socio-economic attribute of the cities.

I-2 Methodology

I-2.1 The study area and the cities of analysis

Fig.1 shows 125 cities of the Kanto region analyzed in this study. These

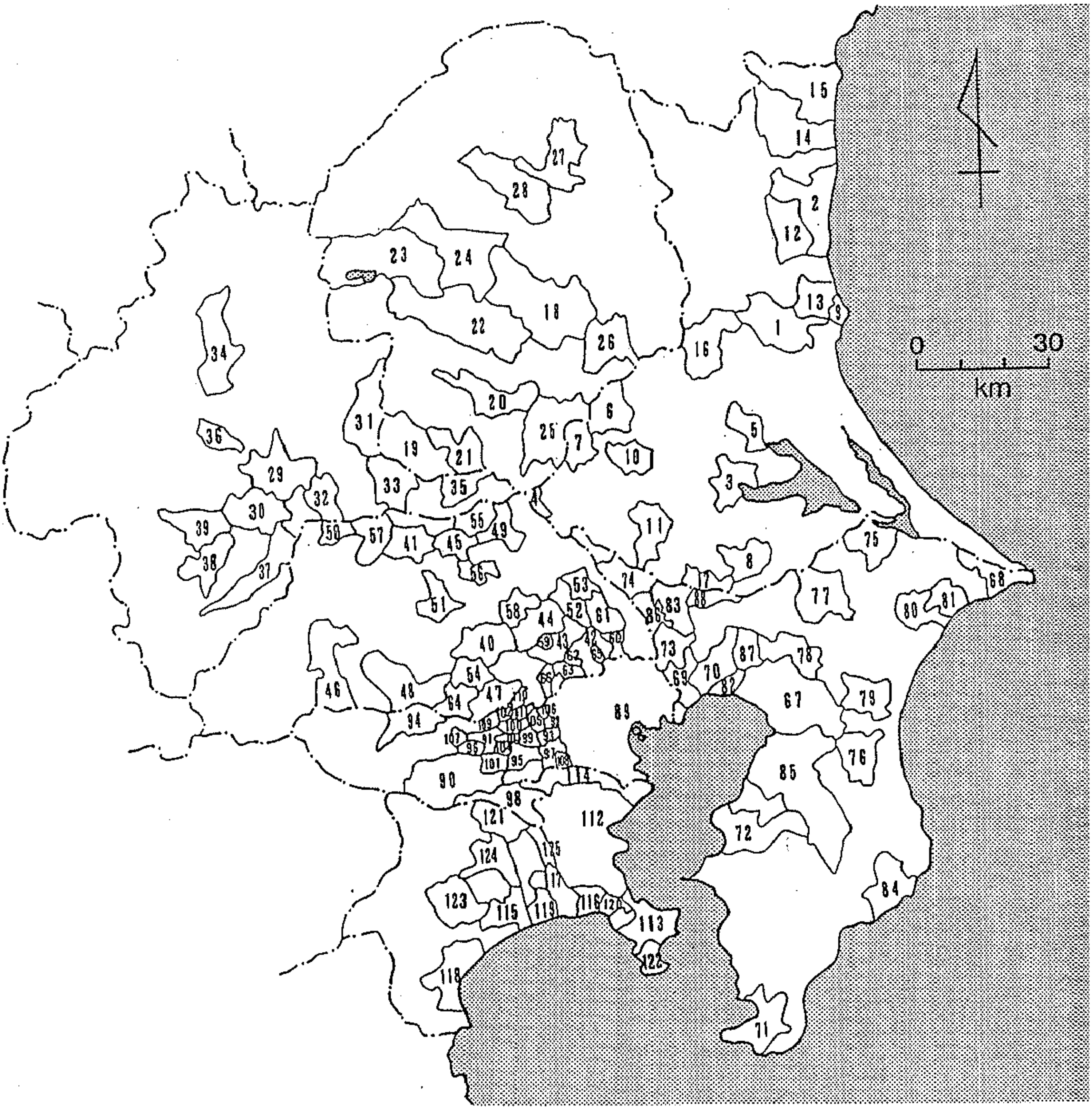


Fig.1 The study area and the unit zones

Ibaraki-prefecture
1. Mito
2. Hitachi
3. Tsuchiura
4. Kbga
5. Ishioka
6. Shimodate
7. Yuki
8. Ryugasaki
9. Nakaminato
10. Shimotsuma
11. Mitsukaido
12. Hitachiota
13. Katsuta
14. Takahagi
15. Kitaibaraki
16. Kasama
17. Toride

Tochigi-prefecture
18. Utsunomiya
19. Ashikaga
20. Tochigi
21. Sano
22. Kanuma
23. Nikko
24. Imaichi
25. Oyama
26. Mooka
27. Otawara
28. Yaita

Gumma-prefecture
29. Maebashi
30. Takasaki
31. Kiryu
32. Isesaki
33. Ota
34. Numata
35. Tatebayashi
36. Shibukawa
37. Fujioka
38. Tomioka
39. Annaka

Saitama-prefectur
40. Kawagoe
41. Kumagaya
42. Kawaguchi
43. Urawa
44. Omiya
45. Gyoda
46. Chichibu
47. Tokorozawa
48. Hanno
49. Kazo
50. Honjo
51. Higashimatsuyama
52. Iwatsuki
53. Kasukabe
54. Sayama
55. Hanyu
56. Konosu
57. Fukaya
58. Ageo
59. Yono
60. Soka
61. Koshigaya
62. Warabi
63. Toda
64. Iruma
65. Hatogaya
66. Asaka

Chiba-prefecture
67. Chiba
68. Choshi
69. Ichikawa
70. Funabashi
71. Tateyama
72. Kisarazu
73. Matsudo
74. Noda
75. Sawara
76. Mobara
77. Narita
78. Sakura
79. Togane
80. Yokaichiba
81. Asahi
82. Narashino
83. Kashiwa
84. Katsuura
85. Ichihara
86. Nagareyama
87. Yachiyo
88. Abiko

Tokyo-metropolis
89. Tokyo
90. Hachioji
91. Tachikawa
92. Musashino
93. Mitaka
94. Ome
95. Fuchu
96. Akishima
97. Chofu
98. Machida
99. Koganei
100. Kodaira
101. Hino
102. Higashimurayama
103. Kokubunji
104. Kunitachi
105. Tanashi
106. Hoya
107. Fussa
108. Komae
109. Higashiyamato
110. Kiyose
111. Higashikurume

Kanagawa-prefecture
112. Yokohama
113. Yokosuka
114. Kawasaki
115. Hiratsuka
116. Kamakura
117. Fujisawa
118. Odawara
119. CHigasaki
120. Zushi
121. Sagamihara
122. Miura
123. Hadano
124. Atsugi
125. Yamato

cities are selected for the following two reasons.

The first is that the Kanto region is the most advanced society of urbanization in Japan. Even at the year of 1980, the urban population was counted up to 28,317 thousand which corresponded to 81.1 % of the total. Also, within a radius of 40 km from the Tokyo Station, 54 cities corresponding to 43.2 % of the total are distributed in the shape of continuum from Tokyo. It means that the Kanto region exhibits the extremely high degree of concentration to city in terms of inhabitation and also includes a huge urbanized area composed of the giant city of Tokyo and its suburban cities.

The second is to secure the spatial scale which is necessary to assess the influence of the Tokyo metropolitan area on migration phenomena. Even with a consideration of the recent increase of commuting distance, previous studies have employed a sphere of 70 km from Tokyo as the appropriate spatial scale of daily life, which is derived from the index of commuting to the central city (Saito,1982; Tomita and Kouno,1990). But, in terms of migration, it would not be enough at that level of sphere in order to grasp the influence of the Tokyo metropolitan area[1]). Especially, the broader spatial scale is needed for the northern part of the Tokyo metropolitan area because of the lack of topographical barrier. Accordingly, the analyzed cities in this study include not only the cities of the southern part of Kanto region which corresponds with the sphere of 70 km from the Tokyo Station but also the cities in the northern part.

Additionally, in this study, because of the employment of the data which represent the migration and socio-economic attribute from 1970 to 1980, the analyzed cities are restricted to 125 cities with municipalization at 1970 which is the start point of the analyzed period:

it is a note that Tokyo 23 wards are treated as a single city.

I-2.2 The migration data

In Japan, though it is capable of obtaining the detailed and manifold data of migration, the greater part of those is available only to the analysis with the unit zones of prefecture. The available data are restricted considerably when the analysis is intended to include not only in- and out-migrations of city but also intra-urban migration. On the analysis of only a single city, though there is a problem of privacy, it is possible to obtain the data by summing up the notice of migration based on the resident registration (Ishiguro,1976; Mori,1980; Ohzeki,1985). But, the method of summing up is physically impossible for this study which is intended to analyze a lot of cities.

The results of internal migration of the Population Census of Japan are the only data source appropriate to the purpose of this study in Japan though some restrictions are imposed on utilizing the data2). In this data source, the volume of migration and the migrants structure by sex and age group are tabulated for each of in-, out- and intra-urban migrations and the volume of migration from or to the other cities, towns and villages of Japan is also tabulated for the in- and out-migrations. In this study, the above mentioned data source is employed as the original data of migration but four significant restrictions are enumerated as follows.

The first is that this data source belongs to the statistics of previous residence. By reason that the statistics of previous residence do not count the migrant which has been dead or returned within the specified period, this lack of uncounted migrants causes underestimate of the volume of migration. For instance, there is a report that the number of migrants recorded over five years in a interregional flow varies from four times to two times the number of migrants recorded over one year (Rees, 1977). Though such a kind of error would be relatively small because the data source of this study is recorded over one year, there is a need to take account of the existence of a few uncounted migrants.

The second is that a part of cities, towns and villages migrated into or out of are omitted from the list: the tabulation is done only for the principal migration counted 50 migrants and over. For that reason, it is impossible by this data source to cover the migration between cities, towns and villages completely. In addition to this, the data source of 1970 is the 20 % sample tabulation. Accordingly, this data source is not endurable to dispute spatial or temporal changes in detail but appropriate to the clarification of the fundamental distribution pattern of migration.

The third is that administrative city is employed as the statistical unit. In the present condition that it is behind in compiling the DID statistics of migration, it is unavoidable to give the definition of urban area with administrative city on comparing the numerous urban migration phenomena at a time. On that occasion, the analysis has to be advanced with taking into consideration of the two: one is that migration of smaller city is partially rural; and the other is that large city occupies only a central part of urban continuum from the core to the suburban fringe.

And the fourth restriction is of the period of analysis. The census containing the results of internal migration has been conducted only once a decade, and what is more, the data of previous residence for one year are obtainable only at the two years: 1970 and 1980[3]. These two years correspond to the turning points of internal migration in Japan: the starting point and ending point of the transition period from the concentration to large city to the dispersion from that. Additionally, from a viewpoint of economic fluctuation, the years of 1970 and 1980 are correspondent to the peak of high economic growth and the time of low economic growth after the second oil crisis, respectively. Especially, the migration in 1980 would be important as an object of analysis in the case of forecasting the future trend of migration in Japan which has arrived again in the face of economic deceleration. Therefore, in this study, the data in 1980 is the principal object in the analysis of migration but also the year of 1970 is employed so as to confirm the degree of temporal stability of the extracted distribution pattern.

I-2.3 Analytical procedure in this study

Fig.2 shows the procedure extracting the distribution pattern of urban migration and the relationship between urban migration and socio-economic attribute of the city. In this study, migration is treated not as a flow but as a regional attribute which characterizes the city. Therefore, the analysis starts from making the geographical matrix on urban migration.

First, the procedure extracting the distribution pattern of urban migration would be described as follows: it is shown by the flow chart at the left side of Fig.2. In the geographical matrix at the top of that flow chart, the rows are 125 cities inputted into the analysis and the columns are migratory attributes which sum up to 61 variables and which are divided into four variable groups as follows: ① three variables for mobility (in-, out- and intra-urban migrations); ② three variables for sex ratio of migrants population (in-, out- and intra-urban migrations); ③ 33 variables for age structure of migrants population (11 age groups × in-, out- and intra-urban migrations); and ④ 22 variables for configuration of migration

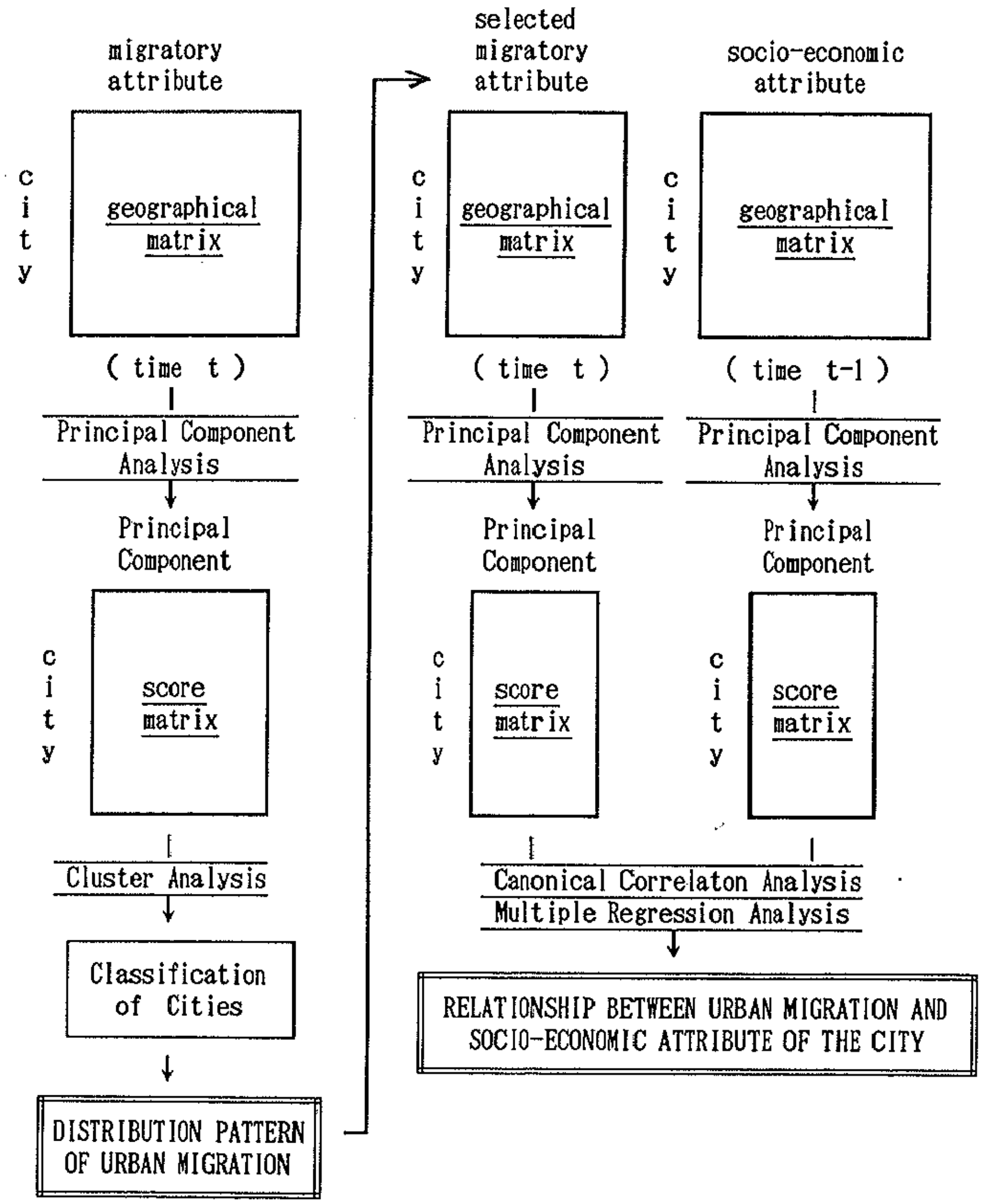


Fig.2 Procedure of the analysis

field (11 traveled distances × in- and out-migrations).

The variable group ① is the attribute indicating fundamental relationship in the volume of urban migration. Each variable of in-, out- and intra-urban migrations is expressed as the number of migrants per ten thousand of residents in order to compare between the cities of different population size. This expression is also the definition of mobility in this study, which means the tendency of urban residents to the move of migration[4)].

The variable groups ② and ③ are the attributes of the structure of migratory population. Especially, sex and age are regarded as the fundamental attribute composing population structure, and therefore, the study has been conducted with a viewpoint of such structure on the level of inter- cities, towns and villages migration (Yano,1989; Nakagawa,1990; Hashimoto and Murayama,1991; Morikawa,1992). Also, in this study, the sex and age structures of migratory population are regarded as fundamental attributes of urban migration and the geographical matrices are made up after the following numerical treatment to the original data.

Sex ratio = (Male mobility / Female mobility) $\times 10^2$

= {(Number of male migrants / Number of male residents) / (Number of female migrants / Number of female residents)} $\times 10^2$. (1)

Standardized mobility = (Mobility by age group / Mobility of all age groups) $\times 10^2$

= {(Number of migrants by age group / Number of residents by age group) / (Number of migrants of all age groups / Number of residents of all age groups) } $\times 10^2$. (2)

Additionally to say, eqn.(1) is applied to each of in-, out- and intra-urban migrations. And, for the age structure, eqn.(2) is applied to each of the 33 variables in order to eliminate the influence of mobility ① which is expressed as the mobility of all age groups in eqn.(2), on the mobility by age group.

The variable group ④ is the attribute of relationship between migration and traveled distance. Generally, the volume of migration decreases with the increase of traveled distance, and it is named as migration field that is the two-dimensional area of a center and its periphery connecting by this decrement relationship (Haggett,1965,pp.40-55). Therefore, the migration field would be reflecting clearly of the relative position of city on the broader regional system. In this study, the data of migration field are traveled distances of in- and out-migrations of the city, which are classified into eleven variables: traveled distance 0 to 200 km is divided into ten variables at 20 km intervals and the other one variable is long-distance migration of 200 km and over. Furthermore, in order to eliminate the influence of migration magnitude on the number of migrants by traveled distance, all the 22 variables are expressed as migrants rate in the following equation:

Migrants rate = (Migrants by traveled distance / All migrants) $\times 10^2$, (3)

where inter<u>shi-cho-son</u>(cities-towns-villages) migrations with migrants under 50 are excluded from migrants by traveled distance; in contrast, all migrants include them.

The above mentioned four variable groups are individually representative of the different features of urban migration and they would be expected to expose the inherent distribution patterns. Therefore, in this study, four geographical matrices are prepared in correspondence with the four variable groups and they would be inputted into the following quantitative analysis[5)].

The second step of analysis is to apply principal component analysis to the geographical matrix in order to eliminate the garrulous correlation which is immanent in spatial variations of the variable group. In previous studies, Bracken (1976) applied cluster analysis with principal component analysis to the geographical matrix of migration by age group in his study area of 124 urban areas in England and Wales. Though he employed net migration data estimated by the residual method, in this study the principal component analysis is to be applied to the more immediate data of gross migration by age group. In addition to this, the other three variable groups are also summarized by principal component analysis individually in order to eliminate their including garrulous covariations[6)].

It is theoretically possible by principal component analysis to extract new composite variables at the same number as the original variables inputted into the analysis. But, it is a question to admit the new variable extracted at the lower rank and lower percentage of contribution as a principal component because such variable indicates the variation of error factor which has participated accidentally. As a standard of the admission, many previous studies have employed the eigenvalue of 1.0 which means the mean explanatory rate of variation of all inputted variables (Okuno,1977,pp.306-307). However, that standard would not be employed in this study for the following reason. That is, the number of input variables is so different between the principal component analyses that the percentage of contribution corresponding to the eigenvalue of 1.0 also varies considerably. For instance, though the eigenvalue of 1.0 on inputting 33 variables corresponds to the only 3 % of contribution, the same eigenvalue for three variables amounts to 33 % of contribution. Therefore, in this study, another standard of the 5 % and over of contribution is employed, which has been utilizing for convenience in previous studies (King,1969,p.174; Miyake et al.,1977,p.254), and the composite variable in fitness with this standard would be admitted as the principal component in this study.

And the third step of analysis is to apply cluster analysis to the score matrix derived from principal component analysis. Because the principal components of score matrix are uncorrelated with each other, it is easily practicable to measure the similarity of migration phenomena between the cities. As a concrete method of this measuring, the Ward's method is employed in this study, which has been highly evaluated in previous studies (Murayama,1990b,pp.107-117). The optimal grouping by the Ward's method is to be decided at the step where the increase of normalized square distance is the maximum without the last step of grouping (Okuno,1977,pp.312-320). In this study, four dendrograms by the variable groups are individually cut off under the above mentioned criterion and these results are decided to be the optimal groupings of cities based on their migration phenomena.

The elucidation of distribution pattern of urban migration would be achieved by the cartography and morphology in terms of spatial distribution of city group which is typified by the above mentioned procedure. Additionally, the same analytical procedure is applied to geographical matrices of 1970 and the results would be an important source of considering the stability of distribution pattern.

Subsequently, the procedure elucidating the relationship between migration and socio-economic attribute would be explained as follows: it is shown by the flow chart at the right side of Fig.2. The first operation is to reconstitute the geographical matrix of migration based on the consideration of distribution pattern of urban migration in the previous step of analysis. In this place, it needs not to input the original 61 variables into the analysis again but to select the migratory variables in the irreducible minimum that is essential to reproduce the above elucidated distribution pattern of urban migration.

On the other hand, in terms of socio-economic attribute, the variables are selected under the condition of effectiveness in explaining the migration with reference to the previous studies of urban dimension and quantitative regional structure, and a new geographical matrix is to be composed of these variables. Additionally to say, the data of socio-economic attribute are representative of the state just prior to occurrence of migration, and therefore there is the temporal difference between time t of migration and time t-1 of socio-economic attribute in Fig.2. Each of the migratory and socio-economic variables is to be described in detail on the selection process, definition and distributional characteristic in Chapter III.

Subsequently, also in this place, principal component analysis is applied to each geographical matrix in order to eliminate the garrulous correlation which is immanent in spatial variations of the variable group.

The measurement of relationship between migration and socio-economic attribute is to be conducted by the canonical correlation analysis and multiple regression analysis of which the data are score matrix derived from the principal component analysis.

By means of canonical correlation analysis, the relationship of interdependency between migration and socio-economic attribute would be investigated based on the correlation between the two principal component groups. In geography, canonical correlation analysis was originally utilized by Berry (1966) in his exemplified study on the general field theory of spatial behavior, and thereafter the analysis has been applied to the various geographical phenomena such as traffic, communication, capital flow, commuting and regional structure of agriculture. Also in previous studies of migration, the application of canonical correlation analysis has not been in small numbers: for instance, Willis (1972), Schwind (1975), Saino and Higashi (1978) and Ishimizu (1979), in which they applied the analysis to composite variables, that is, factors or principal components. The reason of utilizing principal component analysis with canonical correlation analysis is to avoid what is called the problem of multicollinearity (King,1969,pp.162-163).

The canonical correlation analysis would produce some canonical variates which represent the dimensions linking between principal component group of migration and that of socio-economic attribute. It is capable to interpret the canonical variate based on the value of structure coefficient to each of the principal components. But, only the information derived from the canonical correlation analysis is not enough to specify the interdependency between migration and socio-economic attribute not at the level of principal component group but at the individual component level.

So that, in this study, multiple regression analysis is conducted additionally to make the multiple regression model explaining migration with socio-economic attribute, in which the dependent variables are principal components of migration and the independent variables are those of socio-economic attribute. Therefore, in this place, the following hypothesis is to be built up: the distribution pattern of migration is a function of that of socio-economic attribute. In the latter half of this study, a new geographical knowledge of cities in the Kanto region would be taken by means of exemplifying the above mentioned hypothesis with application of the canonical correlation analysis and multiple regression analysis and considering distribution pattern of the principal component score and the residual from the multiple regression model.

Through the procedure mentioned above, it would be capable to accomplish the purpose of this study. Additionally to say, the other attendant analyses are to be mentioned at the suitable part of the following chapters.

CHAPTER II

DISTRIBUTION PATTERNS OF URBAN MIGRATION

II-1 Mobility of urban population

Table 1 shows characteristics of the three variables in terms of mobility in 1980. The mean value of mobility on the 125 cities is declining in the order of in-migration, out-migration and intra-urban migration. The high level of mobility in in-migration would be interpreted as a result of reflecting the fact that the Kanto region includes a lot of cities growing rapidly in population. But, there is a great difference of the mobility value in in-migration between the cities: Narashino shows the maximum which is 7.2 times as large as the minimum, that is, Choshi. In terms of dispersion indicated by the coefficient of variation, the in-migration shows the maximum of all three variables, and therefore this variable would be to play the most important part on characterizing the distribution pattern of mobility. As opposed to this, the intra-urban migration shows the lowest capacity of distinguishing the areal difference. However, also in the case, because there is a difference of 5.0 times between the maximum (Tokyo) and minimum (Shimotsuma) of the mobility, the intra-urban migration is said to be the same important variable as the other two on extracting the distribution pattern of mobility. Of these three variables, the in-migration and out-migration are at the high level of correlation of 0.849. This indicates that there is the in-migration in no small numbers as the counter-stream which compensates for out-migration of the city.

Table 2 shows the results of applying principal component analysis to the geographical matrix of mobility. With reflecting the above correlation,

Table 1 Characteristics of the variable, mobility (1980)

Variable	Mean	Coefficient of variation	Maximum	Minimum
In-migration	585	0.44	1,210 (Narashino)	168 (Choshi)
Out-migration	536	0.41	1,162 (Koganei)	247 (Hanyu)
Intra-urban migration	337	0.28	723 (Tokyo)	144 (Shimotsuma)

Note: Mobility defined as the number of migrants per ten thousand of residents. City names are shown in parentheses.
Data source: Population Census of Japan 1980.

Table 2 Principal component analysis of the mobility (1980)

Variable	Principal component I	Principal component II
In-migration	0.961	···
Out-migration	0.962	···
Intra-urban migration	···	0.999
Eigenvalue	1.850	1.002
Percentage of contribution	61.7	33.4

Note: ··· indicates loading under | 0.3 | .

principal component I summarizes variations of the three variables so as to represent the variation in common between the in-migration and the out-migration. As opposed to this, principal component II represents the variation of intra-urban migration mostly. And the results of classifying 125 cities in the Kanto region are shown in Table 3 and Fig.3, based on the score matrix of those two principal components. Three types of city group A1, A2 and A3 are found out by cutting off the dendrogram between the 122th and 123th steps of grouping. The following is a description of the migratory and distributional characteristics of city group by each type.

Type A1 is composed of 50 cities, which has a characteristic of the lower level of mobility on any of in-, out- and intra-urban migrations. The spatial distribution of these cities is restricted in the intermediate and outer zones of the Tokyo metropolitan area which are 40 km and over distant from the Tokyo Station. Additionally to say, these cities are generally small in population, in which the maximum is only 177 thousand of Odawara in 1980. The 88.0 % of those cities are small city under 100 thousand of population.

Type A2 is also a large group composing of 49 cities. The mobility mean value of this type is in the high level of in- and out-migrations, but for the intra-urban migration, it becomes lower than that of type A1. The 49 cities are all located within a radius of 60 km from the Tokyo Station, and in terms of population, the half and over of these cities belong to the intermediate size inhabited by 100 to 300 thousand. This type includes a lot of dormitory cities which are small in area but with high increase rate of population in the suburb of Tokyo.

And, type A3 is a relatively small group composing of 26 cities. This type shows the high level of mobility on each of in-, out- and intra-urban

Table 3 Means of the mobility for types A1～A3 (1980)

Type	Number of cities	In-migration	Out-migration	Intra-urban migration
A1	50	328	350	311
A2	49	824	739	297
A3	26	631	510	462

Note: Mobility defined as the number of migrants per ten thousand of residents. City names are shown in parentheses.
Data source: Population Census of Japan 1980.

Fig.3 Distribution pattern of the mobility (1980)

Note: See Table 3 for the characteristic of types A1~A3.

migrations. Especially, the intra-urban migration indicates the higher mobility mean value than the case in any other type. The cities of this type are dispersed broadly all over the Kanto region, so that it is impossible to specify the distributional area based on the distance from Tokyo as the other two types mentioned above. Additionally, all the cities of type A3 are inhabited by the population of 100 thousand and over, in which there include four large cities of Tokyo, Yokohama, Kawasaki and Chiba and three prefectural seats of Mito, Utsunomiya and Maebashi.

Based on the analytical results mentioned above, it would be considered that the distribution pattern of mobility exhibits a configuration combining the two components: concentric pattern at the center of Tokyo for cities in type A1 and A2; and dispersive pattern of large or central cities in type A3. Particularly to say, cities of types A2 or A3 are distributed in the shape of a continuum within a radius of 60 km from the Tokyo Station, and therefore, it is possible to identify the distributed area of high mobility cities with the central zone of migration in the Kanto region.

II-2 Structure of migratory population

II-2.1 Sex of the migrants

Table 4 shows the mean, coefficient of variation, maximum and minimum on the sex ratio of migration. Based on the mean value, it is possible to say that the male migration is more active than the female one on the in- and out-migrations. As opposed to these, the intra-urban migration exhibits only a small difference in the sex composition. Also, on the coefficient of variation , the sex ratio of in-migration is the best explanatory variable

Table 4 Characteristics of the variable, sex ratio (1980)

Variable	Mean	Coefficient of variation	Maximum	Minimum
In-migration	116	0.13	164 (Nikko)	73 (Tochigi)
Out-migration	115	0.09	178 (Yokosuka)	97 (Hanno)
Intra-urban migration	102	0.05	122 (Kokubunji)	86 (Yokaichiba)

Note: Sex ratio $=$ (Male mobility / Female mobility) $\times 10^2$.
Mobility defined as the number of migrants per ten thousand of residents. City names are shown in parentheses.
Data source: Population Census of Japan 1980.

of the areal difference between the cities. But, even in that case, the coefficient value is lower than the case of mobility mentioned previously, and therefore, it would be said that the areal difference of sex ratio is not so evident as that of mobility.

Table 5 shows the results of applying principal component analysis to the geographical matrix of sex ratio. Principal component I indicates the percentage of contribution of 57.4 % and represents the variation which is common to the three variables. Especially, the spatial variations of in- and out-migrations are well explained by this composite variable. Principal component II summarizes mainly the variation of intra-urban migration, of which percentage of contribution is 28.1 %. And, principal component III with the percentage of contribution of 14.5 % indicates the loading values which are positive to the in-migration and negative to the out-migration, which means that the score of this principal component is high on the city with the sex ratio being high on the in-migration and low on the out-migration. Table 6 and Fig.4 show the results of applying cluster analysis to the score matrix of these three principal components. The 125 cities are classified into four groups of types B1 to B4 by means of cutting off the dendrogram between the 121th and 122th steps of grouping.

Type B1 is the largest city group composed of 73 cities. This type is characterized by smallness of the sex difference of migration as compared with the other types because the mean value of sex ratio becomes low for each of in-, out- and intra-urban migrations as shown in Table 6. In the spatial context, the cities of this type are distributed broadly in all over the Kanto region, with a tendency of showing high percentage of the type especially in the Ibaraki- and Tochigi-prefectures.

Type B2 is composed of 42 cities and both the types B1 and B2 form 92.0

Table 5 Principal component analysis of the sex ratio (1980)

Variable	Principal component		
	I	II	III
In-migration	0.851	···	0.477
Out-migration	0.827	−0.333	−0.453
Intra-urban migration	0.560	0.827	···
Eigenvalue	1.722	0.843	0.435
Percentage of contribution	57.4	28.1	14.5

Note: ··· indicates loading under | 0.3 | .

Table 6 Means of the sex ratio for types B1～B4 (1980)

Type	Number of cities	In-migration	Out-migration	Intra-urban migration
B1	73	107	112	100
B2	42	124	118	107
B3	8	149	117	100
B4	2	153	168	102

Note: Sex ratio ＝ (Male mobility ／ Female mobility) $\times 10^2$. Mobility defined as the number of migrants per ten thousand of residents.
Data source: Population Census of Japan 1980.

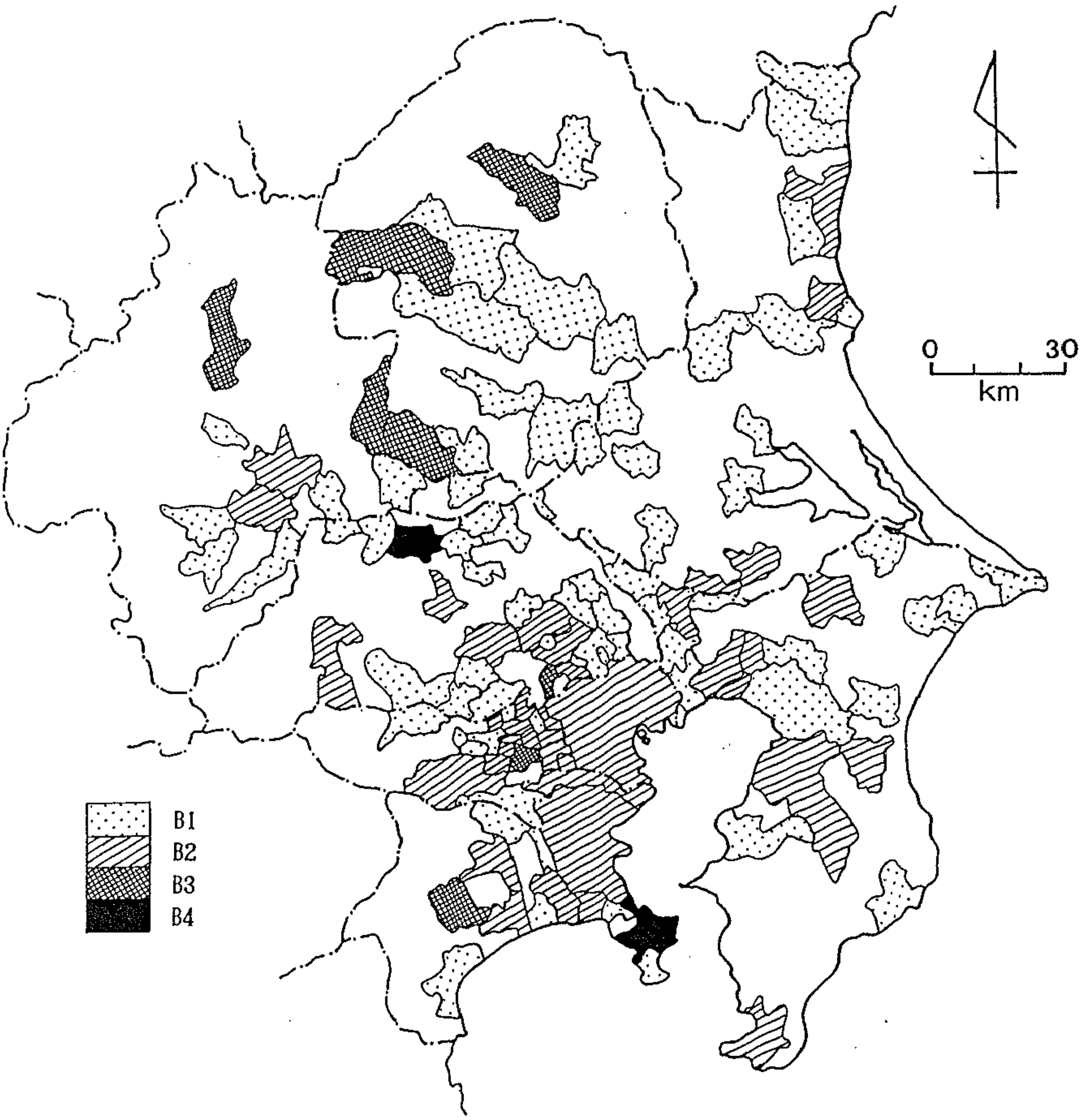


Fig.4 Distribution pattern of the sex ratio (1980)

Note: See Table 6 for the characteristic of types B1～B4.

% of all the 125 cities. Based on the mean of sex ratio, type B2 shows the higher value than type B1 for each of the three variables: especially on the in-migration, male migrants exceeds female ones by 24.0 %. Though a small number of cities of this type exist in the outer fringe of the Kanto region such as Hitachi, Katsuta and Tateyama, many other cities are located within a radius of 60 km from the Tokyo Station, with showing relatively high percentage of the type in the Tokyo-metropolis and the Kanagawa-prefecture as compared with the other prefectures.

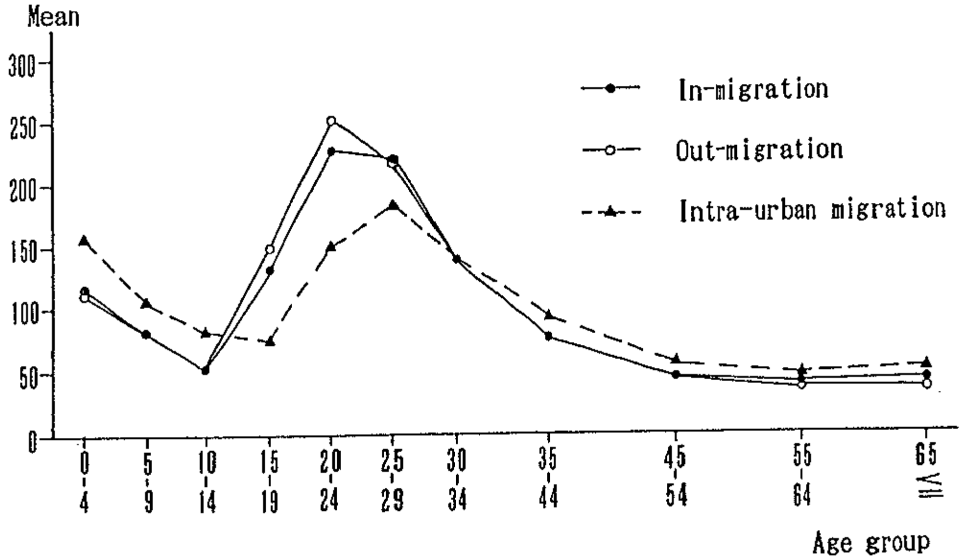
Types B3 and B4 form small groups composed of eight cities and two cities respectively. Both types show exceedingly high sex ratio on the in-migration, and type B4 also shows the high value on the out-migration. Concretely to say, type B3 is composed of three cities of Asaka, Fuchu and Hadano in the neighborhood of Tokyo, and five cities of Ashikaga, Nikko, Yaita, Kiryu and Numata in the northern part of Kanto. And two cities of type B4 are Kumagaya and Yokosuka[7].

The distribution pattern of sex ratio is indistinct in terms of zonal structure as compared with the case of above mentioned mobility. There is a tendency of concentrating type B2 cities on Tokyo and its neighborhood area, but it is difficult to specify the distributional area. Additionally, in terms of migratory characteristic, it is observed that male in-migration tends to be active as the size of city group becomes small.

II-2.2 Age of the migrants

Fig.5 shows means and coefficients of variation of the 33 variables which expose the age structure of the migratory population[8]. Based on the distribution of mean value by age group, it is possible for in- and out-migrations to say that the mean value aged 20 to 24 becomes a peak of which

(1) Means of standardized mobility



(2) Coefficients of variation of standardized mobility

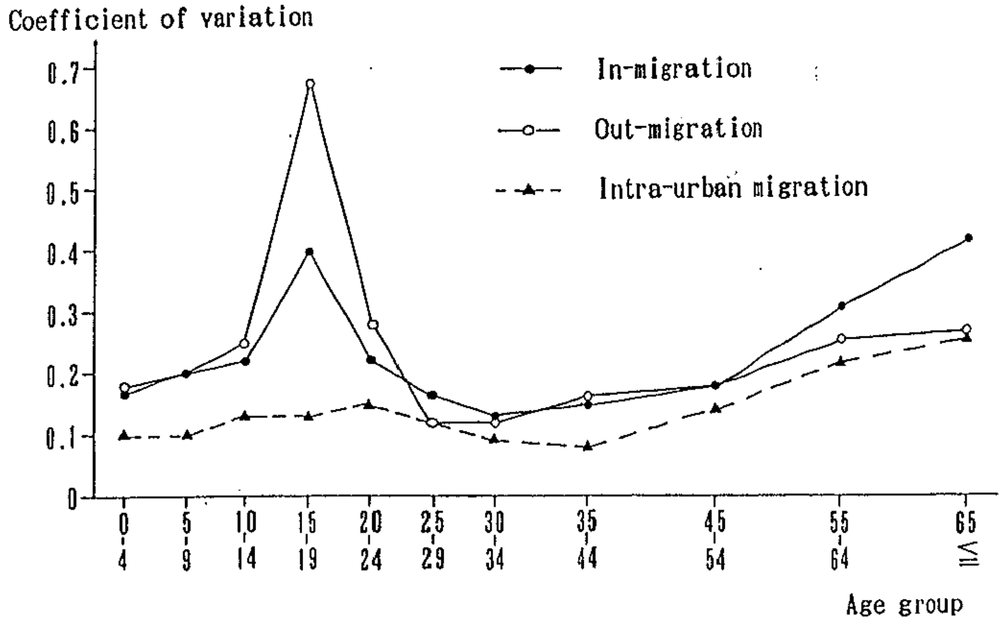


Fig.5 Characteristics of the variable, age structure (1980)

Note: Standardized mobility $=$ (Mobility by age group / Mobility of all age groups) $\times 10^2$.
Mobility defined as the number of migrants per ten thousand of residents.
Data source: Population Census of Japan 1980.

mobility is the maximum of all age groups. For intra-urban migration, though the mobility aged 20's is also in the high level, its mean values are relatively low as compared with those of in- and out-migrations. And, the age group at the peak of distribution is different between intra-urban migration and the other two: the former peak is at the age group of 25 to 29. Additionally, intra-urban migration of childhood aged 0 to 14 is relatively active and it would be considered as a result of reflecting the family migration which shows a marked tendency of traveling short distance.

In terms of dispersion indicated by the coefficient of variation, it is observed that the value tends to increase with the age on each of in-, out- and intra-urban migrations. Therefore, it can be said that the mobility of aged population shows a great areal difference between the cities, and especially on the in- and intra-urban migrations, the coefficient value aged 65 and over is the maximum of all age groups. As opposed to this, the value aged 15 to 19 on the out-migration shows the maximum of all the 33 variables. Accordingly, the variable aged 15 to 19 on the out-migration would play an important role in the following process of extracting spatial distribution pattern.

Table 7 shows the results of applying principal component analysis to the 33 variables on age structure. Five principal components extracted by the analysis summarize those variable variations down to the 70.0 %. Principal component I with the percentage of contribution of 57.4 % is considered to be the composite variable which has a characteristic of the so-called general factor because the absolute value of loading becomes 0.3 and over for 27 out of the 33 variables. Principal component II showing the percentage of contribution of 14.0 % represents the variation of in-migration principally. Three principal components , III to V , indicate the

Table 7 Principal component analysis of the age structure (1980)

Variable (age)	Principal component I	II	III	IV	V
In-migration					
0～ 4	0.369	−0.713	…	…	…
5～ 9	0.481	−0.697	…	…	…
10～14	…	−0.661	…	…	0.443
15～19	−0.358	0.692	…	…	…
20～24	0.468	0.524	…	…	−0.533
25～29	0.566	…	…	…	−0.644
30～34	0.567	−0.650	…	…	…
35～44	0.503	−0.651	…	…	0.300
45～54	…	−0.384	−0.541	…	…
55～64	−0.408	−0.379	−0.524	0.322	…
65≦	−0.524	…	−0.341	0.392	…
Out-migration					
0～ 4	−0.830	…	…	…	…
5～ 9	−0.868	…	…	…	…
10～14	−0.874	…	…	…	…
15～19	0.884	…	…	…	…
20～24	0.908	…	…	…	…
25～29	0.467	−0.379	…	…	…
30～34	−0.666	…	0.316	…	…
35～44	−0.868	…	…	…	…
45～54	−0.835	…	…	…	…
55～64	−0.839	…	…	…	…
65≦	−0.699	…	…	…	…
Intra-urban migration					
0～ 4	0.303	…	0.310	0.649	…
5～ 9	0.385	…	0.620	…	…
10～14	…	−0.429	…	−0.559	−0.426
15～19	…	…	…	−0.675	…
20～24	0.493	0.480	…	…	…
25～29	0.697	…	−0.306	…	…
30～34	0.536	…	…	0.446	…
35～44	…	−0.403	0.533	−0.387	−0.306
45～54	−0.439	…	−0.390	−0.515	…
55～64	−0.429	…	−0.487	…	…
65≦	…	…	−0.544	…	−0.380
Eigenvalue	11.023	4.621	2.908	2.644	1.889
Percentage of contribution	33.4	14.0	8.8	8.0	5.7

Note: … indicates loading under | 0.3 |.

percentage of contribution under 10.0 % each, so that it can be said that these composite variables are to explain variations of the 33 variables a little. Generally to say, on in- and intra-urban migrations, the variable variations tend to be summarized in the form of dispersing into the individual principal components. As opposed to this, in the case of out-migration, the summarization exhibits the form of concentrating on the principal component I. Figs.6 and 7 show the results of applying cluster analysis to the score matrix of these five principal components. Five groups of types, C1 to C5, are derived from cutting off the dendrogram between the 120th and 121th steps of grouping. The migratory and distributional characteristics of each type are described as follows.

Types C1, C2 and C3 are large city groups in which each includes a lot of cities. In terms of migratory characteristic, the difference between these three types is the most obvious on the out-migration aged 15 to 24. That is, the standardized mobility of these age variables is decreasing distinctly in the order of types C3, C2 and C1, so that the mobility at the age groups distinguishes between the three types as a criterion of primary importance. Additionally, the variable value of type C1 is more than the other two types at the in-, out- and intra-urban migration aged 45 and over and the out-migration aged 0 to 14 and 30 to 44. Type C2 shows the relatively high value at the in-migration aged 15 to 24. And, the value of type C3 is relatively high at the in-migration aged 0 to 14 and 25 to 44 and the out-migration aged 25 to 29.

Therefore, type C1 is characterized firstly by the inactive out-migration of youth labor force, and secondly by the active movement both of aged population and out-migrants of which ages correspond to children and their parents. Type C2 exhibits the intermediate level of mobility between

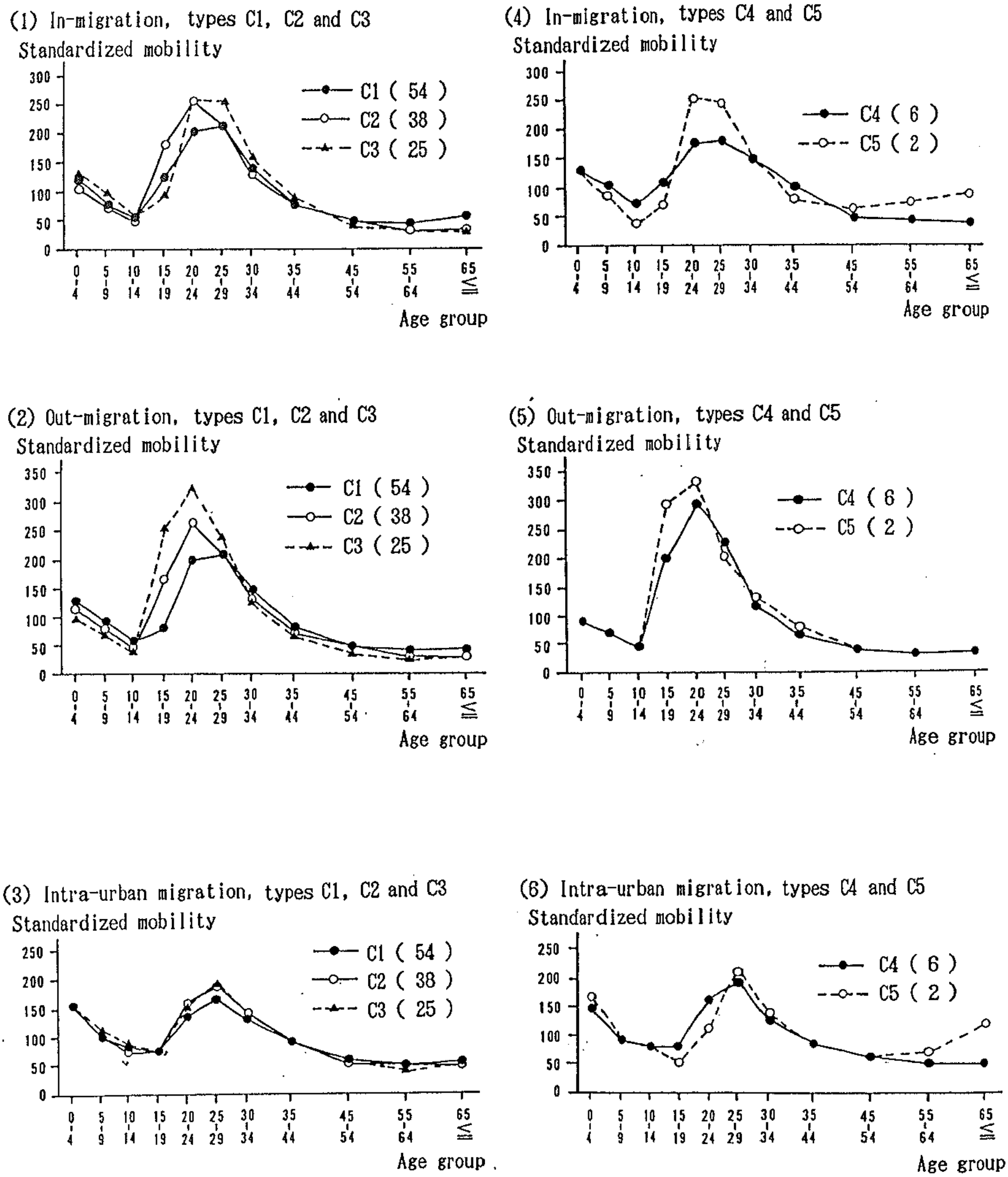


Fig.6 Means of the age structure for types C1～C5 (1980)

Note: Standardized mobility ＝ (Mobility by age group / Mobility of all age groups) × 10^2.
Mobility defined as the number of migrants per ten thousand of residents.
Number of cities is shown in parentheses.
Data source: Population Census of Japan 1980.

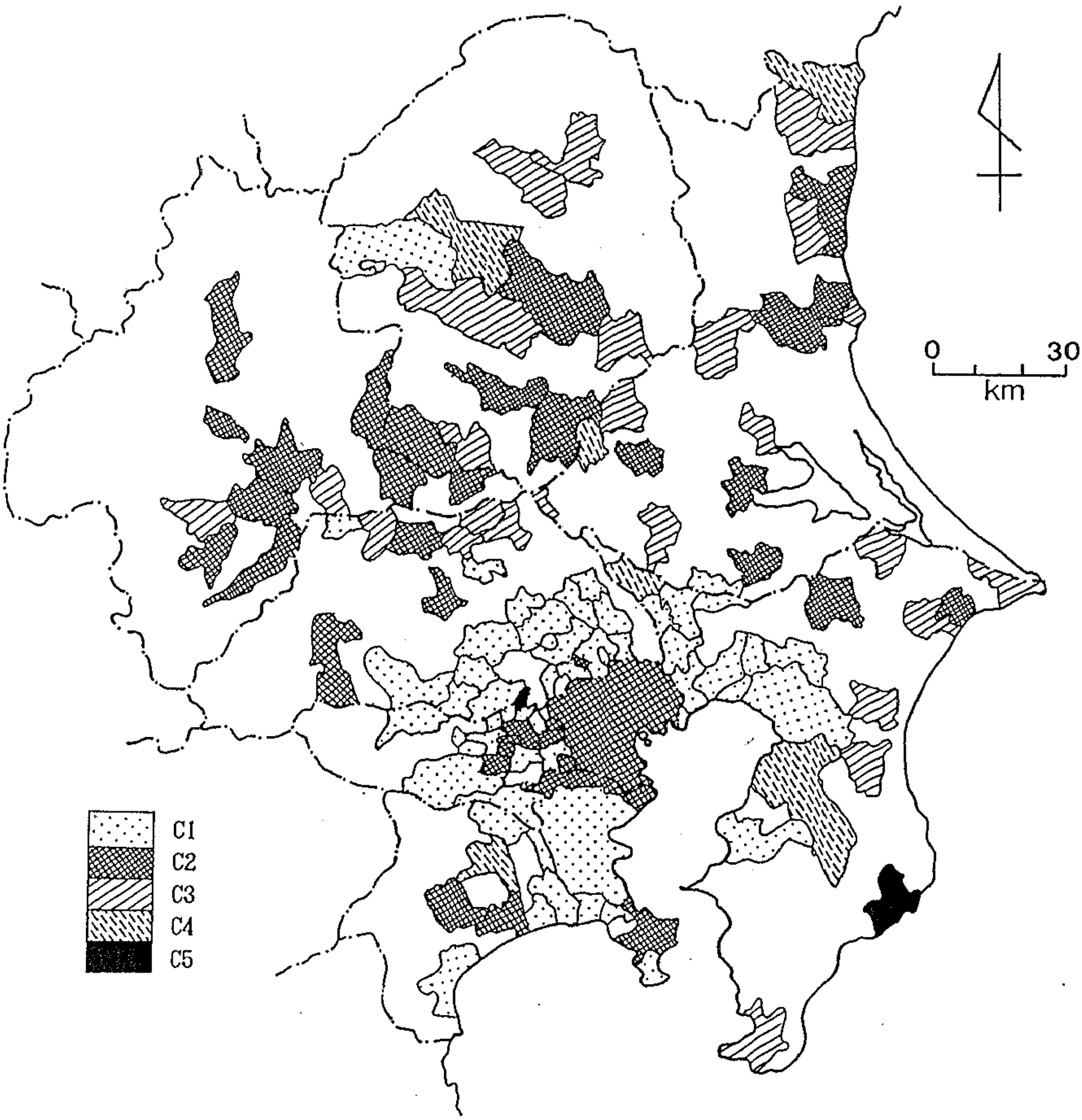


Fig.7 Distribution pattern of the age structure (1980)

Note: See Fig.6 for the characteristic of types C1～C5.

types C1 and C3 in terms of out-migration. Preferably, it can be said that the noticeable feature of this type is the high level of mobility of the youth labor force on in-migration. And, type C3, as opposed to type C1, is active on out-migration of the youth labor force and, in terms of in-migration, exhibits the the high level of mobility at the ages of children and their parents. The latter suggests that the movement in units of family is active on the side of in-migration to the city.

Types C1, C2 and C3 include 117 cities which correspond to 93.6 % of all the 125 cities. Type C1 is composed of 54 cities distributed almost in the inner zone of the Tokyo metropolitan area, that is, within a radius of 60 km from the Tokyo Station. As opposed to this, the city of type C3 is not within a radius of 40 km from the Tokyo Station, but all the 25 cities are in the intermediate and outer zones, with small size of population. It would be considered that these two types differ in the area of distribution by distance from the Tokyo Station and exhibit the so-called concentric pattern. But, type C2, composed of 38 cities, includes cities of the central part of the Tokyo metropolitan area such as Tokyo and Kawasaki on the one hand and a lot of central cities in the outer zone such as Mito, Utsunomiya and Maebashi on the other hand. In other words, it would be considered that the cities of type C2 exhibit the distribution pattern explained by population size or centrality of city.

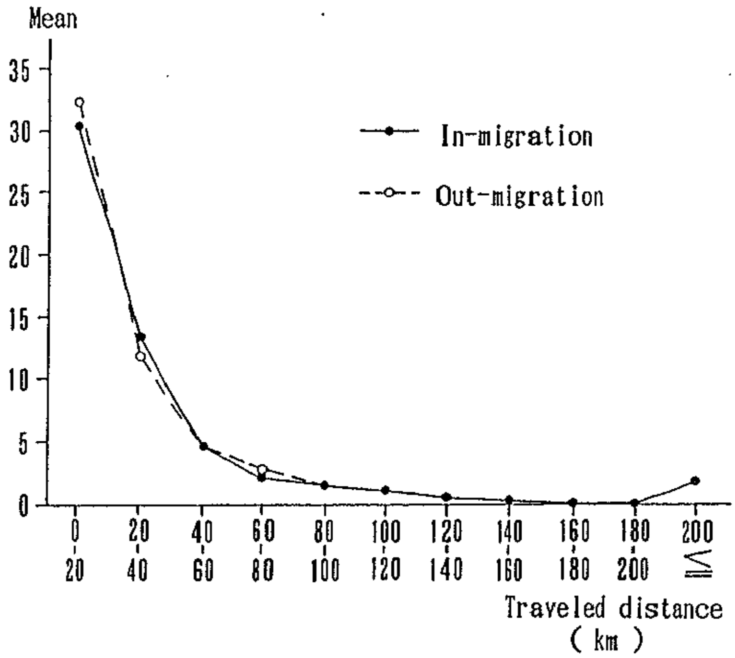
Therefore, it is possible to say that the distribution of urban migration in terms of age structure, in the same way of the mobility mentioned above, exhibits a configuration combining concentric pattern at the center of Tokyo with dispersive pattern of large or central cities. With respect of migratory characteristic, the former pattern is considered to separate the Tokyo metropolitan area into two parts of the inner zone and the intermediate and outer zone based on intensity of out-migration of the youth labor force. And, the latter is characterized distinctly by active in-migration of the youth labor force.

Additionally, eight cities excluding from the above three types are classified into the two types of representing peculiar characteristics of migration: six cities in type C4 and two cities in type C5. Type C4, composed of Yuki, Kitaibaraki, Imaichi, Noda, Ichihara and Atsugi, shows the similar variations of standardized mobility to type C1 in in-migration and to type C3 in out-migration. Type C5, composed of Katsuura and Kiyose, is quite different from the other types in respect that the type exhibits active movement of aged population 65 and over in the in- and intra-urban migrations[9)].

II-3 Configuration of migration field

Fig.8 shows means and coefficients of variation of the 22 variables which expose the configuration of migration field. The average configuration of all the 125 cities is to be described by the mean values of migrants rate. On each of in- and out-migrations in Fig.8, the migrants rate is decreasing with increase of traveled distance: it makes a notable concentration of the migrants especially to the distance of 0 to 20 km. Also, the variable of 0 to 20 km is characterized by the lowest value of coefficient of variation of all the distances. This means that the above mentioned concentration to the short-distance migration is a common phenomenon through the analyzed cities in general. After the distance, the coefficient of variation is increasing with the traveled distance up to the 140 to 160 km. Accordingly, it can be said that the degree of dispersion of

(1) Means of migrants rate



(2) Coefficients of variation of migrants rate

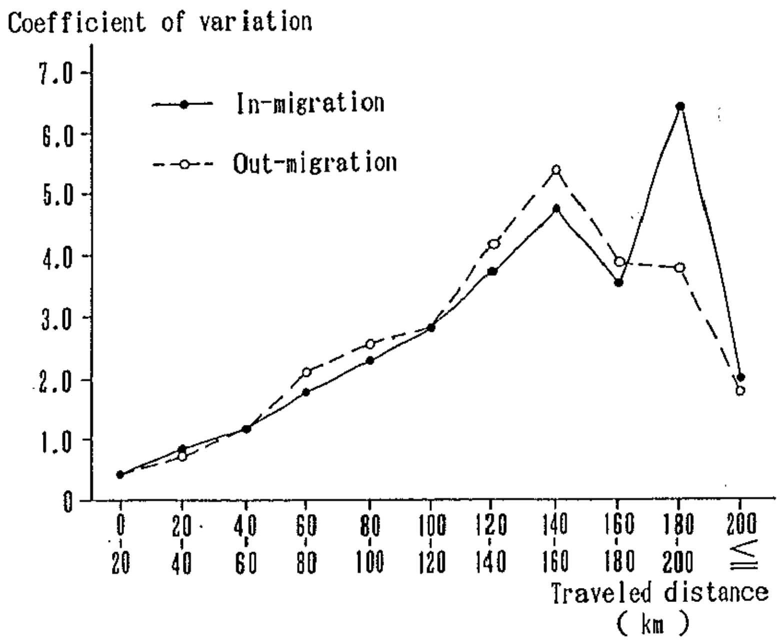


Fig.8 Characteristics of the variable, migration field (1980)

Note: Migrants rate ═ (Migrants by traveled distance ∕ All migrants) × 10^2.
Intershi-cho-son(cities-towns-villages) migrations with migrants under 50 are excluded from migrants by traveled distance; in contrast, all migrants include them.
Data source: Population Census of Japan 1980.

migrants rate between the cities tends to be great with transfer to the long-distance migration. Provided that there are fluctuations of the coefficient value which is decreasing after the peak of 140 to 160 km on out-migration and which is similarly lower at the distances of 160 to 180 km and 200 km and over on in-migration[10].

Table 8 shows the results of applying principal component analysis to the 22 variables of migration field. Eight principal components extracted by the analysis explain 88.1 % of all the variable variations. The loadings of each principal component are quite similar between in-migration and out-migration. This indicates that in-migration as the counter-stream compensating out-migration is given much weight on each migration from short-distance to long-distance. But, as compared with the results of age structure, it can be said that each of the variables by traveled distance in this place tends distinctly to exhibit spatial variation of its own, because the more principal components are extracted in spite of the less number of input variables.

Principal component I with the percentage of contribution of 18.1 % is a composite variable explaining well the variation of long-distance migration of 160 km and over. Principal component II with the percentage of contribution of 14.8 % explains well the variation of short distance migration of 0 to 20 km, and principal components III and IV are related closely to the intermediate-distance migrations of 40 to 120 km and 120 to 160 km respectively. Each of four principal components of V to VIII indicates the percentage of contribution under 10 % and summarizes the rest of spatial variations. Figs.9 and 10 shows the results of applying cluster analysis to the score matrix of the above mentioned eight principal components. As a result, seven types of D1 to D7 are derived from cutting

Table 8 Principal component analysis of the migration field (1980)

Variable (km)	Principal component I	II	III	IV	V	VI	VII	VIII
In-migration								
0~ 20	…	−0.703	0.459	…	…	…	…	−0.363
20~ 40	−0.581	…	…	…	…	…	…	0.564
40~ 60	…	…	−0.573	…	0.653	…	…	…
60~ 80	0.352	0.527	−0.322	…	−0.404	…	…	…
80~100	…	0.619	0.451	…	…	…	−0.361	…
100~120	…	…	0.610	…	0.376	…	0.612	…
120~140	…	0.399	…	0.696	…	−0.422	…	…
140~160	…	…	…	0.744	…	…	…	…
160~180	−0.652	0.379	…	−0.389	…	…	…	…
180~200	−0.368	…	…	0.346	−0.320	0.619	…	…
200≦	−0.811	…	…	−0.368	…	…	…	…
Out-migration								
0~ 20	…	−0.746	0.432	…	…	…	…	…
20~ 40	−0.759	…	…	…	…	…	…	0.417
40~ 60	…	…	−0.653	…	0.568	…	…	…
60~ 80	0.364	0.492	−0.311	…	−0.447	−0.309	…	…
80~100	…	0.573	0.474	…	…	…	−0.390	…
100~120	…	…	0.599	…	0.380	…	0.614	…
120~140	…	0.372	…	0.693	…	−0.446	…	…
140~160	…	…	…	0.555	…	0.589	…	−0.315
160~180	−0.526	0.447	0.340	−0.352	…	…	…	…
180~200	−0.600	…	…	…	…	…	…	…
200≦	−0.811	…	…	−0.381	…	…	…	…
Eigenvalue	3.975	3.256	2.942	2.861	1.800	1.654	1.573	1.311
Percentage of contribution	18.1	14.8	13.4	13.0	8.2	7.5	7.1	6.0

Note: … indicates loading under | 0.3 | .

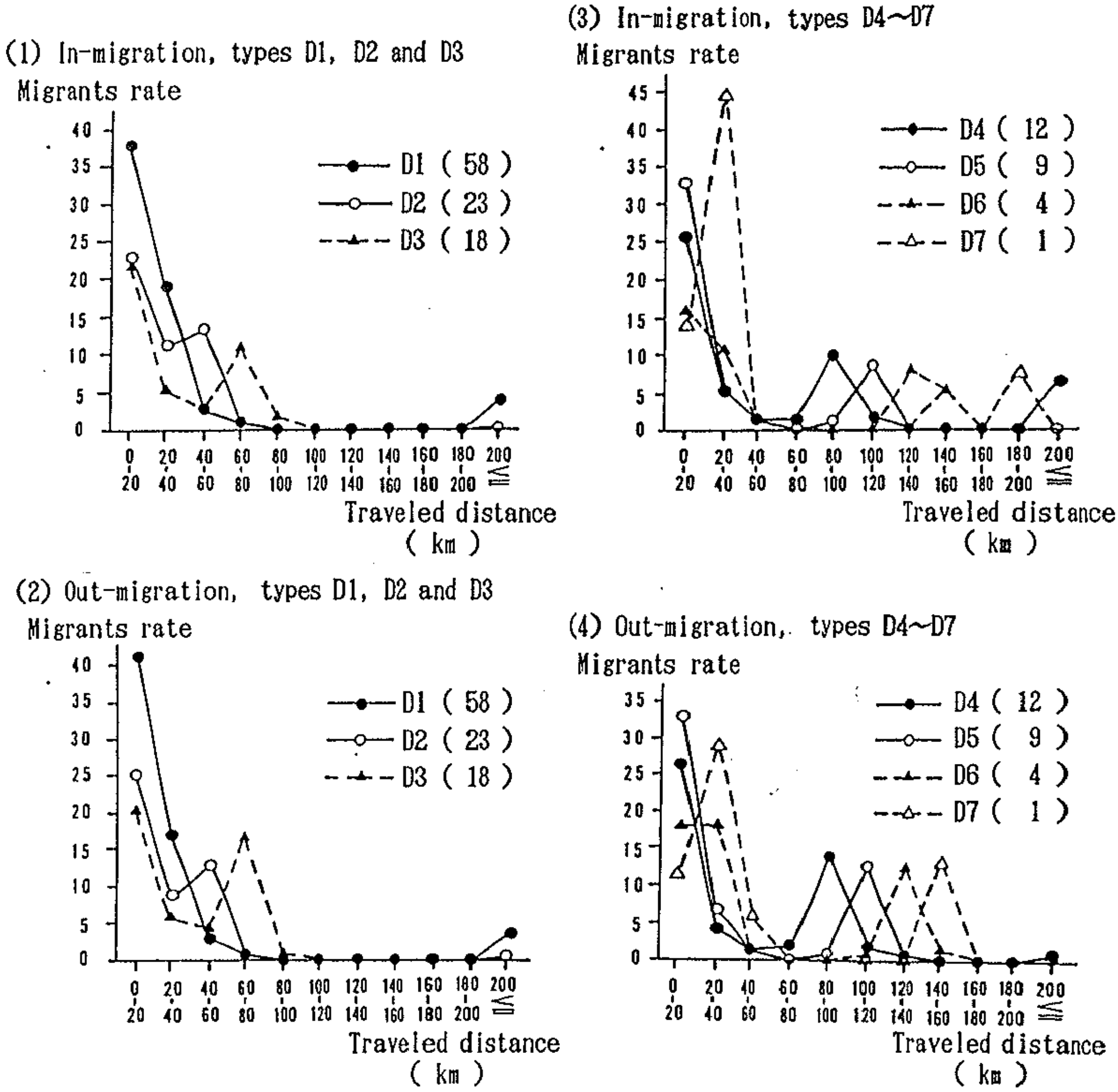


Fig.9 Means of the migratiom field for types D1~D7 (1980)

Note: Migrants rate ＝ (Migrants by traveled distance / All migrants) × 10^2.
Intershi-cho-son(cities-towns-villages) migrations with migrants under 50 are excluded from migrants by traveled distance; in contrast, all migrants include them. Number of cities is shown in parentheses.
Data source: Population Census of Japan 1980.

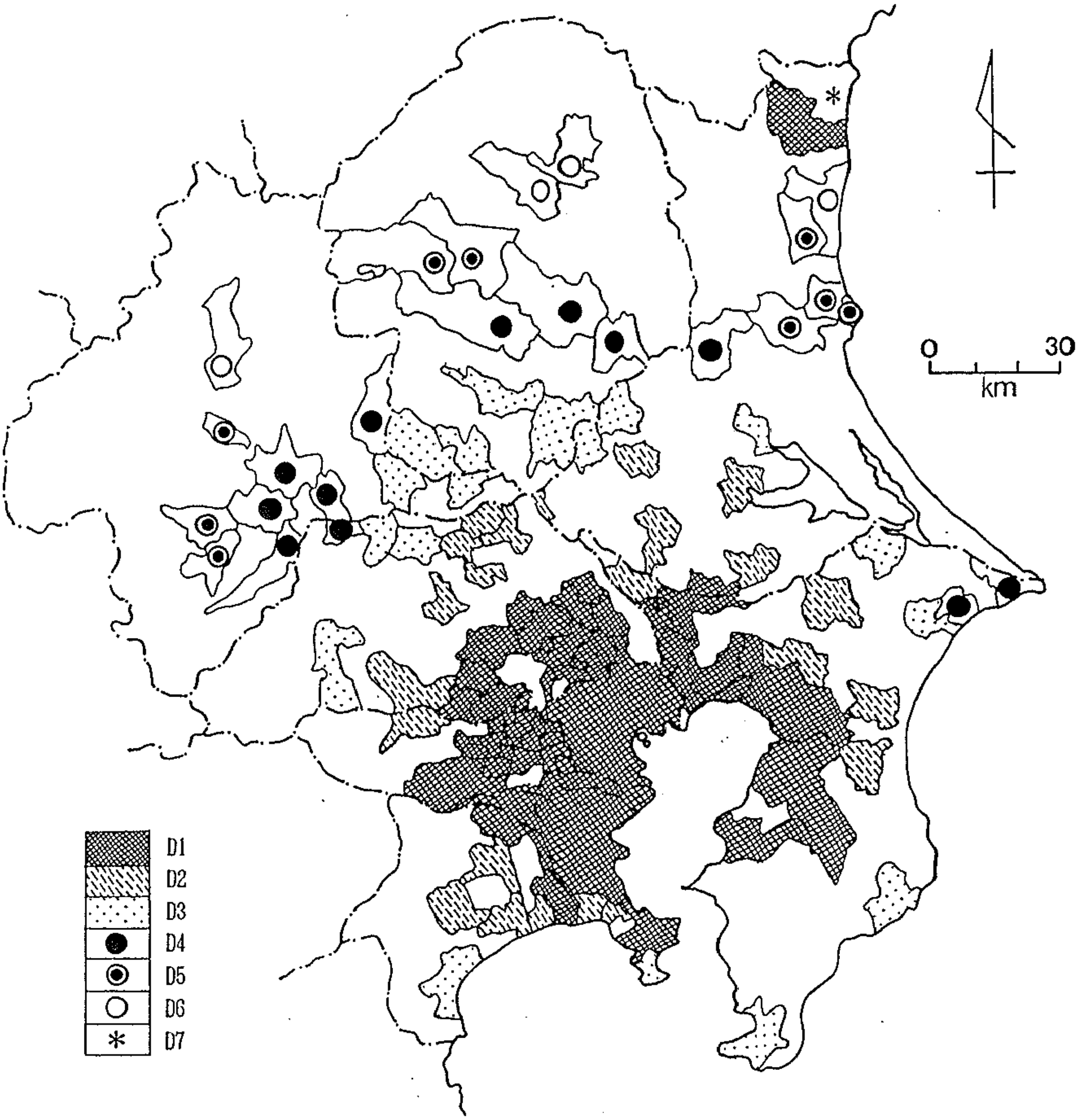


Fig.10 Distribution pattern of the migration field (1980)

Note: See Fig.9 for the characteristic of types D1~D7.

off the dendrogram between the 118th and 119th steps of grouping.

Type D1 is the largest city group composed of 58 cities. The in- and out-migrations of this type exhibit the especially high percentage of short-distance migration under 20 km to the total migration. And, the cities of this type form the shape of continuum from Tokyo and are distributed within a radius of 40 km from the Tokyo Station. Therefore, it can be said that this type represents the city of which short-distance migration is dominant and which is located in Tokyo and its outskirts. In those cities, three large cities of Tokyo, Yokohama and Kawasaki are so much in volume of migration as compared with the other cities that they exhibit the high percentage of long-distance migration to the total inter<u>shi-cho-son</u>(cities-towns-villages) migration with migrants of 50 and over[11]. In type D1, the migrants rate of 200 km and over is in the high level as compared with that of the other type, because of including those cities.

Each of five types D2 to D6 shows a peak of migrants rate at the intermediate or long distance in addition to the high migrants rate of short-distance migration. Concretely to say, the relatively high value of migrants rate is located at 40 to 60 km in type D2, 60 to 80 km in type D3, 80 to 100 km in type D4, 100 to 120 km in type D5, and 120 to 140 km in type D6. These distances of the peak correspond almost with those between Tokyo and the cities of each type, and therefore, it would be expected that the in- and out-migrations to or from Tokyo is a determinant of the configuration of migration field and the spatial distribution of cities for each type. In fact, 23 cities of type D2 are almost distributed in a zone of radius 40 to 60 km from the Tokyo Station. The different distributional zones are detected for the other types: 18 cities of type D3 are in the 60 to 80 km zone from the Tokyo Station; twelve cities of type D4 in the 80 to 100 km zone, nine cities of type D5 in the 100 to 120 km zone, and four cities of type D6 are detectable. Therefore, with the city of type D1, it is considered that the distribution pattern of urban migration in terms of migration field exhibits a concentric formation which firmly depends on the distance from a large city of Tokyo.

Additionally, type D7 is composed of only one city of Kitaibaraki of which migration field differs noticeably from those of the other types, with a high migrants rate of 20 to 40 km. Concretely, the value of this traveled distance is reflecting active in- and out-migrations to a city of Hitachi. Similarly, Takahagi of type D1 is also the city closely related to Hitachi by the migrations. In terms of these two cities located in the northern fringe of Ibaraki-prefecture, the first determinant of the typology is the migrations not with Tokyo but with Hitachi in the neighborhood.

II-4 Regularity and stability of urban migration

The fundamental distribution patterns of urban migration in the Kanto region have been derived from the above mentioned analyses in this chapter. Fig.11 shows the urban migration zones expressing the distributional area of cities with similar characteristic of migration as a descriptive model (see Figs.3, 4, 7 and 10). In this figure, Tokyo-bay is expressed as a white half-circle at the lower part.

In terms of mobility, large cities in population and central cities in the outer part of the Tokyo metropolitan area show the high mobility of urban migration on the whole of in-, out- and intra-urban migrations : the

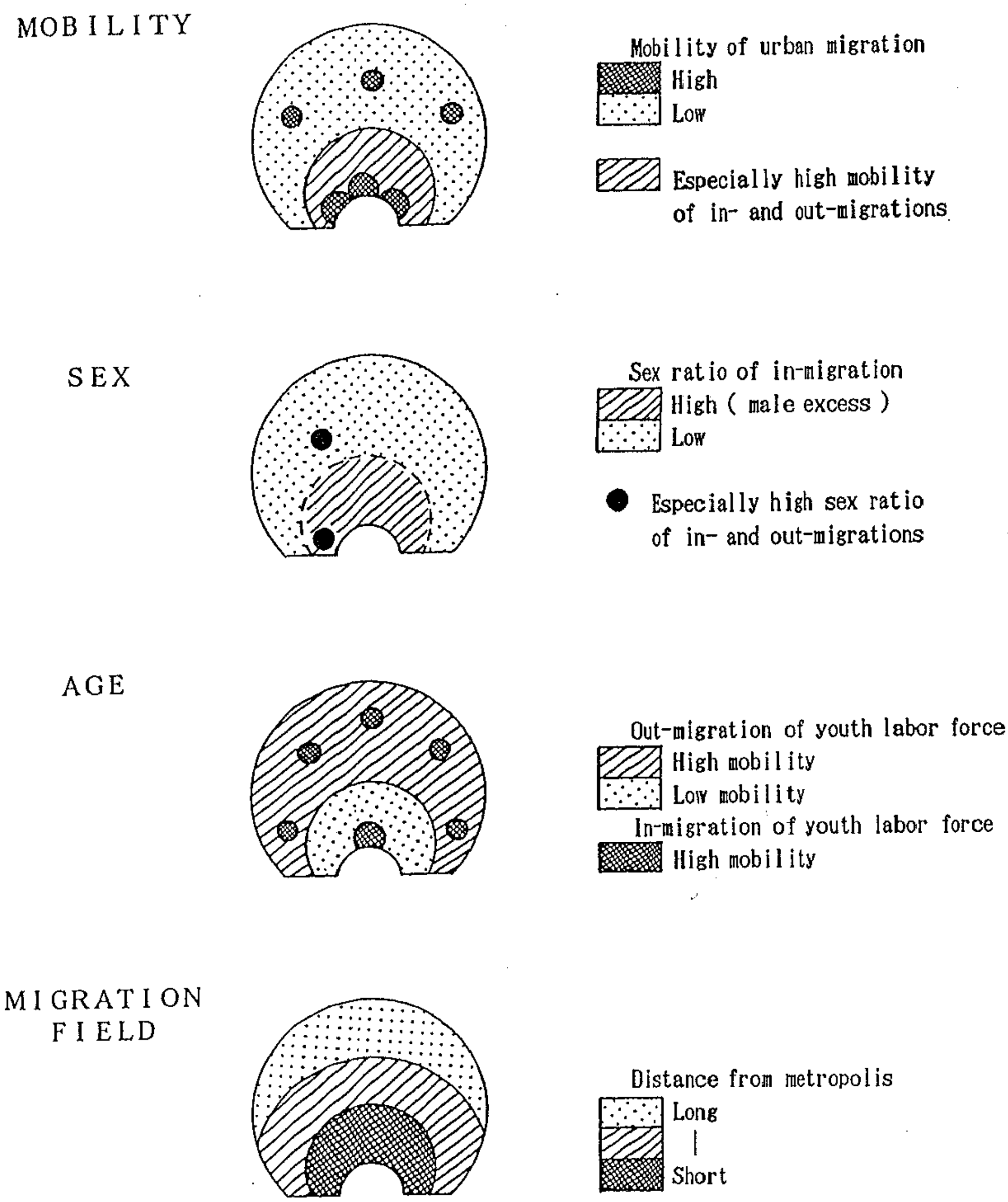


Fig.11 Urban migration zones (1980)

former typical cities are Tokyo, the central city of the metropolitan area, and its neighborhood cities such as Yokohama, Kawasaki and Chiba; and the latter typical cities are Mito, Utsunomiya and Maebashi. Especially, the high level of mobility on intra-urban migration characterizes these large or central cities. Fig.11 exhibits the distributional area of these cities as the zone of high mobility of urban migration. The inner zone of the Tokyo metropolitan area is distributed by the cities of showing especially high mobility of in- and out-migrations, and on the other hand, a lot of cities in the intermediate and outer zones show the low level of mobility of urban migration on the whole of in-, out- and intra-urban migrations.

In terms of sex, the zonal structure is indistinct in the distribution. Provided that there is a slight tendency of showing high sex ratio of in-migration, that is, an excess of male in-migrants to female ones, in the zone of large cities and their outskirts corresponding with the inner part from a broken line in Fig.11. And, only a small number of cities exhibit the remarkably active male-migration into and out of the cities.

In terms of age, the intensity of in- and out-migrations on the youth labor force is the most important index of identifying the urban migration zones. At first, in the out-migration, the age composition of migrants tends to be partial largely to the youth labor force in the city of the intermediate or outer zone of the Tokyo metropolitan area, though it isn't partial to the specific age group in the city of the inner zone. In Fig.11, the former city belongs to a zone of high mobility of youth labor force on the out-migration, and the latter corresponds with that of low mobility. Secondly, in the in-migration, the same partiality is detected in the large city of Tokyo and Kawasaki and in the central city of the outer part of the

Tokyo metropolitan area such as Mito, Utsunomiya and Maebashi. These cities belong to a zone of high mobility of youth labor force on the in-migration in Fig.11.

And, in terms of migration field, The in- and out-migrations to or from Tokyo determines the composition of urban migration zones. Cities in a specific distance zone from the Tokyo Station show a similar configuration of migration field, and therefore, the concentric pattern of distribution centering around Tokyo is remarkably distinct in this case. Provided that, at the level of original variable, the percentage of migrants traveled short-distance shows the same concentric pattern as Fig.11 on one hand, and the migrants rate traveled long-distance of 200 km and over tends to rise at the larger city of population on the other hand.

These four kinds of distribution patterns includes the regularity in common. The most noticeable regularity is the concentric pattern centering around Tokyo. And, another important element is the distribution pattern on intra-urban migration, in-migration of youth labor force and long-distance migration: these migratory characteristics are conspicuous in the large cities such as Tokyo, Yokohama and Kawasaki and the prefectural cities like Mito, Utsunomiya and Maebashi. It is considered that the distribution pattern depends on population size or centrality. In the following, the quantitative measurement is to be done for confirming the intensity of the above mentioned two regularities and the temporal stability of the distribution patterns.

II-4.1 Concentricity of the distribution

The concentric pattern of urban migration in this study reflects the existence of the concentric zonal structure centering around Tokyo.

Accordingly, in order to measure the intensity of the concentric pattern, 124 cities excluding Tokyo are classified into the three zones that are under 40 km, 40 to 80 km, and 80 to 160 km from the Tokyo Station, and then, chi-square statistic is calculated, of which value indicates independency of the contingency table between city groups by the above three distance zones and each types by the cluster analyses in the preceding sections. The input data are the number of cities cross-counted by the above two categories. Also, the chi-square value in this place is divided by the product of rows number and columns number in the contingency table because of standardization of excluding the influence of table size. The standardized chi-square value produced in this way gets the larger, the higher becomes the degree of coincidence between the two classifications, and the value is comparable between the four kinds of distribution patterns with different number of types. Additionally, the correlation coefficient between principal component score in the preceding analyses and distance from the Tokyo Station is also calculated to obtain a measure being independent of the above distance classification[12].

The value in parenthesis in Table 9 is the standardized chi-square value. The value becomes larger in the order of sex ratio, age structure, mobility and migration field, and therefore, the concentricity of distribution is intensifying in the same order. Especially, in terms of migration field and mobility, the large values indicate the relative importance of concentric pattern on their distributions.

The similar result is derived from the correlation coefficient of each principal component. Table 9 shows the existence of significant correlation coefficient at the 0.05 level of confidence on each of mobility, sex ratio, age structure and migration field. Accordingly, it can be said that each of

Table 9 Urban migration and distance from Tokyo (1980)

Group of variables		Principal component							
		I	II	III	IV	V	VI	VII	VIII
Mobility	(8.77)	−0.690*	0.031	···	···	···	···	···	···
Sex ratio	(1.57)	−0.121	−0.479*	−0.002	···	···	···	···	···
Age structure	(3.32)	0.749*	0.088	−0.150	−0.025	−0.140	···	···	···
Migration field	(10.56)	0.254*	0.627*	0.177	0.520*	0.098	0.207*	0.168	−0.059

Note: Main entries are correlation coefficients between principal component score and distance from Tokyo. * indicates significant at the 0.05 level of confidence. ··· indicates the absence of principal component. Parentheses are standardized chi-square values of the independency between city classification by three distance zones (<40km, 40～80km and 80km≦ from the Tokyo Station) and each types in Figs.3,4,7 and 10. Standardized chi-square value ＝ Chi-square value ／ (Number of rows in contingency table × Number of colums in that table).

these four groups includes a distributional element of concentric pattern centering around Tokyo. Separately to say, the half of extracted principal components exhibit the significant correlation coefficient on the two groups of mobility and migration field, and as opposed to these, the one-third on the sex ratio and only the one-fifth on the age structure are significant at the same level. Especially, in the case of sex ratio, only the principal component II shows the significant coefficient of which absolute value is in the low level under 0.5.

II-4.2 Relationship between urban migration and city size

The next investigation is to measure the degree of distributional coincidence between urban migration and city size indicated by the number of residents. The population size is not a perfect indicator of the centrality but the most important attribute on defining urban area[13]. In this place, based on the number of residential population in 1980, all the 125 cities are classified into the first group of 200 thousand and over, the second group of 100 to 200 thousand, the third group of 50 to 100 thousand, and the fourth group under 50 thousand, and then, the standardized chi-square value is calculated, of which input data are the number of cities, in the same manner as the concentricity. Additionally, the correlation coefficient is similarly calculated between residents number and principal component score. The outputs of these analyses are tabulated in Table 10[14].

The standardized chi-square value of mobility is especially greater than the other three values of variable groups in Table 10. This means the high level of coincidence between the two distributions of mobility and city size. And, in terms of correlation coefficient, principal component II

Table 10 Urban migration and city size (1980)

Group of variables		Principal component I	II	III	IV	V	VI	VII	VIII
Mobility	(8.14)	0.016	0.506*	···	···	···	···	···	···
Sex ratio	(1.50)	0.162	0.077	−0.038	···	···	···	···	···
Age structure	(1.98)	−0.187*	0.234*	0.041	−0.032	0.181*	···	···	···
Migration field	(1.82)	−0.686*	0.200*	0.011	−0.313*	0.024	−0.077	0.054	−0.190*

Note: Main entries are correlation coefficients between principal component score and number of residents. * indicates significant at the 0.05 level of confidence. ··· indicates the absence of principal component. Parentheses are standardized chi-square values of the independency between city classification by four size groups (<50,000, 50,000~100,000, 100,000~200,000 and 200,000≦ of residents) and each types in Figs.3,4,7 and 10.

Standardized chi-square value = Chi-square value / (Number of rows in contingency table × Number of colums in that table).

Data source: Population Census of Japan 1980.

of mobility shows a high positive value which is significant statistically. In the preceding analysis, this principal component was a composite variable indicating a high positive loading to the mobility of intra-urban migration. Therefore, it is considered that the intra-urban migration tends to be activating with the increase of the city's population size.

Each of sex ratio, age structure and migration field exhibits only the low level of standardized chi-square value. In age structure and migration field, it is considered that city size plays a certain role on explaining each the distribution pattern because there are plural significant correlation coefficients respectively. But, in sex ratio, no correlation coefficients reach the level of statistical significance. Therefore, it can be said that the coincidence of these three groups between urban migration and city size is in the lower level than that of the above mentioned mobility: among the groups, sex ratio shows the especially low level of coincidence. Additionally to say, it is the result of reflecting the high migrants rate of long-distance migration in large cities that only the principal component I of migration field exhibits a high negative correlation coefficient.

II-4.3 Stability of the distribution pattern

Urban migration is an attribute on the flow of urban population, and it is considered that the temporal fluctuation of the distribution pattern is greater than the other phenomena of the stock such as population distribution. The preceded analyses in this study have clarified distribution patterns of urban migration in 1980. In those distributions, two kinds of patterns would be found out in the mixed form, of which one is stable temporally and the other is inherent in the year. In this place, by means of comparing the preceded results with those derived from the similar analyses inputted the migration data in 1970, the stable feature and fluctuation trend are to be identified in the distribution patterns of urban migration. The principal components in 1970 are extracted in the same number as those in 1980 for each of mobility, sex ratio, age structure and migration field, and the similar cluster analysis is applied to the score matrices.

Table 11 shows the standardized chi-square value of coincidence between the two analyzed results in 1970 and 1980 with correlation coefficients between the two sets of principal components in those years. The input data for the former value are the number of cities cross-counted in the same way as the preceding analyses. The 16 correlation coefficients excluding those of principal components IV and V of age structure are significant statistically, and moreover, the eleven out of those exhibit the large absolute value of 0.5 and over. This result indicates that the distribution pattern of urban migration in 1970 is common to that in 1980 in many respects. Especially, in terms of migration field and mobility, it is considered that the distributional coincidence between the two years is in the high level, for reasons of showing the high standardized chi-square value.

Additionally, in considerations of concentricity and city size, the similar analysis is conducted to the urban migration in 1970. As a result of this, the standardized chi-square values of concentricity in 1970 show mobility 8.79, sex ratio 2.58, age structure 4.69 and migration field 11.33, which are over those in 1980 respectively. Therefore, it can be said that the intensity of concentricity centering around Tokyo has deteriorated from 1970 to 1980. On the other hand, there is a distributional order being

Table 11 Similarity of urban migrations between 1980 and 1970

Group of variables		Principal component I	II	III	IV	V	VI	VII	VIII
Mobility	(10.69)	0.942	−0.857	…	…	…	…	…	…
Sex ratio	(2.29)	0.705	0.352	0.344	…	…	…	…	…
Age structure	(3.29)	0.922	0.733	0.300	0.062@	−0.135@	…	…	…
Migration field	(13.71)	−0.914	0.643	0.846	−0.277	0.579	−0.289	−0.754	0.654

Note: Main entries are correlation coefficients of the principal component score between 1980 and 1970. @ indicates not significant at the 0.05 level of confidence. … indicates the absence of principal component. Parentheses are standardized chi-square values of the independency between each types in 1980 (Figs.3,4,7 and 10) and those in 1970. Standardized chi-square value = Chi-square value / (Number of rows in contingency table × Number of colums in that table).

Data source: Population Census of Japan 1970,1980.

common to both the years, in which the concentric pattern is intensifying in the order of sex ratio, age structure, mobility and migration field.

And, the standardized chi-square values of city size in 1970 show mobility 3.91, sex ratio 1.84, age structure 2.76 and migration field 1.57. Of these four groups, only the mobility has exhibited a great rise of the value in ten years of the 1970s. Also, in the same way as 1980, the city's population size is correlative significantly to the principal component II of mobility which represents the mobility of intra-urban migration in 1970. Therefore, it ca be said that the relationship between city size and intra-urban migration has been intensified in the ten years, in which the migration activates the more, the larger becomes the city size.

Based on the above results, it is considered that mobility and migration field out of the four groups in Fig.11 exhibit the extremely stable distribution pattern temporally. Additionally, the distributional order has been maintained through the 1970s, in which the concentric pattern centering around Tokyo becomes clearer in the order of sex, age, mobility and migration field. But, the intensity of this concentricity has been declining, and it means a fall of the influence of the Tokyo metropolitan area to the migration phenomena. Additionally with considering existence of a tendency being more active on intra-urban migration in the larger city, it can be said that the distribution pattern of urban migration in the Kanto region has attained to a great transitional point in response to the fluctuation of economic circumstances at that period. Namely, in parallel with a transition from expanding to shrinking on the economic growth of Japan, the migration has transferred from the rural-urban or inter-urban dominance centered on the large city of Tokyo to the form in which the importance of intra-urban migration intensifies more than ever.

It is considered that the results of this study exhibit a phase of the advanced society explained by the Zelinsky's hypothesis of mobility transition. But, at the same time, it can be interpreted as grasping a new phase of urbanization he couldn't point out, in which modern metropolitan areas experience the succession to decentralization and furthermore counter-urbanization of the population. Also in previous studies, there are criticisms against his hypothesis on the interpretation and valuation in the manner of the Western world (Lewis,1982,p.24), and the modification or re-presentation has been tried with the exemplification of developing countries (Skeldon,1990). Additionally, at the side of developed countries, it needs a new development of the mobility transition theory explaining the counter-urbanization phenomena in recent years (Kanekiyo,1983). The study of urban migration in Japan becomes valuable to both the two kinds of studies mentioned above, where the urbanized area fluctuates on the inherent suburbanization process under the condition of extremely high land price.

This study has considered migration phenomena comprehensively including not only in- and out-migrations of city but also intra-urban migration. The former migrations are of the inter-regional level based on the linkage system between one city and the whole of its outside area. And, in terms of the determinant of these migrations, previous studies have attached importance to the areal difference indicated by the economic variable such as employment opportunity and income level. However, as shown in the results of this study, the intra-urban migration has intensified its importance of all the migrations concerning the city in recent years. It is considered that the activation of intra-urban migration is caused by the additive increase of urban element on the city. So, in this chapter, the city's population size has been introduced for expressing the above causal relationship. If the economic variable representing the relative status of city and the social variable concerning inhabitation and life-cycle in the city were employed in addition to this, it would be possible to clarify moreover the spatial relationship of correspondence between urban migration and socio-economic attribute of the city.

CHAPTER III

URBAN MIGRATION AND SOCIO-ECONOMIC ATTRIBUTE OF THE CITY

III-1 Selected migratory variables

The fundamental distribution pattern of urban migration has been clarified in analyses of the preceding chapter. Though the pattern is extracted from the 61 variables inputted into the analyses, it is possible to re-present the pattern with the less number of variables. The distribution pattern shown in Fig.11 is mainly composed of the two elements: the concentric pattern centering around Tokyo; and the distribution pattern restricted by city size, that is, the city-size pattern. Because these two distribution patterns are found out apparently in the three variable groups of mobility, age structure and migration field, the variable representing each of the concentric and city-size patterns is selected from these three groups respectively, which is re-identified as the new migratory variable in this chapter. Table 12 shows the new migratory variables employed in this chapter and their definitions. The following description is the reason of selection and distributional characteristic of the individual variable.

1. In- and out-migration: The mobility of in-migration and out-migration represent the concentric pattern out of all the three variables in the preceding chapter. Because these two variables show the extremely high correlation as mentioned in the preceding chapter, they are added up figures to summarize their variations into a new variable named as in- and out-migration. The most active city of in- and out-migration is Musashino (2,273 migrants per 10,000 residents, the following is the same unit) , and

Table 12 List of migratory variables and their definitions

Variable number	Variable name	Definition
1	In- and out-migration	Number of in- and out-migrants per ten thousand of residents
2	Out-migration of youth labor force	{ (Number of out-migrants aged 15~19 / Number of residents aged 15~19) / (Number of out-migrants / Number of residents) } $\times 10^2$
3	Short-distance migration	Percentage of in- and out-migrants traveled 0~40km to the total in- and out-migrants
4	Intra-urban migration	Number of intra-urban migrants per ten thousand of residents
5	In-migration of youth labor force	{ (Number of in-migrants aged 15~19 / Number of residents aged 15~19) / (Number of in-migrants / Number of residents) } $\times 10^2$
6	Long-distance migration	Percentage of in- and out-migrants traveled 200km and over to the total in- and out-migrants

Data source: Population Census of Japan 1980.

the value of 2,000 and over is registered also on seven cities of Koganei, Tanashi, Mitaka, Narashino, Kokubunji, Kodaira and Chofu. Generally to say, the dormitory cities adjacent to Tokyo show the active in- and out-migration, and the value is below the average level on the large cities of Tokyo and Yokohama. On the other hand, the depressed cities of the migration are Kanuma (453) in the lowest and continued in the order of Ashikaga, Hanyu, Tomioka, Mitsukaido, Nakaminato, Annaka and Choshi (531), of which locations are distant a radius of 40 km and over from the Tokyo Station. It can be said that the distribution of in- and out-migration exhibits a concentric pattern centering around Tokyo and Yokohama as a whole.

2. Out-migration of youth labor force: In terms of migrant's age, the standardized mobility aged 15 to 19 of out-migration shows the highest value on the coefficient of variation of all the original 33 variables: it means that the areal difference is noticeable between the cities. Additionally, this variable correlates with the above in- and out-migration at the highly negative correlation coefficient of −0.743, and it tends to display the high value in small cities located in the outer part of the Kanto region and the low value in Tokyo and its neighboring cities. Therefore, the standardized mobility aged 15 to 19 of out-migration is the variable representing concentric pattern of the age structure, so that it is to be employed and named as out-migration of youth labor force in the following analysis of this chapter.

3. Short-distance migration: The distribution of migration field exhibits an apparent concentric pattern as shown in Fig.11. In the original 22 variables of migration field, the variable of short-distance migration shows concentric pattern, though the distribution pattern on the variable

of long-distance migration is closely related to the city size. The shortest traveled distance is 0 to 20 km of in- or out-migration of all the 22 variables. But, it is under the great influence of city's area with the variable of 0 to 20 km only, and therefore, the short- distance migration in this place is defined by adding in- and out-migrations traveled 20 to 40 km to those of the above shortest distance[15]. As shown in Table 12, the short-distance migration in this chapter is the variable indicating percentage of in- and out-migrants traveled 0 to 40 km to the total in- and out-migrants. The high percentage of short-distance migrants is found out on the dormitory cities located in the neighborhood of Tokyo such as Yamato (67.6 %), Kawaguchi, Tokorozawa, Koshigaya and Machida (65.3 %). This variable reflects well the condition of city's circumstances, and therefore, the high value is to be displayed on the city in the outskirts of Tokyo, which has a lot of origins or destinations of migration in the neighborhood. As compared with this, the value of short-distance migration is small in the large or prefectural cities such as Tokyo, Yokohama, Mito, Utsunomiya and Maebashi, which generate a lot of long- distance migrants. And, the value falls more on the small city located in the outer part of the Kanto region.

4. Intra-urban migration: The mobility of intra-urban migration is a variable exhibiting apparently the city-size pattern out of all the three variables in terms of mobility. Based on the value of mobility, the cities generating active intra-urban migration are in the order of Tokyo (723 migrants per 10,000 residents, the following value is the same unit), Yokohama, Utsunomiya, Hitachi, Mito and Maebashi (518), that is, two large cities and four prefectural cities in the northern part of the Kanto region. Additionally, the relatively high value tends to be observed on

cities in the fringe of the Kanto region such as Takahagi (430) and Choshi (394). On the other hand, the depressed cities of intra-urban migration are small in population or characterized as the dormitory city, in which the former examples are Shimotsuma (144) and Yokaichiba (158) and the latter examples are Hoya (203) and Sakura (204).

5. In-migration of youth labor force: The result of preceding chapter has exhibited that the age structure of in-migrants is biased to the age group of youth labor force in large or prefectural cities such as Tokyo, Kawasaki, Mito, Utsunomiya and Maebashi. Namely, it is considered that the in-migration of youth labor force is closely related to the city size. Also in terms of in-migration, the coefficient of variation aged 15 to 19 has shown the highest value of all the young age groups. Therefore, the standardized mobility aged 15 to 19 of in-migration is considered to be representative of the city-size pattern of migrant's age, which is employed in the following analyses of this chapter with the name of in-migration of youth labor force. Tokyo (298.2 %) shows the highest value of the in-migration of youth labor force. This value means that the mobility of youth labor force is in the high level of almost three times as compared with the mobility of all age groups. The in-migration of youth labor force shows the relatively high value on large or prefectural cities such as Yokohama, Kawasaki, Mito, Utsunomiya and Maebashi in addition to Tokyo, but its correlation with the city size is not so obvious as the case of intra-urban migration.

6. Long-distance migration: As mentioned in the short-distance migration, the variable of long-distance migration shows distribution pattern closely related to the city size out of the 22 variables on migration field. Especially, on the traveled distance 200 km and over, the

migrants rate of the total in- and out-migrantions exhibits the relatively high value in the large city with a lot of migrants and broader migration field. Concretely, five large cities of Tokyo (25.8 %), Yokohama, Yokosuka, Kawasaki and Chiba (10.0 %) show the value of ten percent and over, so that these cities contribute much for the formation of migratory network at the national scale which is broader than the Kanto region. In this chapter, the percentage of in- and out-migrants traveled 200 km and over to the total in- and out-migrants is employed as a new migratory variable named as long-distance migration.

It is considered that the variables 1 to 3 of concentric pattern out of the above six are explained their distributions by distance from Tokyo to a considerable extent. Similarly, the variables 4 to 6 of city size are considered to be explained by number of residents. In order to grasp the degree of explanation quantitatively, multiple regression analyses are conducted, in which the dependent variables are the above six migratory variables and the independent variables are the two variables of distance from Tokyo and number of residents. The following is the result of the analyses.

Table 13 shows the standard partial regression coefficient and the coefficient of determination derived from the multiple regression analysis which is applied to each of the six migratory variables[16]. Firstly, based on the standard partial regression coefficients on the migratory variables 1 to 3, it is observed for each variable that the coefficient to distance from Tokyo is much more than that to number of residents in terms of absolute value. Additionally, the absolute value to distance from Tokyo decreases in the order of in- and out-migration, out-migration of youth labor force and short-distance migration, and the sign of coefficient shows

Table 13 Multiple regression analyses of the migration with two independent variables, distance from Tokyo and number of residents

Dependent variable		Standard partial regression coefficient		Coefficient of determination
Variable number	Variable name	Distance from Tokyo	Number of residents	
1	In- and out-migration	−0.704*	0.019	0.507
2	Out-migration of youth labor force	0.692*	−0.173*	0.614
3	Short-distance migration	−0.494*	0.246*	0.412
4	Intra-urban migration	0.498*	0.935*	0.709
5	In-migration of youth labor force	−0.080	0.461*	0.252
6	Long-distance migration	−0.054	0.823*	0.720

Note: * indicates significant at the 0.05 level of confidence.
Distance from Tokyo is straight-line distance between the Tokyo Station and the city hall.
Number of residents is transformed into common logarithm.
Data source: Population Census of Japan 1975, 1980.

positive to out-migration of youth labor force and negative to both of in- and out-migration and short-distance migration. These results support numerically the distributional characteristic of migratory variables mentioned above.

On the other hand, in terms of the migratory variables 4 to 6, the standard partial regression coefficient to number of residents is more than that to distance from Tokyo on the absolute value. The coefficient value decreases in the order of intra-urban migration, long-distance migration and in-migration of youth labor force, showing the positive sign for each variable. Also in this place, these results are consistent with the distributional characteristic mentioned above.

Secondly, based on the coefficient of determination on each of the six multiple regression equations, it can be said that the two independent variables explains 72.0 % of the variation on long-distance migration as even the highest value and only 25.2 % for in-migration of youth labor force as the lowest one. Therefore, it is interpreted that there is much of spatial variation as the residual unexplained by the two independent variables of distance from Tokyo and number of residents, that is, it needs some addition of the new explanatory variable.

III-2 Socio-economic attribute explaining the migration

The variables of socio-economic attribute are selected on the results of previous studies in terms of urban dimension in Japan and quantitative regional structure of the Tokyo metropolitan area. Though there is much accumulation on the quantitative analysis of urban dimension also in Europe and America since the pioneering study of Moser and Scott (1961), the extracted factors are influenced largely by the difference of socio-economic development and cultural foundation between the nations as Berry (1969) and Sung (1977) pointed out. Additionally, even in a country, it is observed that the factor structure varies with the quality or quantity of analyzed city and inputted variable. Therefore, there are not many studies significant on selecting variable in this study. Firstly, only six examples are employed out of previous studies of urban dimension, of which inputted variables and analyzed cities are outlined as follows.

1. Yasuda (1959): As a method of considering the rural-urban continuum hypothesis, factor analysis was applied to 15 variables based on the population Census of Japan 1950 with 124 cities of the whole country.

2. Yamaguchi (1972): With 92 cities in the core region composed of three districts of Kanto, Tokai and Kinki in Japan, principal component analysis was conducted to 50 variables mostly based on the DID data of the population Census of Japan 1960.

3. Yamaguchi (1973): Principal component analysis was conducted to the same 50 variables as mentioned above with 189 cities of the whole country in 1960.

4. Hino (1977): In order to consider the development of urban system in Japan by means of time series comparison of the urban dimension, principal component analysis was applied to each of 34 variables with 153 cities in 1950, 50 variables with 185 cities in 1960, and 54 variables with 242 cities in 1970.

5. Inouchi (1982): With 50 cities and towns including one DID and over within the administrative area in the northern part of the Kanto region, the time series comparison of urban dimension was conducted by means of principal component analysis applied to each of 29 variables in 1965 and 30

variables in 1975.

6. Osada (1991): Factor analysis is conducted to 21 variables mostly based on the data of the index of surplus workers by the type of industry derived from the Workplace Statistics in the lump of four years with the whole cities in the metropolitan area, that is, 116 cities in 1966, 157 cities in 1975, 161 cities in 1981, and 162 cities in 1986 in the one metropolis and seven prefectures.

Secondly, another important source is the quantitative study of regional structure in the Tokyo metropolitan area. In the studies of this kind, not only cities are analyzed, but including towns and villages, the factor or principal component analysis is conducted in the highly urbanized area concentrating a lot of cities around Tokyo. So, it is considered that the employed variables and the analyzed outputs in those studies are helpful for the variable selection in this study as the complement to the studies of urban dimension mentioned above. Six studies outlined as follows are added as the source for selecting variable in this study.

7. Hattori et al. (1960): With 122 cities, towns and villages within a radius of 40 km from the Tokyo Station, factor analysis was conducted to 16 variables concerning size of area and population, location, economic activities and population structure.

8. Yamada et al. (1974): Principal component analysis was conducted to 43 variables based on the population Census of Japan 1970 with 296 cities, wards, towns and villages in the southern part of the Kanto region (one metropolis and three prefectures) and a part of Ibaraki-prefecture.

9. Fukuhara (1977): With 162 cities, wards, towns and villages selected by population change and commuting to Tokyo (23 wards) in the southern part of the Kanto region, principal component analysis was

conducted to 25 variables of population structure, household, employment, finance, etc. The analysis was conducted in each of four years of 1955, 1960, 1965 and 1970, intending to clarify the structure of the Tokyo metropolitan area and its change by comparison between the outputs of four years.

10. Saito (1982): Factor analysis was conducted to 60 variables of population, household, age, education, housing, industry, etc. In 1975 with 296 cities, wards, towns and villages within a radius of 70 km from the Tokyo Metropolitan Government Office.

11. Housing Research and Advancement Foundation of Japan (1983): With 195 cities, wards, towns and villages of the Tokyo metropolitan area within a radius of 50 km from Tokyo, principal component analysis was applied to 33 variables concerning such as population, household and industry in each of three years of 1960, 1970 and 1980 in order to clarify the change of regional structure in the Tokyo metropolitan area.

12. Tomita and Kouno (1990): Factor analysis was applied to the data in 1985 with the same area and the almost same variables as Saito (1982).

There includes much overlapping in the contents of total 711 variables which were employed in the total 20 times factor or principal component analyses conducted in the above twelve examples. Therefore, it is considered that a part of their variables is useful for explaining migration in this study. There exists not the same in those 711 variables as the six migratory variables mentioned in the preceding section, but only a few variables containing migration which become clue for selecting the socio-economic variables in this place.

One of the variables is of population increase. Seventeen times analyses out of the 20 mentioned above employ population increase rate as the input variable. Population increase is composed of natural increase and social increase, in which the latter is nothing else but migration as the net value. Based on the classical laws of migration (Ravenstein, 1885・1889), cities grow more by migration than by natural increase, of which growth has backgrounds of economic prosperity and diversified working opportunities (Sakashita and Asano, 1979). Therefore, by means of employing the variable closely related to population increase rate, it would be possible to prepare the economic attribute significant in explaining the distribution pattern of migration.

Another is the variable reflecting long-term cumulation of migration, which the total seven variables are employed in the above studies, concretely such as the domestic population rate defined as percentage of population with the same birth place as the present residence and the migratory population rate defined as percentage of population in-migrated from the other cities, towns and villages. These variables are representative of the mobility of urban population from the long-term viewpoint. In the branch of urban sociology, mobility of urban residents is considered to be an important variable on defining urbanism (Wirth, 1938), and therefore, the variable showing high level of correlation with those seven variables would be the social attribute closely related to the migration in this study.

Based on the above viewpoints, it is necessary for the socio-economic variable in this study to fulfill the following three requirements entirely: ①the socio-economic variable contributes a factor or principal component in the previous study together with the variable concerning population increase rate or long-term mobility mentioned above; ②the loading to the socio-economic variable is 0.5 and over in the absolute value; and ③the socio-economic variable is employed in the analyses of different years. The requirements ① and ② are intended to guarantee the high level of correlation between the socio-economic variable and the migratory variable. And, the requirement ③ is intended to exclude the peculiar variable employed only in a certain year. Through the above process, 17 socio-economic variables are selected in this study as shown in Table 14.

The newly added variables are the number 3 and over in Table 14. Sex ratio (variable number 3, the following is also the variable number), childhood population rate (4) and aged population rate (5) are fundamental variables representing demographic characteristics of urban population. As mentioned in chapter I, based on the previous studies of regression analysis, it has been known that out-migration depends more on the size and structure of population than on the level of economic opportunity in the origin city. And, in terms of intra-urban migration, it has been considered that not only housing but also demographic characteristic is an important cause explaining the mobility. Therefore, it would be considered that those three variables play an important role as the explanatory variable of migration also in this study containing out-migration and intra-urban migration.

Also in terms of the other twelve variables, each of them is considered to represent the population structure in a broad sense. Number of household members (6) indicates a trend for the nuclear family. Female labor force rate (7) is defined as percentage of female population in labor force including part-time job and temporary retirement, so that the variable correlates negatively with the so-called full-time housewives rate. Employees rate (8) shows percentage of the so-called salaried workers

Table 14 List of socio-economic variables and their definitions

Variable number	Variable name	Definition
1	Distance from Tokyo	Straight-line distance between the Tokyo Station and the city hall
2	Number of residents	Number of residents transformed into common logarithm
3	Sex ratio	Males per 100 females
4	Childhood population rate	Percentage of population aged 14 and less to the total population
5	Aged population rate	Percentage of population aged 65 and over to the total population
6	Number of household members	Number of ordinary household members per number of ordinary household
7	Female labor force rate	Percentage of female population in labor force to the female population aged 15 and over
8	Employees rate	Percentage of employees population to the total employed popultion
9	Owned houses rate	Percentage of ordinary households living in owned houses to the total ordinary households
10	Number of <u>tatami</u>	<u>Tatami</u> per person of ordinary household
11	Managers and officials rate	Percentage of managers and officials population to the total employed population
12	Clerical and related workers rate	Percentage of clerical and related workers population to the total employed population
13	Outflow workers rate	Percentage of outflow population employed at the other area than the city to the total employed population
14	Primary industry rate	Percentage of persons employed in primary industry at the city to the total employed persons at the city
15	Secondary industry rate	Percentage of persons employed in secondary industry at the city to the total employed persons at the city
16	Finance and insurance rate	Percentage of persons employed in financial and insurance business at the city to the total employed persons at the city
17	Higher education rate	Percentage of population completed higher educational institution to the total population aged 15 and over

Data source: Population Census of Japan 1970, 1975.

population. Both owned houses rate (9) and number of <u>tatami</u> (10) are variables of housing, which have been pointed out the importance as the cause of migration at any spatial scale in previous studies (Brown and Longbrake,1970; Speare,1974; Kato,1980; Ueno,1980; Cadwallader,1981; Lewis,1982,p.121; Otomo,1983; Murayama,1985; Otomo,1987). Managers and officials rate (11) and clerical and related workers rate (12) represent the social status in terms of occupation. Outflow workers rate (13) is a variable representing dependency on employment opportunity outside the city, which shows the high value in dormitory cities with a lot of commuters to the other cities, towns and villages. Primary industry rate (14), secondary industry rate (15) and finance and insurance rate (16) are variables representing industrial composition of daytime population. And, higher education rate (17) is a variable representing composition of urban population by the school career[17].

Table 15 shows the results of simple correlation analyses between the newly employed 15 variables numbered 3 to 17 and the residuals from six multiple regression equations in Table 13. Six correlation coefficients are calculated for each variable with their significance tests at the 0.05level of confidence. When the newly input variable is useful for explaining the migration, one or more correlation coefficients should be significant. In practice, each of the 15 socio-economic variables has one or more significant correlation coefficients in Table 15. Finance and insurance rate (16) is a variable with the smallest number of significant correlation coefficients, which correlates with the residual of in- and out-migration at the significant value of 0.256. Each of the other 14 variables has two or more significant correlation coefficients, particularly in which primary industry rate (14) shows the significant correlations with the residuals of

Table 15 Simple correlation analyses between the socio-economic variables and the residuals from the multiple regression equations in Table 13

Variable number	Variable name	Correlation coefficient Maximum (of absolute value)	Minimum	Number of migratory variable significant at 0.05
3	Sex ratio	0.348*	−0.042	1, 2, 3, 5
4	Childhood population rate	−0.421*	0.036	2, 3, 5, 6
5	Aged population rate	−0.450*	−0.023	1, 2, 3, 6
6	Number of household members	−0.577*	−0.020	1, 2, 3
7	Female labor force rate	−0.388*	0.052	1, 2, 3
8	Employees rate	0.488*	0.089	1, 2, 3
9	Owned houses rate	−0.513*	0.073	1, 2, 3, 4, 5
10	Number of *tatami*	−0.364*	0.019	3, 4
11	Managers and officials rate	0.443*	0.005	1, 2, 3
12	Clerical and related workers rate	0.506*	0.002	1, 2, 3
13	Outflow workers rate	0.462*	−0.025	1, 2, 3
14	Primary industry rate	−0.383*	−0.176*	1, 2, 3, 4, 5, 6
15	Secondary industry rate	−0.379*	−0.081	2, 3, 4, 6
16	Finance and insurance rate	0.256*	0.026	1
17	Higher education rate	0.521*	0.066	1, 2, 3

Note: * indicates significant at the 0.05 level of confidence.
Number of migratory variable corresponds with that in Table 12.
Data source: Population Census of Japan 1970, 1975.

all migratory variables. Therefore, it is considered that the 15 variables in Table 15 are useful as the additive variable on explaining the distribution pattern of migration and each of the majority contributes to explaining the plural number of migratory variables at one time. On the other hand, transferred a viewpoint to the migratory variable, that is, in pursuit of the numbers in the right-end column of Table 15 vertically, it is observed that each residual correlates significantly with four or more socio-economic variables. Especially, the residual of short-distance migration (migratory variable number 3) shows the significant correlation with each of 14 socio-economic variables.

The above result suggests that it is necessary for explaining each migratory variable to add one or more socio-economic variables to those in Table 13. Furthermore, it means that there are garrulous correlations within the socio-economic variables in no small quantities as well as the migratory variables. Therefore, it is obvious to need some operation of eliminating the garrulity of correlation in Table 15 for measurement of covariation between the two variable groups of migration and socio-economic attribute.

III-3 Principal component of variable variations and its distribution

III-3.1 Principal component of the migration

In the same way of chapter II, principal component analysis by variable group is conducted to the geographical matrix with 750 data composed of 6 migratory variables × 125 analyzed cities. As mentioned in the preceding section, the six migratory variables are divided into two groups of variable number 1 to 3 and 4 to 6, in which the former shows the concentric pattern centering around Tokyo and the latter represents the city-size pattern. It is necessarily expected that these distribution patterns become two principal components of the variable variations by means of applying principal component analysis to each of the variable groups[18].

Out of 15 pairs of correlation relationships between the total six variables, three pairs show the absolute value 0.7 and over of correlation coefficient: −0.796 between out-migration of youth labor force and short-distance migration; 0.744 between in- and out-migration and short-distance migration; and −0.743 between in- and out-migration and out-migration of youth labor force. All of these variables are of the concentric pattern. Continuously, the absolute value is decreasing in the order of 0.525 between intra-urban migration and long-distance migration, 0.438 between in-migration of youth labor force and long-distance migration, and 0.380 between intra-urban migration and in-migration of youth labor force. Each of these three pairs is composed of variables representing the city-size pattern. Namely, it is considered that the six variables as a whole exhibit a structure in which the correlation is high within the variable group of concentric pattern or city-size pattern and low between the groups.

Table 16 shows the results of applying principal component analyses to the migratory variables. Firstly, the three variables of concentric pattern are summarized as follows. Three principal components I to III are extracted, in which the first principal component exhibits the extremely high percentage of contribution (explanation) of 84.1 % to the total variable variations. Additionally, principal component I displays the absolute value of loading over 0.9 to each of the migratory variables 1 to 3. This means that principal component I is capable of explaining the 80 %

Table 16 Principal component analyses of the migratory variables (1980)

(1) Concentric pattern

Variable number	Variable name	Principal component I	II	III
1	In- and out-migration	0.903	0.431	…
2	Out-migration of youth labor force	−0.924	…	−0.317
3	Short-distance migration	0.924	…	−0.322
	Eigenvalue	2.522	0.274	0.204
	Percentage of contribution	84.1	9.1	6.8

Note: … indicates loading under | 0.3 | .

(2) City-size pattern

Variable number	Variable name	Principal component I	II	III
4	Intra-urban migration	0.803	−0.419	−0.423
5	In-migration of youth labor force	0.747	0.653	…
6	Long-distance migration	0.834	…	0.522
	Eigenvalue	1.898	0.635	0.467
	Percentage of contribution	63.3	21.2	15.5

Note: … indicates loading under | 0.3 | .

and over of variations for each migratory variable. As opposed to this, it is impossible to say that the other two principal components represents the variation common to the three migratory variables, because there exists the variable with loading under 0.3 in the absolute value for each of the two components. Based on the above consideration, it is possible to say that only the principal component I represents the concentric pattern that the three migratory variables hold in common. In the following analysis, this principal component is to be called as concentric principal component in order to distinguish it from the other.

Secondly, in summarization of the city-size pattern, the similar output is taken as follows. Namely, principal component I shows the overwhelmingly high percentage of contribution and the relatively high loadings to each of the three migratory variables 4 to 6. And, there exists the variable with loading under 0.3 in the absolute value for each of principal components II and III. Therefore, it is also possible to say that only the principal component I represents the city-size pattern that the three migratory variables hold in common, which is renamed as city-size principal component. The following is a description of the distributional characteristics based on loadings and scores of both the concentric and city-size principal components.

Based on loadings in Table 16, the concentric principal component (principal component I on the concentric pattern) correlates positively with each of in- and out-migration and short-distance migration and negatively with out-migration of youth labor force. It means that the concentric principal component score exhibits high value in the city with high mobility of in- and out-migrations or high migrants rate traveled short distance of 0 to 40 km and low value in the city with higher mobility on out-migration of youth labor force aged 15 to 19 than that of the other age group.

Fig.12 shows distribution of the concentric principal component score in terms of migration. The cities with positive value of the score are distributed in Tokyo and its outskirts, and the cities with distance of 60 km and over from the Tokyo Station exhibit the negative value entirely. In other words, the concentric pattern centering around Tokyo is observed, of which inner and outer zones are composed of the cities showing positive and negative principal component scores respectively. In detail, the high-ranking ten cities of this score are all dormitory cities in the outskirts of Tokyo, enumerated in the order of Musashino, Koganei, Mitaka, Tanashi, Narashino, Ichikawa, Chofu, Kokubunji, Hoya and Kodaira. The value of Tokyo is nothing but in the almost average level of all 125 cities. On the other hand, the low-ranking ten cities are enumerated in the order of Katsuura, Shimotsuma, Tateyama, Choshi, Yokaichiba, Sawara, Mitsukaido, Asahi, Chichibu and Yaita. These are all small cities, and a few of them are not so distant from Tokyo. Therefore, though the distribution of this principal component score is on the basis of concentric pattern centering around Tokyo, at the same time, it is also obvious that the distribution includes the spatial variation unexplained by the linear relationship with distance from Tokyo.

Continuously, based on the loadings of city-size principal component (principal component I on the city-size pattern in Table 16), it is understandable that the principal component correlates positively with each of the three variables of intra-urban migration, in-migration of youth labor force and long-distance migration. It means that the city-size principal component tends to show high score in the city with high mobility

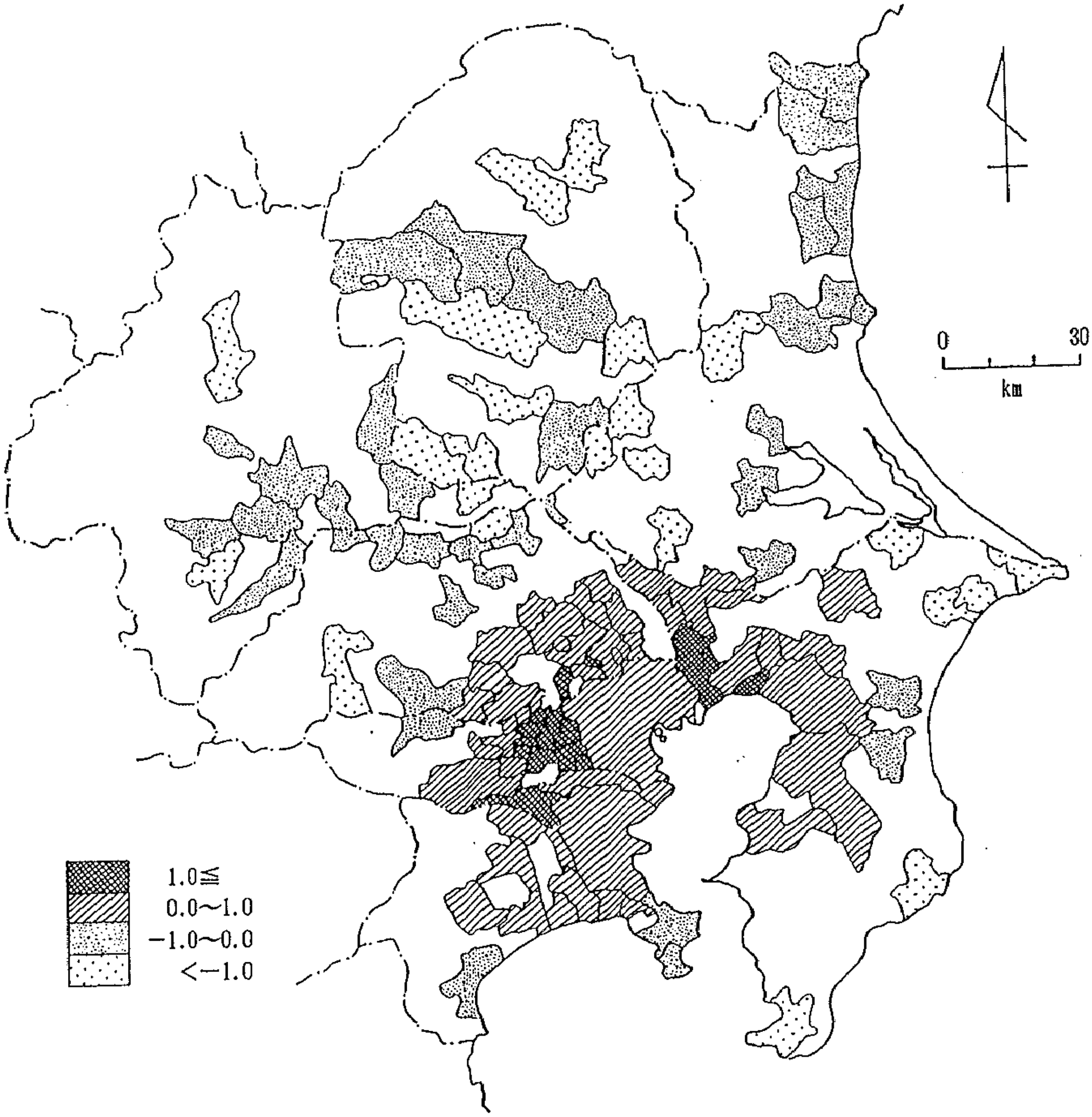


Fig.12 Distribution of the concentric principal component scores, migration (1980)

of intra-urban migration or high migrants rate traveled long distance of 200 km and over. And, in terms of age composition of in-migrants, this score is increasing with mobility of youth labor force aged 15 to 19. In other words, this score exhibits higher value in the city with more active in-migration of youth labor force than the other age group.

Fig.13 shows distribution of the city-size principal component in terms of migration. The high-ranking ten cities of this score are enumerated in the order of Tokyo, Yokohama, Kawasaki, Yokosuka, Chiba, Utsunomiya, Hiratsuka, Ichikawa, Mito and Hachioji, including six out of the high-ranking ten cities of the number of residents. On the other hand, the low-ranking ten cities are enumerated in the order of Yokaichiba, Shimotsuma, Katsuura, Mitsukaido, Sakura, Kazo, Kasama, Sawara, Zushi and Higashiyamato, in which the four cities of Yokaichiba, Shimotsuma, Katsuura and Kasama are also classified into the low-ranking ten cities of the number of residents. Therefore, this principal component score exhibits high correlation with the city size represented by number of residents, but there exist a part of cities with not a small difference between the two orders of principal component score and number of residents.

As a result of the above analysis, it is possible to say that the concentric and city-size patterns exhibited by the six variables of migration have been summarized into the two composite variables of concentric and city-size principal components. It has been mentioned above that the three variables of concentric pattern correlate weakly with those of city-size pattern. Also in this place, it is confirmed by the correlation coefficient of 0.332, that is, only 9.9 % of the explained variation between the concentric and city-size components.

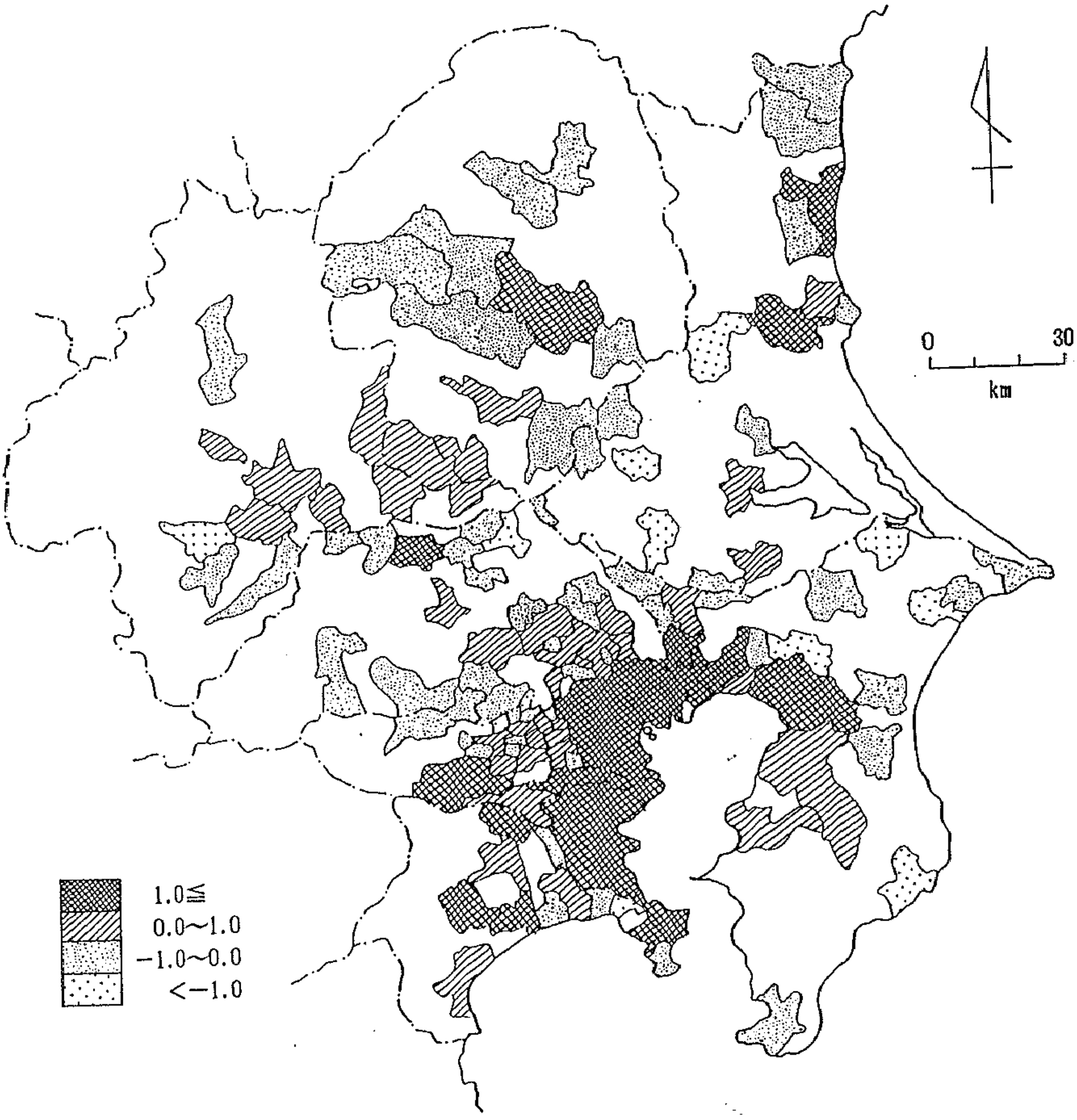


Fig. 13 Distribution of the city-size principal component scores, migration (1980)

III-3.2 Principal component of the socio-economic attribute

The variables of socio-economic attribute tend to show the high level of correlation each other as compared with the case of migration. Forty out of the 136 pairs of socio-economic variables exhibit the correlation coefficient of 0.7 and over in the absolute value, and it amounts to almost 30 percent of the total pairs. Therefore, it is considered that the summarization is more necessary to variations of socio-economic variables than those of migratory variables. In this place, principal component analysis is conducted to the geographical matrix with 2,125 data composed of 17 socio-economic variables × 125 analyzed cities. The socio-economic variables are not divided into groups unlike the migratory variables. Accordingly, the principal component analysis in this place is conducted in the ordinary procedure of summarizing all at one time.

Table 17 shows the results of applying principal component analysis to the socio-economic variables. Principal components I to III are extracted on the percentage of contribution of 5 % and over, and they reach 79.9 % of the cumulative percentage of contribution. Especially, the first principal component (principal component I) exhibits the 58.8 % of percentage of contribution as a reflection of the correlation relationships between the input variables mentioned above. The following descriptions are of relationship between the principal component and the socio-economic variable and distributional characteristic based on the principal component score.

The first principal component is considered to be the composite variable which has a characteristic of the general factor because the absolute value of loading becomes 0.3 and over for 16 variables excluding secondary industry rate out of the total 17 socio-economic variables. Based

Table 17 Principal component analysis of the socio-economic variables (1970 and 1975)

Variable number	Variable name	Principal component I	II	III
1	Distance from Tokyo	0.772	···	···
2	Number of residents	−0.607	···	0.556
3	Sex ratio	−0.789	···	···
4	Childhood population rate	−0.433	−0.584	−0.406
5	Aged population rate	0.879	0.374	···
6	Number of household members	0.885	···	···
7	Female labor force rate	0.875	···	···
8	Employees rate	−0.941	···	···
9	Owned houses rate	0.900	···	···
10	Number of tatami	0.601	0.465	···
11	Managers and officials rate	−0.808	0.409	···
12	Clerical and related workers rate	−0.932	···	···
13	Outflow workers rate	−0.832	···	−0.468
14	Primary industry rate	0.875	···	···
15	Secondary industry rate	···	−0.807	···
16	Finance and insurance rate	−0.515	0.612	···
17	Higher education rate	−0.869	0.366	···
	Eigenvalue	10.187	2.244	1.154
	Percentage of contribution	59.9	13.2	6.8

Note: ··· indicates loading under | 0.3 | .

on the positive loadings, this principal component represents the characteristics as follows: the high percentage of households living in owned houses, persons employed in primary industry, extended families, aged persons and female labor force; a lot of tatami per person; and the location distant from Tokyo. These are considered to indicate rural characteristics of the city as a whole. Conversely, the variable with high negative loading is expected to indicate the urban characteristic. In practice, the first principal component score exhibits the low value in the city with a lot of employees, clerical and related workers, population completed higher educational institution, outflow workers, managers and officials, females, residents, and persons employed in financial and insurance business.

Fig.14 shows distribution of the first principal component score in terms of socio-economic attribute. The cities with the positive score are all located away from the Tokyo Station at the distance of 30 km and over. As opposed to this, Tokyo and its outskirts are filled with the cities showing the negative score, in which it is observed clearly that the city with the lower score tends to locate nearer to Tokyo. In other words, the distribution of this principal component score exhibits the concentric pattern centering around Tokyo. The high-ranking ten cities of this score are all rural and small cities, enumerated in the order of Yokaichiba, Shimotsuma, Otawara, Asahi, Hitachiota, Togane, Kasama, Mitsukaido, Katsuura and Tomioka. On the other hand, the low-ranking ten cities are enumerated in the order of Koganei, Higashikurume, Musashino, Hoya, Narashino, Kunitachi, Kokubunji, Chofu, Mitaka and Tanashi. These are all dormitory cities in the neighborhood of Tokyo, and the nine cities excluding Narashino are located in the western sector of the metropolitan

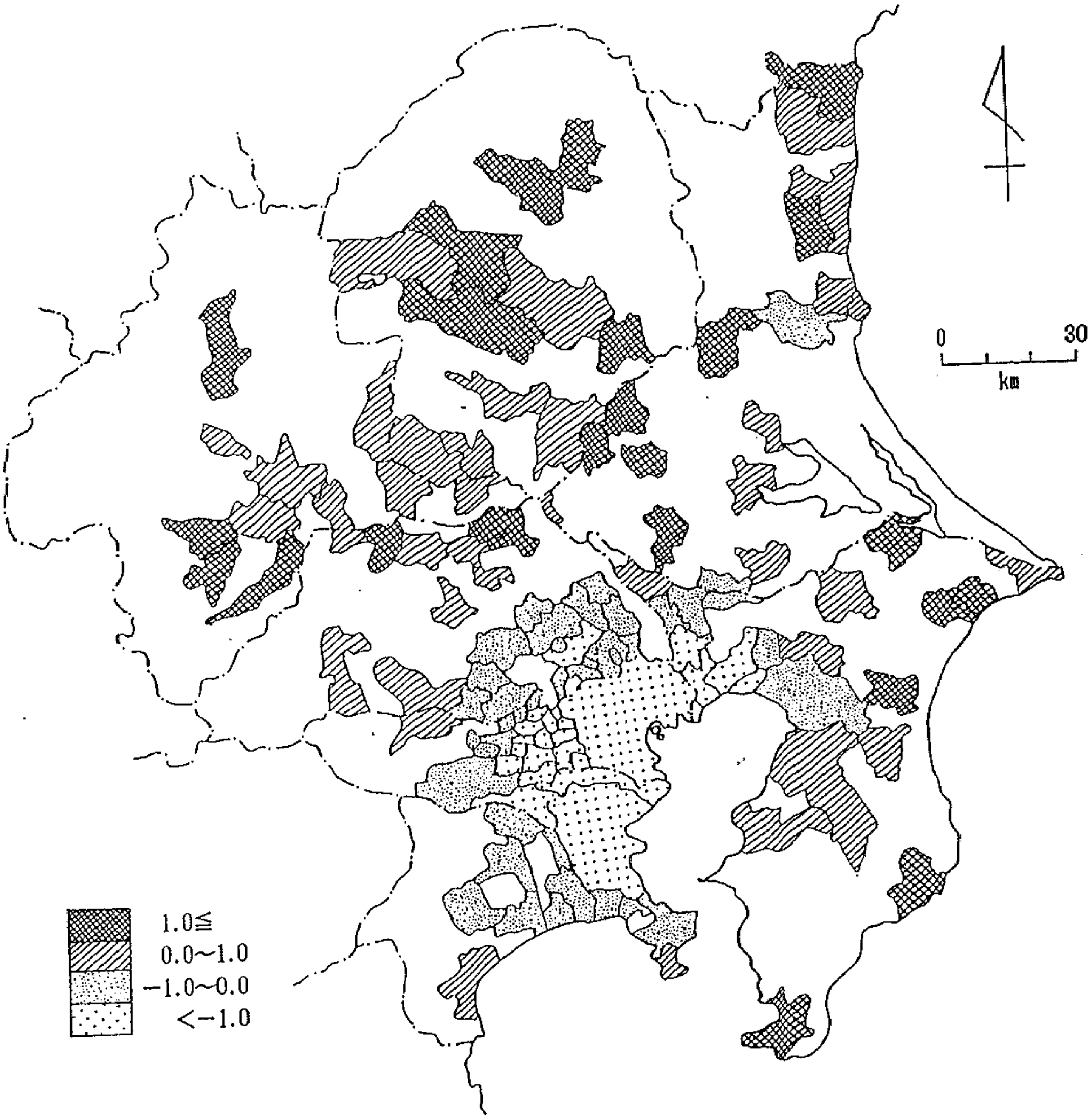


Fig. 14 Distribution of the first principal component scores, socio-economic attribute (1970 and 1975)

area. Therefore, fixed eyes upon the negative loadings and the low-ranking cities of the score, the first principal component can be interpreted as the composite variable of urbanity being typical of dormitory cities in the western sector of the Tokyo metropolitan area and it is named as residential urbanity in this study.

The second principal component (principal component II) exhibits the percentage of contribution of 13.2 % and the absolute value of loading 0.3 and over for seven socio-economic variables in Table 17. The absolute value takes the maximum for secondary industry rate and it is decreasing with the order of finance and insurance rate, childhood population rate, number of tatami, managers and officials rate, aged population rate and higher education rate. In these variables, the sign of loading is negative for secondary industry rate and childhood population rate and positive for the other five variables. Accordingly, the second principal component score exhibits the high value in the city with a small number of persons employed in secondary industry and childhood population and with a lot of persons employed in financial business and insurance business, managers and officials, aged population, population completed higher educational institution and tatami per person.

Fig.15 shows distribution of the second principal component score in terms of socio-economic attribute. The high-ranking ten cities of this score are enumerated in the order of Musashino, Kamakura, Zushi, Kunitachi, Kokubunji, Mito, Koganei, Hoya, Tateyama and Tokyo. The shortage of industrial element as compared with the other industries is common to these cities though they are diversified functionally in terms of dormitory, resort, education, capital and so on. On the other hand, the low-ranking ten cities are almost specialized in manufacturing industry, enumerated in

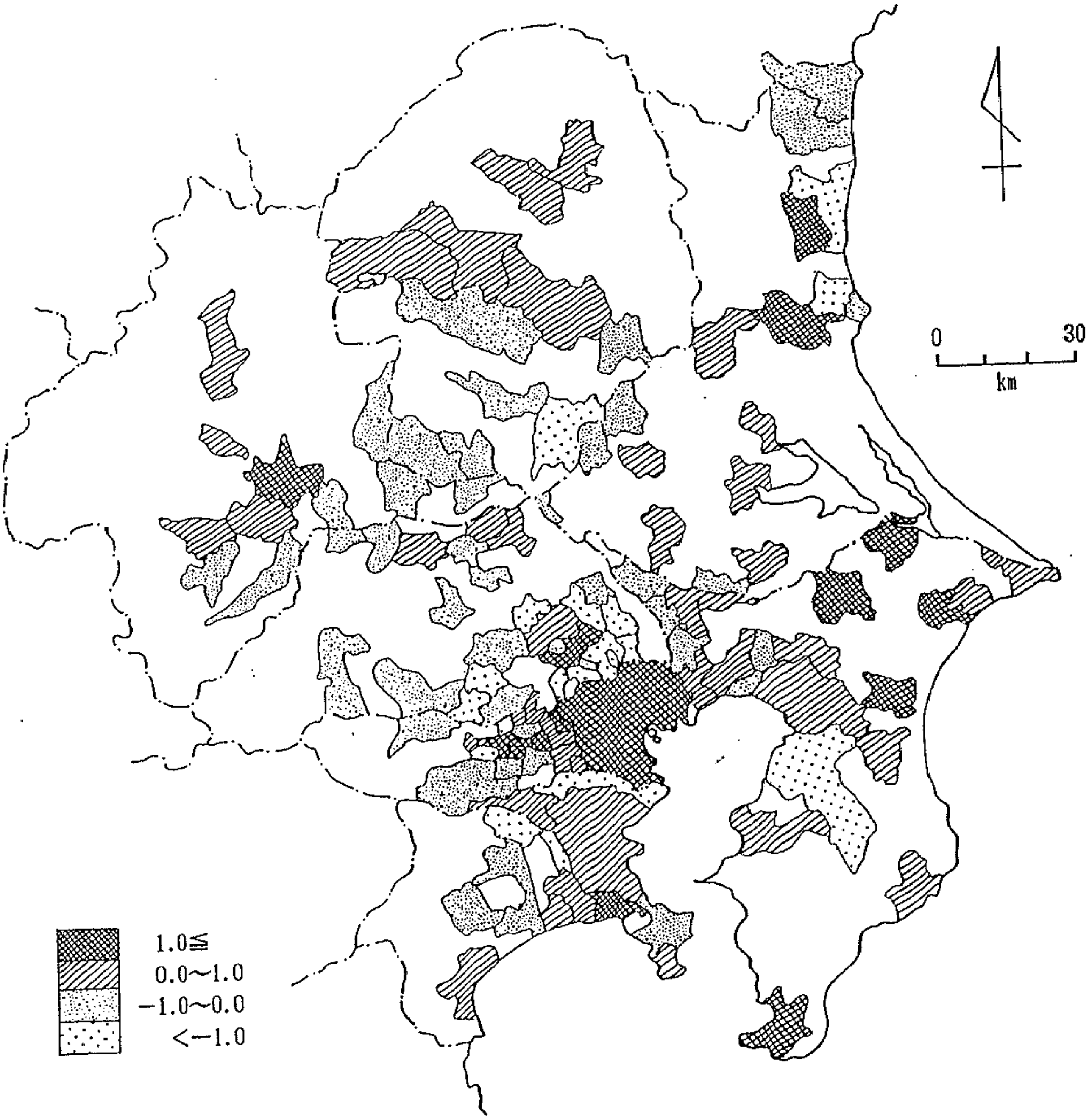


Fig.15 Distribution of the second principal component scores, socio-economic attribute (1970 and 1975)

the order of Toda, Hatogaya, Ageo, Katsuta, Ichihara, Soka, Kawaguchi, Iwatsuki, Asaka and Hitachi. Therefore, fixed eyes upon the negative loadings and the low-ranking cities of the score, it is reasonable that the second principal component of socio-economic attribute is interpreted as the composite variable representing manufacturing urbanity.

The third principal component (principal component III) exhibits the percentage of contribution 6.8 % and the absolute value of loading 0.3 and over for only three socio-economic variables as shown in Table 17. The absolute value is decreasing with the order of the positive loading to number of residents, the negative loading to outflow workers rate, and the negative loading to childhood population rate. Accordingly, the third principal component score exhibits the high value in the city with a large number of residents, self-support in employment, that is, being capable of supplying enough employment opportunities for the residents within the city, and with a small number of childhood population.

Fig.16 shows distribution of the third principal component score in terms of socio-economic attribute. The high-ranking ten cities of this score are enumerated in the order of Tokyo, Kawasaki, Kiryu, Yokohama, Utsunomiya, Ashikaga, Maebashi, Hitachi, Takasaki and Mito. These are the cities with the relatively large population size and the eight excluding Kawasaki and Yokohama conform to the self-supporting city mentioned above. On the other hand, the low-ranking ten cities are enumerated in the order of Nagareyama, Abiko, Sakura, Higashikurume, Zushi, Kasukabe, Yachiyo, Higashiyamato, Katsuura and Toride. The nine excluding Katsuura with especially small population size are all the relatively new dormitory cities in the inner zone of the Tokyo metropolitan area, in which each residents' economic base depends strongly on the employment opportunities

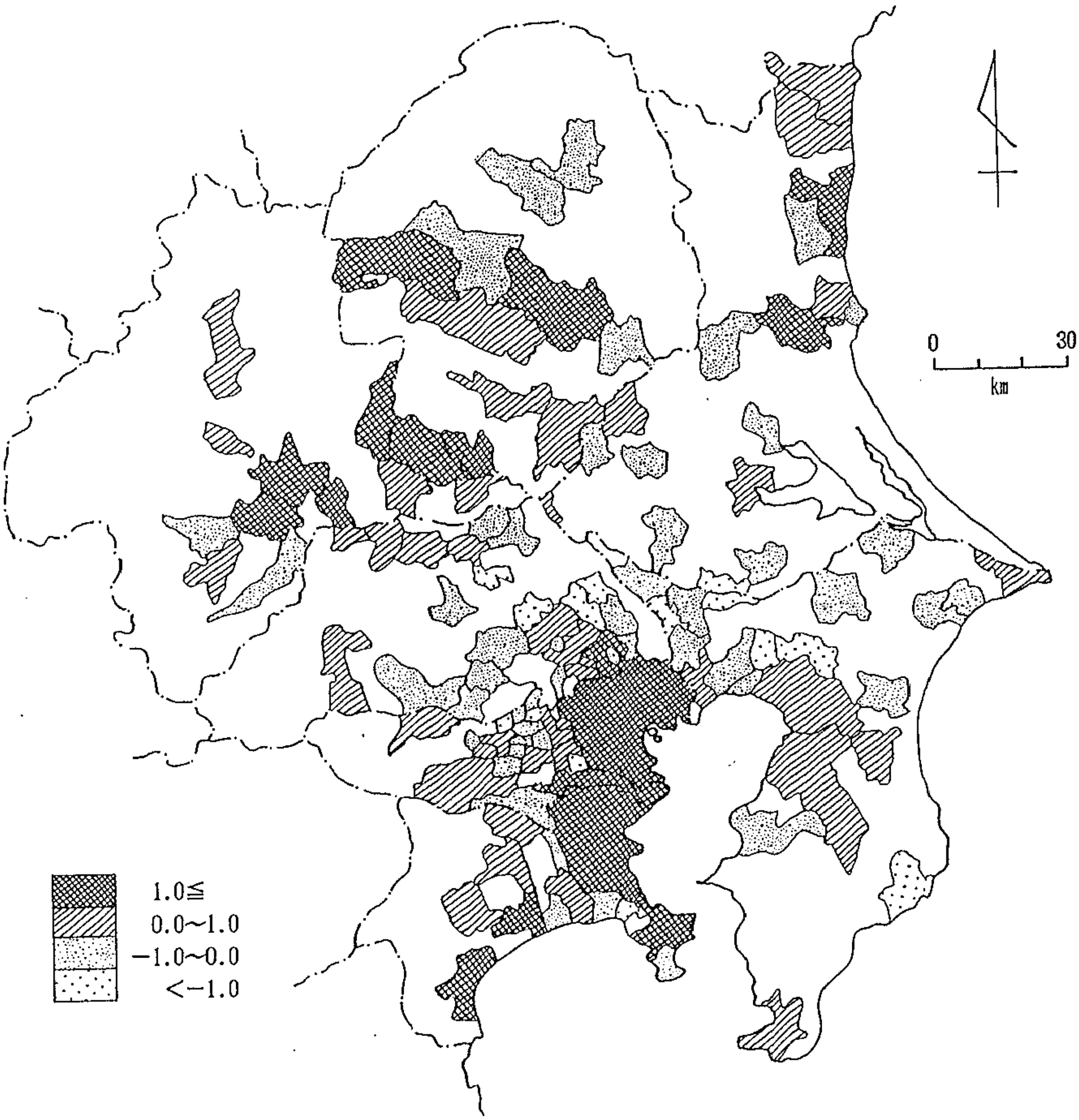


Fig. 16 Distribution of the third principal component scores, socio-economic attribute (1970 and 1975)

outside the city. Additionally, the eight cities excluding Katsuura and Zushi exhibit the high childhood population rate that is a characteristic of the so-called bedroom town with rapidly growing population. Based on the above considerations, it is possible to interpret that the third principal component of socio-economic attribute is the composite variable representing population size and self-support in employment of the city named as size and employment urbanity.

In the above three principal components, the first principal component of socio-economic attribute is considered to correlate negatively with the concentric principal component of migration, based on their loadings and score distributions. In other words, it is possible to build up a hypothesis that the concentric pattern of migration is explainable with the residential urbanity of socio-economic attribute in this section. On the other hand, the city-size principal component is expected to correlate positively with the third principal component of socio-economic attribute. Namely, it is considered that the city-size pattern of migration is interpretable with not only population size but also self-support in employment of the city. The following section is intended to clarify the spatial relationship between urban migration and socio-economic attribute of the city based on the correlation and regression relationships between the principal components of migration and socio-economic attribute mentioned above.

III-4 Explanation of migration by socio-economic attribute

The analyses in the preceding section have clarified the principal components summarizing spatial variations for each of migration and socio-economic attribute. In this place, canonical correlation analysis and multiple regression analysis are applied to the above two groups of principal components in order to clarify the correlation relationship between migration and socio-economic attribute and the regression relationship with the dependent variable of migration and the independent variable of socio-economic attribute.

Table 18 shows the results of canonical correlation analysis, in which the structure coefficients with the absolute value of 0.3 and over suggest the relationship between each principal component and two canonical variates with the canonical correlation coefficient being significant at the 0.05 level of confidence[19]. The significance of these canonical variates is confirmed by the most popular method of chi-square test with Wilks lambda (Murayama,1990b,pp.118-128). And, the redundancy coefficient in Table 18 is equivalent to the multiple determination coefficient of which dependent variable is the principal component of migration and independent variable is that of socio-economic attribute, indicating the explained variation rate of migration by socio-economic attribute. The characteristic of each canonical variate is described as follows.

Canonical variate I exhibits the extremely high canonical correlation coefficient of 0.948, so that 89.9 % of the variation of migration is explainable with that of socio-economic attribute in terms of this variate. And, the canonical variate displays the negative structure coefficient to the concentric principal component of migration and the positive one to the principal component I of socio-economic attribute. Therefore, it is considered that canonical variate I explains the close relationship between the concentric pattern of migration and the residential urbanity of socio-economic attribute. Also , the sign of structure coefficient is different

Table 18 Canonical correlation analysis between migration and socio-economic attribute

Principal component		Canonical variate I	Canonical variate II
Migration	Concentric	−0.973	…
	City-size	−0.540	−0.842
Socio-economic attribute	I	0.997	…
	II	…	…
	III	…	−0.992
Canonical correlation coefficient		0.948*	0.830*
Redundancy coefficient		0.820	

Note: … indicates structure coefficient under | 0.3 | . * indicates significant at the 0.05 level of confidence.

between the above two principal components, reflecting the negative correlation relationship between these components. Furthermore, it would be expected that the residential urbanity is useful as an explanatory variable of the city-size pattern of migration, because canonical variate I displays the negative structure coefficient also to the city-size principal component of migration.

Canonical variate II exhibits also the high canonical correlation coefficient of 0.830, so that 68.9 % of the variation of migration is explainable with that of socio-economic attribute in terms of this variate. And, the canonical variate displays the negative structure coefficient to each of city-size principal component of migration and principal component III of socio-economic attribute. Therefore, canonical variate II is a dimension explaining that the city-size pattern of migration is closely related to not only the population size but also the self-support in employment of the city. Additionally, principal component II of socio-economic attribute shows low structure coefficient under the absolute value of 0.3 to each canonical variate, so that it is considered that the manufacturing urbanity of socio-economic attribute is not useful as an explanatory variable of the distribution pattern of migration.

Based on the redundancy coefficient in Table 18, the explained variation rate of migration by socio-economic attribute reaches 82.0 % in the total of canonical variates I and II. It means that the migration is almost explainable with the socio-economic attribute in the relationship between the two groups of principal components. But, it is impossible to specify the explanatory relationship between the principal components individually on the above structure coefficients, and therefore, the following multiple regression models are constructed for each of the concentric and city-size patterns of migration[20].

Firstly, the multiple regression analysis has been conducted with the dependent variable of the concentric principal component of migration and the independent variables of the principal components I, II and III of socio-economic attribute. The result indicates that only the partial regression coefficient to the principal component II is not significant at the 0.05 level of confidence, that is, the principal component is not useful as the explanatory variable. Accordingly, the multiple regression analysis is re-conducted without the principal component II, so that a multiple regression equation is obtained as follows:

$$\underline{MGCON} = -0.932\ \underline{SEPC\ I} - 0.127\ \underline{SEPC\ III}, \tag{4}$$

where <u>MGCON</u> is the concentric principal component of migration, and <u>SEPC I</u> and <u>SEPC III</u> are the principal components I and III of socio-economic attribute respectively.

The multiple regression equation (4) shows the determination coefficient of 0.885, so that 88.5 % of the variation on the concentric pattern of migration is explainable with the principal components I and III of socio-economic attribute, that is, the residential urbanity and the size and employment urbanity. Especially, it is possible to say that the residential urbanity is a very important attribute on explaining the concentric pattern of migration because the partial regression coefficient shows the absolute value of nearly 1.0 to <u>SEPC I</u>. Additionally, the partial regression coefficient to <u>SEPC III</u> is also significant, and therefore, it can be said that the size and employment urbanity has a certain explanatory power to the concentric pattern, which has not been assessed enough by the preceding canonical correlation analysis.

Secondly, the similar multiple regression analysis has been conducted, in which the dependent variable is the city-size principal component of migration and the independent variables are the same as the above analysis, so that the following multiple regression equation is obtained:

$$\underline{MGSIZE} = -0.466\ \underline{SEPC\ I} + 0.728\ \underline{SEPC\ III}\ , \tag{5}$$

where <u>MGSIZE</u> is the city-size principal component of migration.

The multiple regression equation (5) shows the determination coefficient of 0.748, so that 74.8 % of the variation on the city-size pattern of migration is explainable with the principal components I and III of socio-economic attribute, that is, the residential urbanity and the size and employment urbanity. In this place, the size and employment urbanity plays a very important role in explaining the city-size pattern of migration because the partial regression coefficient shows the high positive value to <u>SEPC III</u>. Additionally, it is also possible to say that the residential urbanity is useful as an explanatory variable of the city-size pattern, though the partial regression coefficient exhibits the lower absolute value to <u>SEPC I</u> than that to <u>SEPC III</u>.

In the last part of the preceding section, two hypotheses have been proposed: one is that the concentric pattern of migration is explainable with the residential urbanity of socio-econimic attribute; and the other is that the city-size pattern of migration is explainable with the size and employment urbanity of socio-economic attribute. Based on the results of canonical correlation analysis and multiple regression analyses between the migration and the socio-economic attribute in this section, it is considered that the above proposed hypotheses have been exemplified in the correlation and regression relationships. Additionally, it is obvious that each of the multiple regression models in this study has a certain power of explanation to the two relationships: the residential urbanity explains the city-size pattern; and the size and employment urbanity does the concentric pattern. Therefore, there exists a strong explanatory relationship between the migration and the socio-economic attribute as a whole shown by the redundancy coefficient in Table 18. In other words, it is possible to say that the analysis of this section has drawn a verified result to the hypothesis that the distribution pattern of migration is function of that of socio-economic attribute.

III-5 Migration mobility and its generating cities in the Kanto region

As shown in the results of the preceding section, the percentages of explaining migration by socio-economic attribute have been 88.5 % for the concentric pattern, 74.8 % for the city-size pattern, and 82.0 % for the total of these two patterns. Accordingly, though no less than three fourths of variations on the migration are explainable with the socio-economic attribute, on the other hand, there exist the residual variations unexplained by the multiple regression models mentioned in the preceding section. The analyzed 125 cities in the Kanto region are classified into two groups based on the size of residual between the actual value and the theoretical one derived from each of the multiple regression models of eqns.(4) and (5) in the preceding section: one is the cities fitting the model; and the other is the unique cities of which migratory characteristics are unexplained by the socio-economic attribute. The following is a description of distribution pattern on the residual derived from each of the multiple regression models of eqns.(4) and (5), considering regional characteristic of the city in the Kanto region from a viewpoint of migration mobility.

Fig.17 shows distribution of the residual in terms of concentric pattern of migration. In this place, the residual is defined by subtracting the theoretical value derived from eqn.(4) from the actual one of concentric principal component score of migration. Therefore, the large positive residual means the underestimate of actuality by the multiple regression model of eqn.(4), and conversely, the large negative one corresponds with the overestimate of actuality by the same model.

In Fig.17, the number of cities showing the residual −0.5 to 0.5 are counted up to 110 which form 88.0 % of the total. This percentage is almost equal to the explained variation rate of eqn.(4). Accordingly, it is possible to say that the model of eqn.(4) is proper well to the 110 cities, that is, their migratory characteristics of the concentric pattern of migration are explained well by the residential urbanity and the population size and self-support in employment of socio-economic attribute. As mentioned previously, the concentric pattern of migration in this place exhibits the distributional characteristic that the concentric principal component score becomes high on cities in the outskirts of Tokyo and low on those in the outer zone of the Tokyo metropolitan area. Additionally, on the original variable level, the city with high concentric principal component score exhibits the migratory characteristics of high mobility on the in- and out-migrations, high short-distance migrants rate, and inactivity on the out-migration of youth labor force. These distributional and migratory characteristics have been related quantitatively to the first

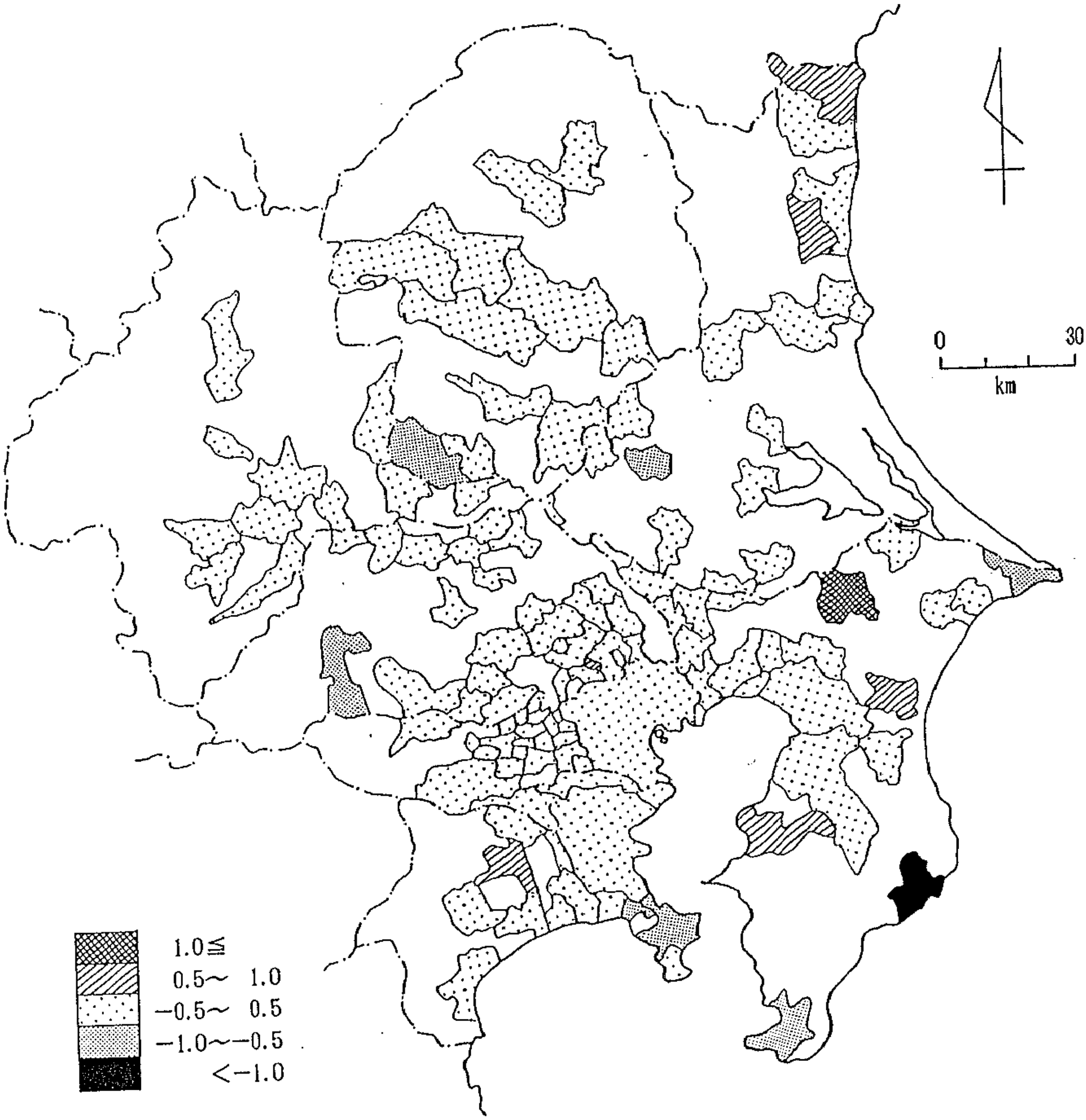


Fig.17 Distribution of the residual, concentric pattern of migration

and third principal components of socio-economic attribute on the multiple regression model of eqn.(4).The following description is of regional characteristic of the 110 cities fitting the model, based on the above relationships.

In the dormitory city located in the outskirts of Tokyo, the in- and out-migrations are generated actively, of which origins and destinations are mainly cities, towns and villages in the neighborhood. Accordingly, even after the migration, the great number of migrants maintain a functional relationship of depending on the central part of the metropolitan area such as Tokyo and Yokohama for their employment bases. As opposed to this, in the city located in the outer zone of the Tokyo metropolitan area, the residents tend apparently to be employed within the city. But, the city can not meet the demand for work or study by the new generating youth labor force, so that the out-migration of this age group is conspicuous in the outer zone. Based on the explanatory scheme by Roseman (1971), the former traveled relatively short distance is nothing but the partial displacement migration which displaces only a part of the daily reciprocal movements centered on the residence such as commuting and shopping. And, the latter traveled longer distance is the total displacement migration which displaces all the reciprocal movements, in which the migrant renews all of his life-space inevitably. In the Kanto region, the explanation on this dichotomy is applicable to the majority of cities, in which the city characterized by the partial displacement migration is located in the inner zone of the Tokyo metropolitan area and the city of the total displacement migration is distributed in the outer zone.

On the other hand, there are several cities failed in the explanation, which are unique and showing the large absolute value of residual on the model of eqn.(4). Firstly, in terms of positive residual, seven cities are enumerated in the order of Narita, Hitachiota, Atsugi, Kisarazu, Togane, Kitaibaraki and Warabi. In particular, Narita shows the largest residual value of 1.017 which is much more than the secondary value 0.696 of Hitachiota. The following description is of causes generating the residual, based on the relationship between the migratory variable and the principal component of socio-economic attribute.

Narita is in the same low level of the residential urbanity on socio-economic attribute as that of Gyoda, Chichibu etc. At the same time, Narita shows high value of the mobility on in- and out-migrations as well as the city located in the nearer neighborhood of Tokyo such as Matsudo and Funabashi. In addition to this, Atsugi, Togane and Warabi are also the cities generating more active in- and out-migrations than the estimate from the level of residential urbanity. Hitachiota shows the extremely low level of residential urbanity at the rank of 121 in the total 125 cities, on the other hand, its migrants rate traveled short distance on in- and out-migrations is in the relatively high level over the average. Also in Kisarazu and Kitaibaraki, there exists the similar relationship as the cause of residual. Hitachiota and Kitaibaraki generate much in- and out-migrations to Mito or Hitachi located in their neighborhood, though they are not characterized as the dormitory city of Tokyo because of their distant location from Tokyo. On the other hand, Kisarazu shows high value of the short-distance migration because of its location in the inner zone of the Tokyo metropolitan area, but the city is in the low level of residential urbanity as compared with the migration.

Secondly, in terms of negative residual, eight cities show the large absolute value, enumerated in the order of Katsuura, Choshi, Shimotsuma, Zushi, Yokosuka, Tateyama, Chichibu and Ashikaga. In these cities, only Katsuura shows the residual under −1.0. Katsuura is characterized by the highest value on the out-migration of youth labor force and the lowest one on the short-distance migration. And, on the in- and out-migration, Katsuura shows the lower level at the rank of 20 from the bottom. In terms of these three migratory variables, Katsuura contrasts with the dormitory city in the neighborhood of Tokyo, in which the multiple regression model has failed to assess the singularity. The similar migratory characteristics are observed in each of the other five cities of Choshi, Shimotsuma, Tateyama, Chichibu and Ashikaga. Zushi and Yokosuka are located within a radius of 50 km from the Tokyo Station and accessible to the secondary large city, Yokohama, and they show the high level of residential urbanity on socio-economic attribute. But, in terms of migratory characteristic, these two cities are quite different from the dormitory city in the neighborhood of Tokyo, so that it is considered that the large negative residual is derived from the difference.

Fig.18 shows distribution of the residual in terms of city-size pattern of migration. Also in this place, as the same way of concentric pattern, the residual is defined by subtracting the theoretical value derived from eqn.(5) from the actual one of city-size principal component score of migration. The number of cities showing the residual −0.5 to 0.5 are counted up to 87 which form 69.6 % of the total. Though this percentage is slightly lower than the explained variation rate of eqn.(5), the model is well applicable at least to the 87 cities. In other words, it can be said for the 87 cities that the migratory characteristics of the city-size pattern are explained well by the size and employment urbanity

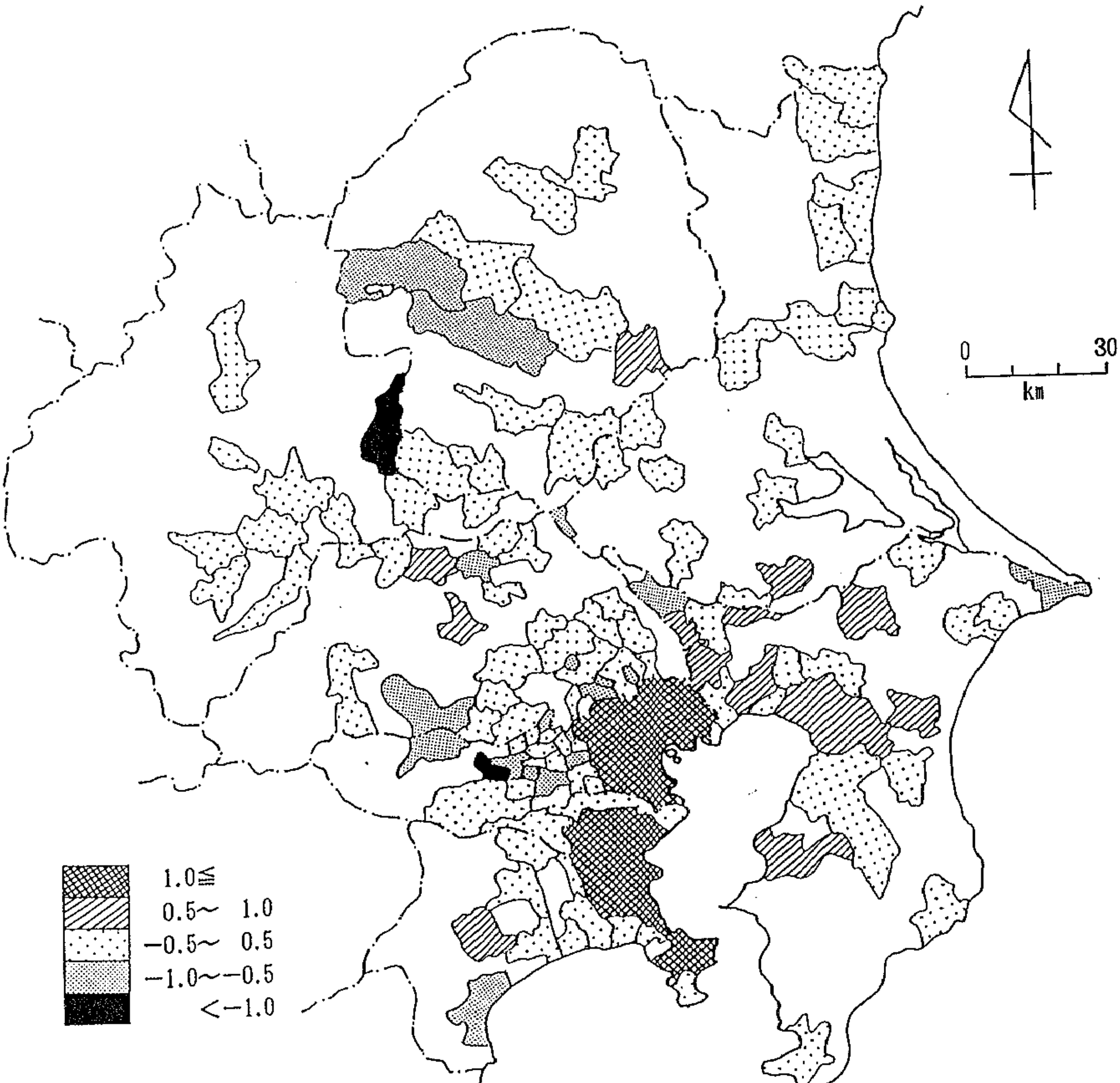


Fig.18 Distribution of the residual, city-size pattern of migration

and the residential urbanity of socio-economic attribute. As mentioned previously, the city with high city-size principal component score exhibits migratory characteristics of high mobility on the intra-urban migration and in-migration of youth labor force and high long-distance migrants rate. These distributional and migratory characteristics have been related to the two principal components of socio-economic attribute on the multiple regression model of eqn.(5). The following description is of regional characteristic of the 87 cities fitting the model, based on the above relationships.

The city with high level of the size and employment urbanity and the residential urbanity shows high mobility on the intra-urban migration and the in-migration of youth labor force, and high migrants rate on the long-distance migration. The former condition of socio-economic attribute means that the city is large in population size, in plenty of employment opportunities within the city, and high in the social status as the residence with a lot of white collars, managers and officials, and persons completed higher educational institution. These are combined in linear form on the right side of eqn.(5), indicating the total urbanity of socio-economic attribute as a whole. It is possible to say that the urbanity well explains migratory characteristics of the 87 cities showing small residual in terms of city-size pattern.

But, the other 38 cities are not explainable enough with the multiple regression model. Especially, the residual shows the absolute value 1.0 and over for the six cities of Tokyo, Yokohama, Yokosuka, Akishima, Kiryu and Fussa. In these cities, Tokyo shows the largest positive residual. Tokyo is in the extremely high level of the urbanity of socio-economic attribute mentioned above, which is caused mainly by the high level of the size and employment urbanity. On the residential urbanity, Tokyo is not equal to the dormitory cities in its outskirts such as Koganei, Higashikurume and Musashino. On the other hand, in terms of migratory characteristic, Tokyo shows the highest value on each of intra-urban migration, in-migration of youth labor force and long-distance migration in the total 125 cities. Accordingly, it is considered that the positive residual in Tokyo is caused by activeness of the above three migrations over the estimation from the urbanity of socio-economic attribute. Yokohama and Yokosuka with the largest positive residual after Tokyo show the similar tendency, that is, the underestimate of the migratory characteristic by the urbanity of socio-economic attribute. Additionally, cities with the positive residual 0.5 to 1.0 are divided into two groups: one is the cities such as Chiba, Funabashi and Kumagaya showing the similar migratory characteristic to the above three cities; and the other is the cities with the positive residual caused by low level of the urbanity such as Togane, Mooka and Nagareyama.

On the other hand, the city with the large negative residual shows low value of the migratory variable as compared with the urbanity of socio-economic attribute. Akishima with the largest negative residual is over the average value of all 125 cities on each of the size and employment urbanity and the residential urbanity on the socio-economic attribute. But, at the same time, Akishima is under the average value on each of intra-urban migration, in-migration of youth labor force, and long-distance migration. Fussa also shows low value on each of the above three migratory variables as compared with its high level of residential urbanity. Kiryu is in the high level of self-support in employment, of which outflow workers rate is 9.7 %, so that the residents' demand for employment is met within the city up to 90.3 %. But, the employment opportunities in Kiryu have no power of pulling much youth labor force even from the distant area. The cities with the residual −1.0 to −0.5 are divided into two groups: one is the cities showing the high level of residential urbanity as well as Fussa in the outskirts of Tokyo such as Hoya, Kunitachi, Mitaka and Fuchu; and the other is the cities showing the high level of self-support in employment as well as Kiryu in the outer zone of the Tokyo metropolitan area such as Nikko, Gyoda, Koga, Choshi, Ome and Kanuma.

Through the above investigation of residuals, it has been possible to discriminate between the two kinds of cities, that is, the city of which mobility of migration is explained well by its socio-economic attribute and the city with individuality indicated by its large residual, and to clarify the distributional and migratory characteristics for each of the cities. Tokyo, the central city of its metropolitan area, is characterized by intra-urban migration, long-distance migration and in-migration of youth labor force. The similar migratory characteristics are observed in cities with the relatively large population size such as Yokohama, Yokosuka, Chiba, Funabashi and Kumagaya. The city in the outskirts of Tokyo is in the high level of residential urbanity of socio-economic attribute, which explains active in- and out-migrations with the other cities, towns and villages, especially showing the migratory characteristic of much short-distance migration. Additionally, there are a lot of small and rural cities distributed in the outside of the outskirts, which show the low level of residential urbanity and the notable out-migration of youth labor force. But, the same outer zone includes several cities of which migratory characteristic is not explained enough by the multiple regression model. In these cities, Kiryu, Choshi, Nikko and Kanuma show the high level of self-support in employment.

In general, the results of canonical correlation analysis and multiple regression analyses in this study have exemplified the extremely goodness of coincidence between the two spatial variations of migration mobility and socio-economic attribute. In other words, though the similar urbanity of socio-economic attribute has been extracted in previous studies, the results of this study suggest that the urbanity can be reconstructed with the characteristics of migration mobility. It is possible to regard the migratory variables in this study as a kind of socio-economic attribute explaining the regional characteristic of city. The usefulness of those variables has not been exemplified enough in previous studies. As opposed to this, the fruits of this study implies importance of the urbanity composed here as an indicator of being urban. Additionally, the mobility has been regarded conceptually as one of the three important elements on defining urbanism (Wirth,1938; Yamada,1980,pp.8-12). It would be considered that this study exemplifies validity of the above assertion from the geographical viewpoint. Also, it is possible to say that the migration mobility is an important element composing urban dimension. For the most part of cities in the Kanto region, the urbanity is measurable with the migration mobility.

It is considered that cities in Japan have met a great turning point of their socio-economic characteristics in the middle of the 1970's. Namely, after the time symbolized by rapid growing cities, it has turned largely to the next era in which slowly growing cities play the central part, accompanied with the economic deceleration (Sanuki,1983). Accordingly, in terms of the analytical viewpoint to migrations of city, the mobility analysis based on the gross migration concept including intra-urban migration like this study increases its importance, as compared with the analysis of net migration subtracting out-migration from in-migration so as to measure the urban growth directly. Additionally, the manufacturing function as a factor of population increase has turned to the relative reduction in the Tokyo metropolitan area, accompanied with change of the industrial and occupational structure (Tomita and Kouno,1990). In this study, the above condition is considered to be a background of slight contribution of the manufacturing urbanity shown by principal component II of socio-economic attribute to the canonical variate. It is also possible to say that the migration mobility, which is an attribute not of stock but of flow on human inhabitation, has exhibited the individual distribution pattern in sensitive response to the above changes of socio-economic condition.

CHAPTER IV
CONCLUSION

In previous studies on the geographical branch of migration, generally to say, it has made a distinction between the short-distance movement like intra-urban migration and the other movement traveled longer distance. However, of late years, it has been recognized that it is an important theme to explain the different scale of migrations with unification. Urban migration is the comprehensive terminology including not only interregional scale of migrations, that is, in-migration into the city and out-migration out of the city but also intra-urban migration. Especially in the highly urbanized society of Japan, it is valuable as a geographical theme to clarify the regional characteristic of the urbanized area through analyzing those three elements of urban migration collectively.

The purpose of this study is to extract the distribution pattern of urban migration based on the difference of migration phenomena between the 125 cities in the Kanto region including the Tokyo metropolitan area and to consider the pattern based on the temporal stability and the spatial covariation between the migratory attribute and the socio-economic attribute of the cities.

As the analytical procedure for the above purpose, firstly, the partitioned principal component analysis is applied to the geographical matrix of urban migration in 1980 which belongs to the period of low economic growth in Japan, in order to eliminate the garrulous correlation contained within spatial variations of the migratory variables. Then, by means of cluster analysis of the principal component scores, the cities are classified into the fewer types based on the similarity of migratory characteristics, considering distribution pattern of cities for each type. The above procedure is conducted to the urban migration in 1970 which belongs to the period of high economic growth in Japan, and the result is used for comparing with that in 1980 and discriminating between the temporally stable pattern and the variable one on the distribution of urban migration.

Secondly, the fewer migratory attributes are newly selected on the above consideration. On the other hand, the selection of socio-economic attributes is conducted on previous studies of urban dimension and quantitative regional structure. Also in this place, the similar principal component analysis is applied to each geographical matrix of those two kinds of attributes. Then, canonical correlation analysis and multiple regression analysis are applied to the principal component scores in order to specify the correlation relationship between migration and socio-economic attribute and the regression functional relationship in which the dependent variable is principal component of migration and the independent variable is that of socio-economic attribute. Moreover, a geographical explanation of cities in the Kanto region from a viewpoint of migration is obtained by considering spatial distributions of the principal component score and the residual from regression.

This study is intended to clarify the distribution pattern of urban migration and its stability in the first half and the results are summarized as follows.

1. The cities with low mobility are distributed in the outer zone of the Tokyo metropolitan area. In the outskirts of Tokyo, cities show high mobility of the in- and out-migrations. And, in terms of intra-urban migration, high mobility characterizes the cities with large population or

high centrality.

2. It can be observed that Tokyo and its neighborhood cities tend to be male-dominant in the in-migration. However, it is not sure whether the distribution has a zonal structure or not, and the sex selectivity is of less significance especially in the intra-urban migration.

3. On considering the migration by age group, the youth labor force aged 15 to 19 is the most important age group in explaining the distribution pattern of age structure. The out-migration of this age group shows high mobility on cities in the outer zone of the Tokyo metropolitan area and low mobility on cities in the outskirts of Tokyo. Additionally, the cities with high centrality are characterized by the active in-migration of youth labor force aged 15 to 19.

4. In terms of migration field on city's in- and out-migrations, the configuration is explainable with distance between the city and Tokyo. Therefore, it is very apparent that the distribution of migration field exhibits a concentric pattern centering around Tokyo.

5. In quantitative comparison between the four distributions of urban migration mentioned above, the intensity of concentric pattern becomes lower in the order of migration field, mobility, age structure and sex ratio. Also, in terms of population size, it can be confirmed that there is the high level of coincidence between the two distributions, that is, mobility and city size in population.

6. By means of temporal comparison between 1970 and 1980, it becomes clear that the distribution patterns of mobility and migration field are far stable than those of sex ratio and age structure. During the 1970's, while the concentric pattern centering around Tokyo tends to be weakened, the positive correlation between the mobility of intra-urban migration and

the city size in population is relatively intensified.

Two fundamental distribution patterns of urban migration are clarified through the above analyses. One is the concentric pattern centering around Tokyo, and the other is the distribution pattern restricted by city size, that is, the city-size pattern. The investigation of spatial relationship between the migratory attribute representing these two distribution patterns and the socio-economic attribute selected from previous studies is conducted in the second half of this study, and the analytical outputs are summarized as follows.

7. Distance from Tokyo and number of residents are significant explanatory variables to each of six migratory variables representing the concentric pattern and city-size pattern. But, there is much of spatial variation as the residual unexplained by these two variables. Therefore, it needs some addition of explanatory variable in terms of socio-economic attribute.

8. The newly added 15 variables are of sex, age, household, labor force, occupation, housing, commuting and school career on the city's population. These socio-economic variables are significant as the explanatory variable of urban migration. At the same time, it is clarified that there are garrulous spatial variations to be eliminated within the socio-economic variables as well as the migratory variables.

9. By means of partitioned principal component analysis by three variables, the spatial variations of six migratory variables are summarized into the two composite variables of concentric and city-size principal components which are representative of the concentric and city-size patterns respectively. The concentric principal component shows the high score in cities with high values of mobility on the in- and out-migrations

and migrants rate traveled short distance and the low score in cities with active out-migration of youth labor force. The spatial distribution of this component tends to show the high score in cities within a radius of 60 km from the Tokyo Station, especially in dormitory cities in the outskirts of Tokyo. On the other hand, the city-size principal component shows the high score in cities with high values of mobility on the intra-urban migration, migrants rate traveled long distance, and active in-migration of youth labor force. The spatial distribution of this component exhibits the positive high correlation with population size of city.

10. Applied principal component analysis to the total 17 variables, the spatial variations of socio-economic attribute are summarized into the three composite variables named as residential urbanity, manufacturing urbanity, and size and employment urbanity. The residential urbanity shows the high value in cities with a lot of employees, clerical and related workers, nuclear families, persons completed higher educational institution, outflow workers, managers and officials, females, residents, and persons employed in financial and insurance business, which are typified by dormitory cities in the neighborhood of Tokyo. The manufacturing urbanity shows the high value in cities with a large number of persons employed in secondary industry and childhood population, which are represented by industrial cities in the inland part of Kanto region. And, the size and employment urbanity shows the high value in cities with a lot of residents and those employed within the city, such as Tokyo, Kawasaki, Kiryu, Yokohama and Utsunomiya.

11. Based on the results of canonical correlation analysis and multiple regression analyses between migration and socio-economic attribute, the following two hypotheses are exemplified in the correlation

and regression relationships. One is that the concentric pattern of migration is explainable with the residential urbanity of socio-economic attribute. And, the other is that the city-size pattern of migration is explainable with the size and employment urbanity of socio-economic attribute. Additionally, it is obvious that the multiple regression models in this study have a certain power of explanation to the two relationships: the residential urbanity explains the city-size pattern; and the size and employment urbanity does the concentric pattern. Therefore, there exists a strong explanatory relationship between the migration and the socio-economic attribute as a whole. In other words, it is considered that the analysis in this place has drawn a verified result to the hypothesis that the distribution pattern of migration is a function of that of socio-economic attribute.

12. The cities in the Kanto region are classified into two groups: one is the cities fitting the hypothesis of this study; and the other is the unique cities of which migratory characteristics are unexplained by the socio-economic attribute. The city with large population size such as Tokyo, Yokohama, Yokosuka and Chiba is characterized by activeness of intra-urban migration, long-distance migration and in-migration of youth labor force. The city in the outskirts of Tokyo is in the high level of residential urbanity of socio-economic attribute, which explains active in- and out-migrations with the other cities, towns and villages, especially showing the migratory characteristic of much short-distance migration. And, there are a lot of small and rural cities distributed in the outside from the outskirts, which show the notable out-migration of youth labor force.

Generally to say, this study exhibits that the intra-urban migration plays an important part on understanding the characteristic of city in terms of migration. The intra-urban migration in this place is residential movement within the city as an administrative unit. In addition to this, no small number of in- and out-migrations in this study are considered to be the same context as the above intra-urban migration substantially, of which origins and destinations are both located within the Tokyo metropolitan area. In other words, the migration within the Tokyo metropolitan area is interpreted as an intra-urban migration in a huge urban area. From such viewpoint, it is considered that the intra-urban migration occupies the more important position of all migrations, so that it would play the more important part on understanding the urbanity.

Migration is a response to new socio-economic circumstances, but equally important it is a major catalyst to change for those areas gaining and losing migrants (Bell,1980,p.84; Lewis,1982,p.1). Accordingly, time lag is included conceptually in interrelation between migration and socio-economic attribute. Socio-economic attribute of city at time <u>t−1</u> is a cause of urban migration generated at time <u>t</u>, and then the migration influences condition of socio-economic attribute at time <u>t+1</u>. The spatial variation of this study is a slice of the above spatial process of migration. And, it is considered that the relationship between urban migration and socio-economic attribute of the city clarified in this study becomes a guide to telling the fortune of cities in the Kanto region.

Notes

1) Tokyo's sphere of immediate influence on migration extends all over the eastern part of Japan excluding Hokkaido, and it is possible to magnify the sphere to all over Japan based on a viewpoint of hierarchical urban system (Morikawa, 1985; Saino, 1987). Also, investigated the origin and destination of in- and out-migrations in the Tohoku district, though the city of Yamagata prefecture shows the maximum number of migrants with Sendai or the other city in the same prefecture, in Fukushima prefecture half and over cities are connected firstly with Tokyo on the migrations (Ohzeki, 1987 • 1989).

2) Bureau of Statistics , Office of the Prime Minister : 1980 Population Census of Japan, volume 6, results of tabulation on internal migration. Bureau of Statistics, Office of the Prime Minister: 1970 Population Census of Japan, volume 7, internal migration.

3) In the 1990 Population Census, the investigation of previous residence for one year is abolished and it is only possible to utilize the results based on the usual place of five years previous residence. This data source is different from that of this study not only in the temporal scale observing migration but also in the counting method of migration: the former is derived from counting five years previous residence; on the other hand, the latter is based on the usual place of residence immediately before the present residence. As Otomo (1994) has pointed out, the statistics for five years is inferior to that for one year in conformity with the Basic Resident Resisters. Considering the above conformity and errors in time series comparison, the 1990 statistics is not employed as the data source of this study.

4) The human mobility in a broader sense refers not only to change of the spatial location but also to change of the socio-economic status and occupational position. In this context, migration is considered to be a representative of the permanent part of spatial mobility or residential mobility (Roseman,1971,pp.91-93; Schwind,1971,pp.4-23).

5) In quantitative technique, there are two reasons for not employing the ordinary procedure of summarizing the total 61 variables at one time. One is that the number of variables is quite different between the variable groups ① to ④. And, the other is that each group includes the variable pair with high correlation relationship.

6) Though there is much argument about data transformation on multivariate analysis in geography (Yano,1984・1985), the usual method with correlation matrix and standardization is employed in this study for the following two reasons. One is that the multivariate analysis of this study needs the relative relation between the variables rather than the variable value itself. And, the other is that the extraction of composite variable is conducted for summarization of original variable variations rather than interpretation of outputted new variable.

7) Of cities with the noticeably high sex ratio, there exist some cases in which the city has its inherent factor of migration. For instance, it is considered that the migratory characteristic is largely influenced by the Self-Defense Force establishments in Asaka and Yokosuka, the Fuchu Prison, and the University of Gunma in Ashikaga. But, it is impossible to discriminate the migration of these specific factor with the data source of this study.

8) In the Population Census, the migrants number aged 0 to 34 is tabulated

by five years age group and that aged 35 and over is done by ten years age group. The scale of horizontal axis in Figs.5 and 6 is in proportion to the age interval of these groups.

9) In the case of Kiyose, there exist establishments drawing aged persons intensively in the southern area, for example, hospital, medical research institute and sanatorium, which are considered to explain the unique characteristic of migration.

10) The increase of coefficient reflects the following two conditions : one is that number of cities in the distance zone are decreasing with increase of distance from Tokyo; and the other is that migrations to and from Tokyo are the most important determinant on the morphological classification of migration field. For instance, only two cities of Kitaibaraki and Takahagi are located in the zone of 140 to 160 km from the Tokyo Station, which show high percentage of long-distance migration traveled 140 to 160 km including migrations to and from Tokyo. But, the migrants rate at that traveled distance is extremely low in the other 123 cities. Additionally, the high coefficient of variation at 180 to 200 km on in-migration is caused by 159 migrants from Fujisawa to Kitaibaraki for one year until September, 1980. It is exceptional only for the year that this volume of long-distance migration traveled 197 km is greater than that of in-migration from Tokyo to Kitaibaraki.

11) Conversely, the city with a small volume of migration exhibits the high percentage of inter<u>shi-cho-son</u>(cities-towns-villages) migration under 50 migrants to the total, so that the long-distance migration tends to be particularly underestimated as compared with that in the city with a lot of migrants.

12) The chi-square statistic is to be an immediate measure of concentricity on the distribution pattern. But, the distance division in this place is employed for nothing but facilitation. So, in addition to this, the correlation coefficient between the principal component score and the distance from Tokyo is calculated to take the more detailed and objective measure though it is the indirect method.

13) The centrality especially in dormitory city located in the outskirts of large city is in the low level as compared with its population size. The urbanity is defined by three fundamental attributes: dense and huge aggregation of residence; land use dominated by economic activities of non-agricultural sector; and residents' heterogeneity maintained by their mobility (Yamada,1980,pp.8-12). The population size in this study is an indicator of the first aggregation. The third heterogeneity is maintained by the two kinds of movements: human interchange between the city and the outside area; and the active migration behavior of residents within the city. Therefore, the explanation of urban migration by city size in this study is to clarify the spatial correspondence between the above mentioned aggregation and heterogeneity.

14) Strictly, the migration data of 1980 registers migrations from October, 1979 to September, 1980, so that the residents number in September, 1980 includes the result of these migrations. Accordingly, it needs to be paid attention to the influence of tautology on considering relation between migration and city size at the micro level of spatial scale like one city.

15) The migration with traveled distance under 20 km tends to be counted as intra-urban migration in the city with large area like Tokyo.

16) The data of residents number in this place is from the preceding census of 1975 in order to conduct the estimation strictly.

17) Six variables from 11 to 16 are based on 20 % sample tabulation. And, the other variables are of 100 % inspection. Also, only higher education rate (17) is of the item of large-scale survey in the Population Census, of which 1970 is the latest census year prior to the migration in this place. All the other variables are derived from the 1975 Census.

18) Though it is also considered to employ the ordinary principal component analysis applied to the total six migratory variables at one time, as Ishimizu (1979) pointed out, this method is not appropriate for the input variables being divided clearly into a few groups like this study, for reason that the canonical variate becomes difficult for interpretation in the succeeding analysis. Therefore, in this place, principal component analysis is applied to each variable group one by one.

19) Because some correlation relationship exists between the concentric and city-size principal components, the canonical variate is interpreted with the structure coefficient corresponding to correlation coefficient between the canonical variate and the principal component.

20) It is also possible to express the explanatory relationship between the migration and the socio-economic attribute by means of canonical score. But, this method is to measure the high level of abstractive relation, that is, the canonical score of migration is regressed by that of socio-economic attribute. Thus, the interpretation of the derived result is considered to be so difficult as not to utilize the canonical score in this study.

BIBLIOGRAPHY

Bell,M.(1980): Past mobility and spatial preferences for migration in East Africa. White,P. and Woods,R.eds.: The geographical impact of migration. Longman, London/New York, 84-107.

Berry,B.J.L.(1966): Essays on commodity flows and the spatial structure of the Indian economy (Department of Geography, Research Paper, No.133). University of Chicago, Chicago, 173p.

Berry,B.J.L.(1969): Relationships between regional economic development and the urban system: the case of Chile. Tijdschrift voor Economishe en Sociale Geografie, 60, 283-307.

Bracken,I.J.(1976): Estimation and cluster analysis of net migration age profiles for urban areas in England and Wales. Regional Studies, 10, 53-69.

Brown,L.A. and Longbrake,D.B.(1970): Migration flows in intraurban space: place utility consideration. Annals, Association of American Geographers, 60, 368-384.

Cadwallader,M.T.(1981): A unified model of urban housing patterns, social patterns, and residential mobility. Urban Geography, 2, 115-130.

Cadwallader,M.T.(1982): Urban residential mobility: a simultaneous equations approach. Transaction, Institute of British Geographers, N. S. 7, 458-473.

Cadwallader,M.T.(1986): Migration and intra-urban mobility. Pacione,M.ed.: Population geography: progress and prospect. Croom Helm, London, 257-283.

Cadwallader,M.T.(1989a): A conceptual framework for analyzing migration behavior in the developed world. Progress in Human Geography, 13, 494-511.

Cadwallader,M.T.(1989b): A synthesis of macro and micro approaches to explaining migration: evidence from inter-state migration in the United

States. Geografiska Annaler, 71B, 85-94.

Cadwallader,M.T.(1992): Migration and residential mobility. The University of Wisconsin Press, Madison, 275p.

Clark,W.A.V. and Cadwallader,M.T.(1973): Locational stress and residential mobility. Environment and Behaviour, 5, 29-41.

Courgeau,D.(1989): Recent conceptual advances in the study of migration in France. Ogden,P.E. and White,P.E.eds.: Migrants in modern France: population mobility in the Later 19th and 20th centuries. Unwin Hyman, London, 60-73.

Flowerdew,R. and Salt,J.(1979): Migration between labour market areas in Great Britain, 1970-1971. Regional Studies, 13, 211-231.

Fukuhara,M.(1977): A study of regional structure of the Tokyo Metropolitan Regions. Journal of Geography, 86, 158-173. (JE: in Japanese with English abstract)

Haggett,P.(1965): Locational analysis in human geography. Edward Arnold, London, 339p.

Hama,H.(1990): Jinko-ido to toshika (Migration and urbanization). Kuroda,T. and Ohbuchi,H.eds.: Gendai no jinko-mondai (Population problems at the present day). Taimeido, Tokyo, 105-128. (J: in Japanese)

Hashimoto,Y. and Murayama,Y.(1991): Regional characteristics of the migration by sex and age classes in Aichi Prefecture. Annals of the Tohoku Geographical Association, 43, 122-138. (JE)

Hattori,K., Kagaya,K. and Inanaga,S.(1960): The regional structure of surrounding areas of Tokyo. Geographical Review of Japan, 33, 495-514. (JE)

Hino,M.(1977): Fundamental dimensions of the Japanese urban system in the years of 1950, 1960 and 1970. Geographical Review of Japan, 50, 335-353.

(JE)

Housing Research and Advancement Foundation of Japan(1983): Tokyo-daitoshiken no chiiki-kozo no henka ni kansuru chosa-kenkyu (A research study on changes of regional structure in Tokyo metropolitan area). Housing Research and Advancement Foundation of Japan, Tokyo, 114p.

Inouchi,N.(1982): Kitakanto no toshi-shisutemu (Urban system in Northern Kanto District). Tanabe,K.ed.: Nihon no toshi-shisutemu—chirigakuteki-kenkyu— (Urban system in Japan—a geographical study—). Kokon-shoin, Tokyo, 436-451. (J)

Ishikawa,Y.(1978): Internal migration in postwar Japan. Geographical Review of Japan, 51, 433-450. (JE)

Ishiguro,M.(1976): An analysis of out-migrants from the center of the metropolis: a case study of Naka-Ku, Nagoya City. The Human Geography, 28, 257-284. (JE)

Ishimizu,T.(1979): An analysis of the geographic-field for in- and out-migration of urban centers—a case study: Niigata-ken, 1970-76. Annals of the Tohoku Geographical Association, 31, 205-221. (JE)

Kanekiyo,H.(1983): Amerika-gasshukoku no jinko-ido-tenkan (Migration transition in the United States). The Journal of Population Studies, 6, 15-21. (J)

Kato,Y.(1980): A study of intra-urban migration in Kobe Metropolitan Area. The Human Geography, 32, 72-84. (JE)

King,L.J.(1969): Statistical analysis in geography. Prentice-Hall, Englewood Cliffs, 288p.

Kishimoto,M.(1978): Jinko-ido-ron (Migration theory). Ninomiya-shoten, Tokyo, 291p. (J)

Kuroda,T.(1976): Nihon-jinko no tenkan-kozo (Transitional structure of

Japanese population). Kokon-shoin, Tokyo, 262p. (J)

Lewis,G.J.(1982): Human migration. Croom Helm, London/Canberra, 220p.

Miyake,I., Nakano,Y., Mizuno,K. and Yamamoto,K.(1977): SPSS tokei-pakkeiji II kaiseki-hen (SPSS statistical-package II analytical-volume). Toyo Keizai Inc., Tokyo, 318p. (J)

Moore,E.G.(1969): The structure of intra-urban movement rates: an ecological model. Urban Studies, 6, 17-33.

Moore,E.G.(1971): Comments on the use of ecological models in the study of residential mobility in the city. Economic Geography, 47, 72-85.

Mori,N.(1980): Toyonaka-shi no kyoju-patan to kyoju-ido (Residential patterns and mobility in Toyonaka city). The Human Geography, 32, 452-465. (J)

Morikawa,H.(1975): A multiple regression analysis of migration between a regional center and its surrounding area: a case study of Hiroshima city. Geographical Sciences, 22, 43-55. (JE)

Morikawa,H.(1985): The Japanese urban system based on the analysis of internal migration. The Human Geography, 37, 20-38. (JE)

Morikawa,H.(1992): The 1985-90 net migration of age groups within Hyogo Prefecture. The Human Geography, 44, 439-457. (JE)

Moser,C.A. and Scott,W.(1961): British towns: a statistical study of their social and economic differences (Centre for Urban Studies, Report No.2). Oliver and Boyd, London, 169p.

Murayama,Y.(1985): Causing factors of the population mobility in Metropolitan Tronto. Tsukuba Studies in Human Geography, 9, 219-242. (JE)

Murayama,Y.(1990a): Space-time analysis of internal migration in Postwar Japan. Tsukuba Studies in Human Geography, 14, 169-188. (JE)

Murayama,Y.(1990b): CHiikibunseki—chiiki no mikata•yomikata•shirabekata—

(Regional analysis—how to observe, how to interpret, and how to investigate region—). Kokon-shoin, Tokyo, 169p. (J)

Nakagawa,S.(1990): Changing segregation pattern by age group in the Tokyo metropolitan area—from the viewpoint of migration with cohort analysis—. Geographical Review of Japan, 63B, 34-47.

Ohzeki,Y.(1985): Simulation analysis of the intra-urban migration within Kofu city. Annals of the Tohoku Geographical Association. 37, 145-158. (JE)

Ohzeki,Y.(1987): Yamagata-ken no toshi-jinkoi-do (Urban migration in Yamagata prefecture). Area Research Reports, 9, 91-100. (J)

Ohzeki,Y.(1989): Fukushima-ken ni okeru toshi-jinko-ido no chiikiteki-sai (Areal difference of urban migration in Fukushima prefecture). Area Research Reports, 11, 83-91. (J)

Ohzeki,Y. and Takahashi,N.(1984): Hokota-machi-chushinshigaichi ni okeru jinko-ido ni kansuru chirigakuteki-kenkyu (A geographical study of migration in central Hokota town). Area Research Reports, 6, 85-104. (J)

Ohzeki,Y., Kawaguchi.H. and Takahashi,N.(1985): Hokota-machi ni okeru jinko-ido no shokeitai—zokuho— (Various forms of migration in Hokota town—a continued report—). Area Research Reports, 7, 155-172. (J)

Okuno,T.(1977): Keiryo-chirigaku no kiso (Fundamentals of quantitative geography). Taimeido, Tokyo, 358p. (J)

Osada,M.(1991): Urban network transformation in the National Capital Region. Papers on City Planning (City Planning Review, Special Issue), 28-B, 469-474. (JE)

Otomo,A.(1983): Nihon ni okeru kokunai-jinko-ido no ketteiin (Determinants of internal migration in Japan). The Journal of Population Studies, 6, 1-5. (J)

Otomo,A.(1987): Some aspects of household migration in Japan. The Journal of Population Studies, 10, 25-32.

Otomo,A.(1994): Nihon no jinko-ido-tokei no genjo to shorai (Present and future of migration statistics in Japan). Periodical Journal [Statistics], 45(4), 7-13. (J)

Ravenstein,E.G.(1885): The lows of migration. Journal of the Statistical Society, 48, 167-235.

Ravenstein,E.G.(1889): The lows of migration: second paper. Journal of the Royal Statistical Society, 52, 241-305.

Rees,P.H.(1977): The measurement of migration, from census data and other sources. Environment and Planning A, 9, 247-272.

Roseman,C.C.(1971): Migration as a spatial and temporal process. Annals, association of American Geographers, 61, 589-598.

Saino,T.(1987): Structure and its change of migration field in Japan: 1971-1980. Annals of the Tohoku Geographical Association. 39, 34-45. (JE)

Saino,T. and Higashi,K.(1978): Structure and its change of inter-prefectural migration in Japan. Geographical Review of Japan, 51, 864-875. (JE)

Saito,K.(1982): Tokyo-daitoshiken no shakai-keizaiteki-chiikikozo (Social and economic structure of the Tokyo metropolitan area). The Human Geography, 34, 363-377. (J)

Sakashita,N. and Asano,N.(1979): Kenkyu-shirizu dai-32-go: toshi-seicho-bunseki－toshidotai-moderu-josetsu－ (Research series no.32: urban growth analysis－an introduction to urban dynamic model－). Economic Research Institute, Economic Planning Agency, Tokyo, 606p. (J)

Sanuki,T.(1983): Seicho suru toshi suitai suru toshi (Growing cities and declining cities). Jiji Press Ltd., Tokyo, 522p. (J)

Schwind,P.J.(1971): Migration and regional development in the United States

1950-1960 (Department of Geography, Research Paper, No.133). University of Chicago, Chicago, 173p.

Schwind,P.J.(1975): A general field theory of migration: United States, 1955-1960. Economic Geography, 51, 1-16.

Skeldon,R.(1990): Population mobility in developing countries. Belhaven Press (a division of Pinter Publishers), London/New York, 273p.

Speare,A.Jr.(1974): Residential satisfaction as an intervening variable in residential mobility. Demography, 11, 173-188.

Sung,J.(1977): The urban system in Korean cities. Geographical Review of Japan, 50, 381-401. (JE)

Tomita,K. and Kouno,T.(1990): Recent changes in regional structure based on socio-economic characteristics in Tokyo metropolitan area, 1975-1985. Geographical Science, 45, 60-75. (JE)

Ueno,H.(1980): Osaka-shi no jinko-bunsan ni tsuite no ichi-kosatsu (An analysis of out-migration from Osaka city to the suburban zone). The Human Geography, 32, 530-542. (J)

Willis,K.G.(1972): The influence of spatial structure and socio-economic factors on migration rates, a case study: Tyneside 1961-1966. Regional Studies, 6, 69-82.

Wirth,L.(1938): Urbanism as a way of life. American Journal of Sociology, 44, 1-24.

Wolpert,J.(1964): The decision process in spatial perspective. Annals, Association of American Geographers, 54, 220-229.

Wolpert,J.(196): Behavioural aspects of the decision to migrate. Papers and Proceedings of Regional Science Association, 15, 159-172.

Wolpert,J.(1966): Migration as an adjustment to environmental stress. Journal of Social Issues, 22, 92-102.

Woods, R. (1982): Theoretical population geography. Longman, London/New York, 220p.

Yamada, H. (1980): Toshi no keizai bunseki (Urban economic analysis). Toyo Keizai Inc., Tokyo, 230p. (J)

Yamada, H., Kobayashi, Y. and Kondo, M. (1974): Tokyo-daitoshiken no ken-iki-kozo (Zonal structure of the Tokyo metropolitan area). The Economic Analysis, **46**, 1-58. (J)

Yamaguchi, T. (1972): Parallel structure of urban functions in Japan. Geographical Review of Japan, **45**, 411-429. (JE)

Yamaguchi, T. (1973): Toshikino no kukan-kozo (Spatial structure of urban functions). Ishimizu, T. and Okuno, T. eds.: Keiryo-chirigaku (Quantitative geography). Kyoritsu-shuppan, 162-180. (J)

Yano, K. (1984): A delimitation of functional regions by means of higher-order factor analysis: a case study of the Keihanshin Metropolitan Area. The Human Geography, **36**, 385-412. (JE)

Yana, K. (1985): A note on Direct Factor Analysis of geographic matrices: a case of binary data matrices. Geographical Review of Japan, **58A**, 516-535. (JE)

Yana, K. (1989): Age-disaggregated intra-metropolitan migration in Tokyo Metropolitan Area. Geographical Review of Japan, **62A**, 269-288. (JE)

Yasuda, S. (1959): Tohirenzokutai-kasetsu no kosatsu (ge)－inshibunseki ni yoru toshido-sokutei to toshibunrui no atarashii kokoromi－ (Concerning the Rural-Urban Continuum Hypothesis, part 2, concluded). Municipal Problems, **50**, 850-861. (J)

Zelinsky, W. (1971): The hypothesis of the mobility transition. Geographical Review, **61**, 219-249.