Vol. 23 No. 1, 2 (1986. 10)

PEOPLE FOLLOW JOBS IN JAPAN?: SUBURBANIZATION OF LABOUR AND JOB MARKETS

TATSUHIKO KAWASHIMA*

CONTENTS

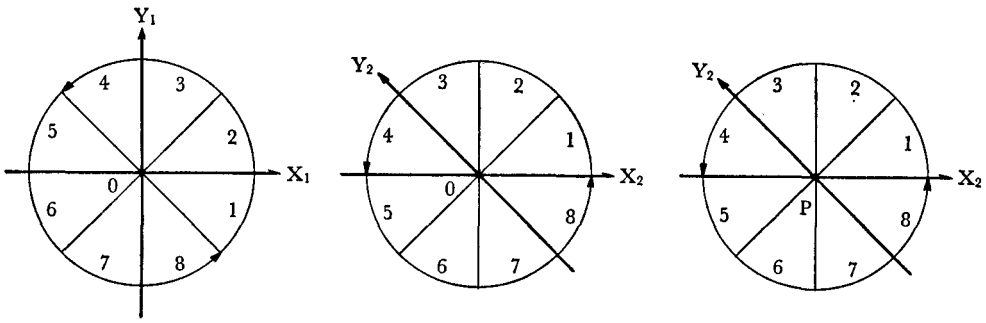
ABSTRACT

This study examines the pattern of intra-metropolitan spatial redistribution of (1) population by place of residence and (2) employed persons by place of work. An important conceptual framework and analytical means, the spatial cycle hypothesis and the ROXY index method are directly applied in this study. The results indicate (1) that, geographically speaking, the Tokyo metropolitan area has been suburbanizing clockwise in terms of the development of both labour and job markets, and (2) that, in the three major railway-line regions in Tokyo metropolitan area, people seem to generally follow job opportunities which are created by the secondary industry while the tertiary industry itself follows people. Suggestions are made for research that would contribute to a better understanding of the basic mechanism that causes intra- and inter-metropolitan shifts of labour markets and job markets in order to improve regional labour market policies and to design effective strategies for regional industrial development.

1. INTRODUCTION

We have eighty-six metropolitan areas in Japan. They are the Japanese versin of Standard Metropolitan Statistical Areas (SMSAs) and called Functional Urban Cores (FUCs)[1]. We pick up Tokyo FUC out of them to examine the speed of suburbanization for (1) the residing population and (2) the existing jobs supplied by the secondary and

* Economics Department at Gakushuin University in Tokyo. The author is grateful to The Ministry of Education, Science and Culture for its Grant-in-Aid Scientific Research (B).



(a) Type-α Scheme (b) Type-β Scheme (c) Type-γ Scheme

(Note)

X_1 : population change in central city
Y_1 : population change in suburbs
X_2 : population growth rate of central city
Y_2 : population growth rate of metropolitan area
z : average growth rate of national total population
Coordinates of point P : (z, z)
Number in each fan-shaped segment: substage number
Urbanization stage : substages 1 and 2
Suburbanization stage : substages 3 and 4
Disurbanization stage : substages 5 and 6
Reurbanization stage : substages 7 ann 8

Figure 1 Three Types of Spatial Cycle Schemes

Table 1 ROXY Index for the Period between Year t and Year t+1
(Weighting Factor: Population of Metropolitan Area)

ROXY Index

$$=\left(\frac{\text{weighted average growth ratio}}{\text{simple average growth ratio}}-1.0\right)\times 10,000$$

where weighted average growth ratio:

$$\sum_{i=1}^{n} X_{i,\,t+1} / \sum_{i=1}^{n} X_{i,\,t}$$

simple average growth ratio:

$$\sum_{i=1}^{n} (X_{i,\,t+1}/X_{i,\,t}) \times \frac{1}{n}$$

$X_{i,\,t}$: population level of metropolitan area i in year t
n : number of metropolitan areas.

本論文目次

tertiary industries.

At the outset in this paper we will briefly discuss the primary relationships between the conceptual framework and the analytical means both of which are applied in this study; the former is the spatial cycle hypothesis and the latter is the ROXY index method. Secondly, the speed of suburbanization will be investigated for the population of Tokyo FUC as well as for the population of its three major railway-line regions, the Chuo Line, the Takasaki Line and the Joban Line regions. Thirdly, the speed of suburbanization of the job markets will be examined for the secondary and tertiary industries located in each of the three railway-line regions. Then the spatial shift pattern of population residing (i. e., labour markets or labour-supply markets located) in each railway-line region will be compared with that of each region's job markets (i. e., job-supply markets). In a concluding section, some suggestions will be made for research on the analysis of metropolitan labour markets.

2. SPATIAL CYCLE HYPOTHESIS AND ROXY INDEX METHOD

The basic framework of the spatial cycle hypothesis which was originally conceived by Klaassen et al. (1981), is diagrammatically illustrated by the "type-α spatial cycle scheme" in Figure 1-(a). Based on this scheme, various versions of the spatial cycle framework can be developed without losing its essence. Among such possible alternatives are the "type-β spatial cycle scheme" and the "type-γ spatial cycle scheme"[2] which would provide us with a convenient analytical basis for interpreting the spatial cycle hypothesis in cojunction with the population growth rate of a metropolitan area as compared with that of its central city area.

Meanwhile, the ROXY index whose weighting factor is the population of the metropolitan area, is defined as shown in Table 1. This ROXY index has been developed primarily for the analysis of inter-metropolitan spatial redistribution of population.[3] The implications of the value of ROXY index are explained in Table 2.

In the present paper, we modify this type of ROXY index to the "ROXY index whose weighting factor is the distance to the CBD of the central city in a metropolitan area from each of subareas of that metropolitan area" so that we can effectively analyze the intra-metropolitan spatial redistribution processes of population and job opportunities. This newly developed ROXY index is defined as shown in Table 3, while Table 4 presents the relationships among (1) the value of ROXY index, (2) the intra-metropolitan spatial redistribution pattern of population shares, (3) the direction of changes in the value of ROXY index, and (4) the changes in the speed of centralization or suburbanization of population. The spatial cycle concept underlying the arguments in Table 4 are diagrammatically illustrated by Figures 2 and 3.[4]

Table 2 Implications of ROXY Index for Inter-metropolitan Spatial Redistribution Processes of Population (Weighting Factor: Population of Metropolitan Area)

(i) Value of ROXY Index	(ii) Inter-metropolitan Spatial Redistribution Pattern of Population Shares	(iii) Direction of Changes in Value of ROXY Index	(iv) Speed of Spatial Redistribution of Population
ROXY>0	Concentration of Population (Agglomeration of Population)	(1) (2) (3)	(1) Accelerating (2) Stabilizing (3) Decelerating
ROXY=0	Symmetric Growth or Decline of Population (viz. BGD, BSGD or CSGD of Population)	0.0→0.0	Can not be specified
ROXY<0	Deconcentration of Population (Dispersion of Population)	(1) (2) (3)	(1) Decelerating (2) Stabilizing (3) Accelerating

(Note)

1. BGD : Balanced Growth or Decline (Namely, the growth rate curve is nearly flat, reflecting the constant share of population over different population-size groups of metropolitan areas.)
2. BSGD: Bell-shaped Growth or Decline (Namely, the growth rate curve is bell-shaped, reflecting the "medianization" of population over population-size groups. This "medianization" means increase in population share by medium population-size groups of metropolitan areas and, at the same time, decrease in populaion share by small and large population-size groups of metropolitan areas.)
3. CSGD: Cup-shaped Growth or Decline (Namaly, the growth rate curve is cup-shaped, reflecting the "bipolarization" of population over population-size groups. This "bipolarization" means increase in population share by amall and large population-size groups of metropolitan areas and, at the same time, decrease in population share by medium population-size groups of metropolitan areas.)

Table 3 ROXY Index for the Period between Year t and Year t+1 (Weighting Factor: Distance to CBD)

Roxy index

$$=\left(\frac{\text{weighted average growth ratio}}{\text{simple average growth ratio}}-1.0\right)\times 10,000$$

$$=\left(\frac{\sum_{i=1}^{n} d_i r_i^{t,t+1}}{\sum_{i=1}^{n} d_i}\times\frac{n}{\sum_{i=1}^{n} r_i^{t,t+1}}-1.0\right)\times 10^4$$

$$=\frac{n\sum_{i=1}^{n} d_i r_i^{t,t+1}-\sum_{i=1}^{n} d_i\times\sum_{i=1}^{n} r_i^{t,t+1}}{\sum_{i=1}^{n} d_i\times\sum_{i=1}^{n} r_i^{t,t+1}}\times 10^4$$

where d_i: distance from subarea i to CBD,

$r_i^{t,t+1}$: population growth ratio of subarea i for the period between year t and year t+1, growth ratio defined as the population level in year t+1 divided by the population level in year t,

n: number of subareas.

本論文目次

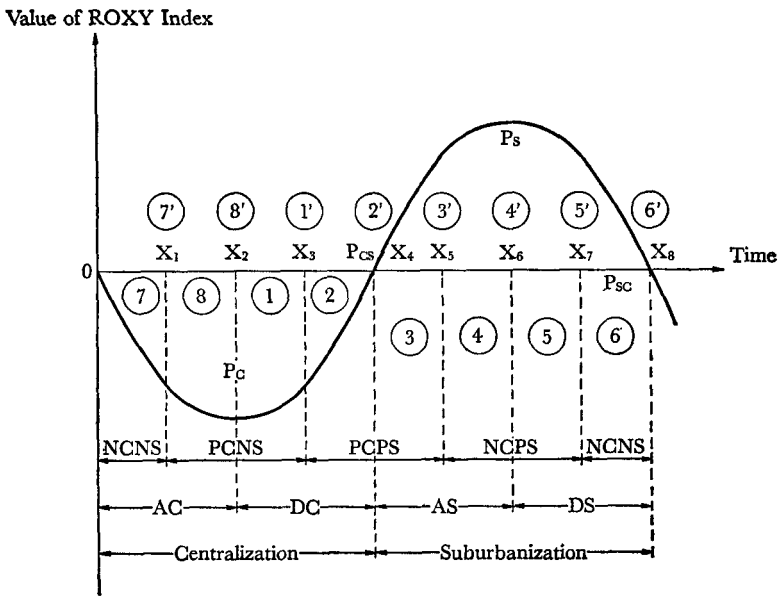
Table 4 Implications of ROXY Index for Intra-metropolitan Spatial Redistribution Processes of Population (Weighting Factor: Distance to CBD)

(i) Value of ROXY Index	(ii) Intra-metropolitan Spatial Redistribution Pattern of Population Shares	(iii) Direction of Changes in Value of ROXY Index	(iv) Speed of Spatial Redistribution of Population
ROXY>0	Suburbanization of Population (Dispersion of Population)	(1) (2) (3)	(1) Accelerating (2) Stabilizing (3) Decelerating
ROXY=0	Symmetric Growth or Decline of Population (viz. BGD, BSGD or CSGD of Population)	0.0→0.0	Can not be specified
ROXY<0	Centralization of Population (Agglomeration of Population)	(1) (2) (3)	(1) Decelerating (2) Stabilizing (3) Accelerating

(Note)

1. BGD : Balanced Growth or Decline (Namely, the growth rate curve is nearly flat, reflecting the constant share of population over different distance-zone groups of localities.)
2. BSGD: Bell-shaped Growth or Decling (Namely, the growth rate curve is bell-shaped, reflecting the "medianization" of population over distance-zone groups. This "medianization" means increase in population share by middle distsance-zone groups of localities and, at the same time, decrease in population share by near and far distance-zone groups of localities.)
3. CSGD: Cup-shaped Growth or Decline (Namely, the growth rate curve is cup-shaped, reflecting the "bipolarization" of population over distances-zone groups. This "bipolarization" means increase in population share by near and far distance-zone groups of localities and, at the same time, decrease in population share by middle distance-zone groups of localities.)
4. In this table, special attention should be paid to the fact that, for the intra-metropolitan spatial redistribution processes of population, ***negative*** values of ROXY index would imply agglomeration phenomenon. In contrast with this, for the inter-metropolitan spatial redistribution processes of population as shown in Table N-1, ***positive*** values of ROXY index would imply agglomeration phenomenon. One of the possible means to maka positive values of ROXY index to imply agglomeration phenomenon for the intra-metropolitan spatial redistribution processes of population, would be to employ d^{-1} as a weighting factor; where d indicates the distance from each locality to the CBD of the central city of the metropolitan area to which that locality belongs and i indicates any positive number.

(a) Wave Diagram



(Note)

1. AC : Accelerating Centralization
2. DC : Decelerating Centralization
3. AS : Accelerating Suburbanization
4. DS : Decelerating Suburbanization
5. Pc : Zenith Point of Centralization
6. Pcs : Turning Point from Centralization Stage to Suburbanization Stage
7. Ps : Zenith Point of Suburbanization Speed
8. Psc : Turning Point from Suburbanization Stage to Centralization Stage
9. PCNS : Possible Positive Growth in Central Area (Inner-ring Aaea) and Negative Growth in Suburban Area (Outer-ring Area)
10. PCPS : Possible Positive Growth in both Central and Suburban Areas
11. NCPS : Possible Negative Growth in Central Area and Positive Growth in Suburban Area
12. NCNS : Possible Negative Growth in both Central and Suburban Areas.
13. Number enclosed with a Circle : Substage Number
    Urbanization Stage : Substages ① and ②
    Suburbanizaton Stage : Substages ③ and ④
    Disurbanization Stage : Substages ⑤ and ⑥
    Reurbanization Stage : Substages ⑦ and ⑧
14. It should be noted that the lower portion of the vertical axis in the "Circle Diagram" presents positive values and that its upper portion presents negative values.

Figure 2 ROXY Index and Life Cycle of a Metropolitan Area (Spatial Cycle Scheme in terms of ROXY Index)

(b) Circle Diagram

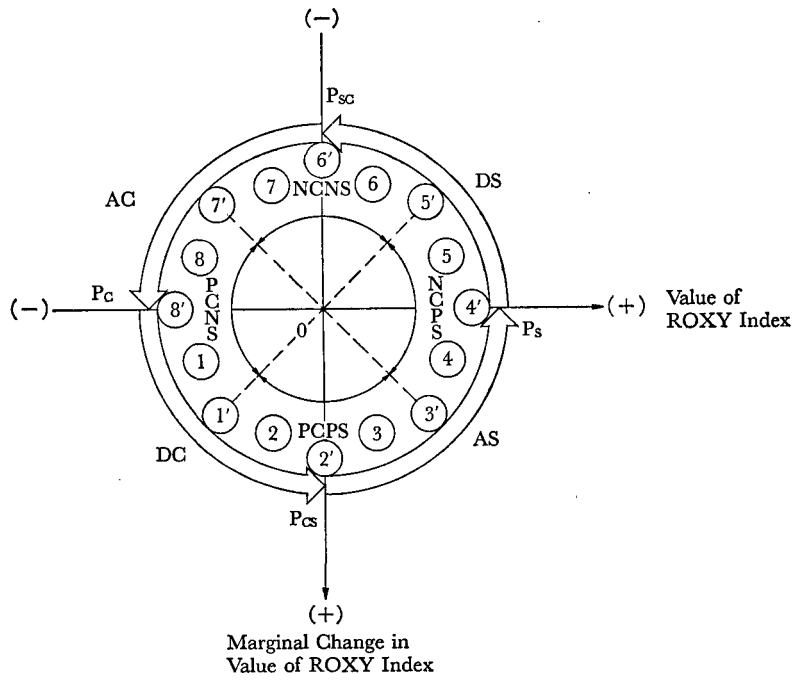


Figure 2 (Continued)

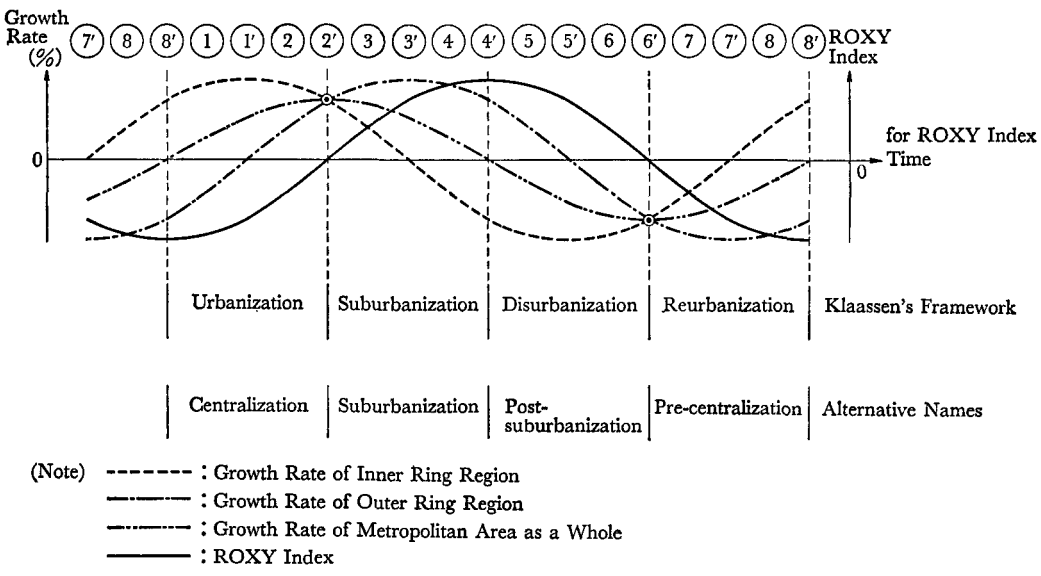


Figure 3 Cyclical Movements of ROXY Index and Population Growth Rates of Metropolitan Area and Its Inner Ring and Outer Ring Regions

3. SUBURBANIZATION OF POPULATION (LABOUR-SUPPLY MARKET)

3.1 TOKYO FUC

Table 5 Five-year Growth Rate (%) of Population by Distance Zone for Tokyo FUC

Distance Zone (km)	Number of Localities	Period			
		1960-65	1965-70	1970-75	1975-80
0-15	3	7.77	0.08	−1.62	−2.25
15-25	30	47.88	30.35	19.35	7.85
25-35	26	46.20	40.50	27.73	13.48
35-45	32	26.59	39.91	31.86	19.35
45-55	16	7.57	13.18	22.78	15.29
55-65	8	10.36	12.84	14.35	8.39
65-75	6	−0.15	5.06	7.37	8.33
Tokyo FUC	121	18.34	13.64	10.83	5.48

Table 6 ROXY Index for Tokyo FUC

Spatial Unit	Number of Localities	Period			
		1960-65	1965-70	1970-75	1975-80
Tokyo FUC	121	−120.39	−68.99	−21.96	3.32

Tokyo FUC is composed of 121 constituent localities (cities, towns and villages), and had 22.1 million population in 1985, and Table 5 shows the five-year population growth rates for Tokyo FUC by distance-zone, the distance being the airline distance from each locality to the CBD of Tokyo city. By the aid of this table, the following general tendencies can be remarked on the dynamic changes in the population growth rate.

(1) The peak of growth rate curve gradually shifted over time from inner distance-zones toward outer distance-zones with the peak corresponding to a 15-25 km distance-zone for the 1960-65 period, a 25-35 km distance-zone for the 1965-70 period and a 35-45 km distance-zone for the 1970-75 and 1975-80 periods.

(2) The maximum growth rate among all distance-zones for each fiveyear period decreased as time went on.

(3) The growth rate of inner distance-zones fell over time, while that of outer distance-zones increased until the 1965-70 period or the 1970-75 period and then began to fall.

(4) The growth rate curve looks almost bell-shaped for the 1970-75 period, while the curve for the 1975-80 period is a slightly skewed toward outer distance-zones.

本論文目次

Such tendencies as stated above would suggest that Tokyo FUC had already been in the late stage of centralization[5] in the 1960-80 period, or would perhaps indicate that it had already entered the early stage of suburbanization toward the end the 1970s. This hunch is likely to be verified to some extent through the velues of ROXY index for Tokyo FUC shown in Table 6. The ROXY index increased continuously from −120.39 for the 1960-65 period to 3.32 for 1975-80, with the negative sign turning positive around 1975, implying that the centralization in Tokyo FUC took place during 1960-75 with its speed decelerating[6]. In the second half of the 1970s, however, Tokyo FUC seems to have started to experience the first substage of suburbaniztion with the speed of suburbanization accelerating.

3.2 THREE RAILWAY-LINE REGIONS

Let us now turn our attention to the spatial redistribution processes of population in the region consisting of localities situated along the Chuo Line. This railway line is one of the busiest commuting lines in Tokyo FUC and extends westwards from the CBD of Tokyo city. The five-year growth rates of population for the ten component localities of the Chuo Line region are shown in Table A-1, while the geographical boundary of the Chuo Line region is exhibited by Figure 4. Based on Table A-1, we obtain the value of ROXY index for the Chuo Line region as listed in Table 7. The ROXY index for this region increased from 38.73 for the 1960-65 period to 53.72 for 1965-70. It then began to decrease to 51.86 for the 1970-75 period and 37.66 for 1975-80. This implies that the Chuo Line region had been experiencing the accelerating suburbanization of population until the late 1960s. After that, the suburbanization process began to decelerate and this decelerating tendency of the speed suburbanization continued throughout the 1970s.

Table 7 also shows the value of ROXY index obtained based on Tables A-1-(b) and (c) for two other railway-line regions stretching along the Takasaki and Joban Lines both of which are among the major commuting railway lines in Tokyo FUC just like the Chuo Line. The geographical boundaries of the Takasaki Line and Joban Line regions are exhibited in Figures 5 and 6 respectively. In Table 7, the ROXY index for the Takasaki Line region which extends northwards from the CBD of Tokyo city, increased from −75.63 for the 1960-65 period to 38.94 for the 1975-80 period with the negative sign turning positive around 1965. This implies that the Takasaki Line region was being deceleratingly centralized during 1960-65. Around 1965, however, the region entered the stage of suburbanization with the speed of suburbanization acceleratihg afterwards.

For the Joban Line region which extends northeastwards from the CBD of Tokyo city, the ROXY index increased from −82.28 for the 1960-65 period to 36.05 for 1975-80 with the negative sign turning positive around 1970. This implies that the Joban Line region was in the stage of decelerating centralization in the 1960s, but also that the region reached the stage of suburbanization around 1970 with the suburbanization process

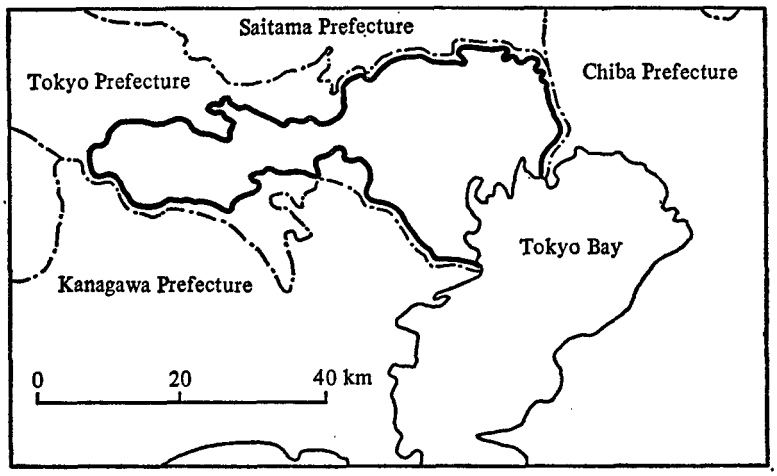


Figure 4 Geographical Boundary of the Chuo Line Region

Table 7 ROXY Index for Three Railway-line Regions in Tokyo FUC

Spatial Unit	Number of Localities	Period			
		1960–65	1965–70	1970–75	1975–80
Chuo Line Region	10	38.73	53.72	51.86	37.66
Takasaki Line Region	14	−75.63	3.95	25.79	38.94
Joban Line Region	9	−82.28	−25.47	16.05	36.05

accelerating throughout the 1970s.

In addition to the aforementioned, Table 7 it should be noticed that, among the three major railway-line regions in Tokyo FUC, the Chuo Line region whose process of suburbanization was decelerating, was in the most advanced phase along the path of the spatial cycle scheme during the 1975–80 period. Next comes the Takasaki Line region. This railway-line region was still in the stage of accelerating suburbanization during tne 1975–80 period, and so was the Joban Line region. However, the Takasaki Line region had been ahead of the Joban Line region along the dynamic path of the spatial cycle scheme (1) since the former region already reached the stage of suburbanization in the middle of the 1960s as compared with the year 1970 around which the latter region reached the stage of suburbanization, and (2) since the former region had a higher value of ROXY index than the latter region for the 1975–80 period. The relative positions in the "spatial cycle race" for the three major railway-line regions in Tokyo FUC is graphically described by Figure 7. In this figure, the dynamic paths in the spatial cycle scheme are expressed by, as suggested in Figure 2-(b), the coordinates of the value of ROXY index and its marginal change. We can produce Figure 7 based on Table 8 that is constructed from Table 7.

It is often mentioned that, geographically speaking, Tokyo metropolitan area has been

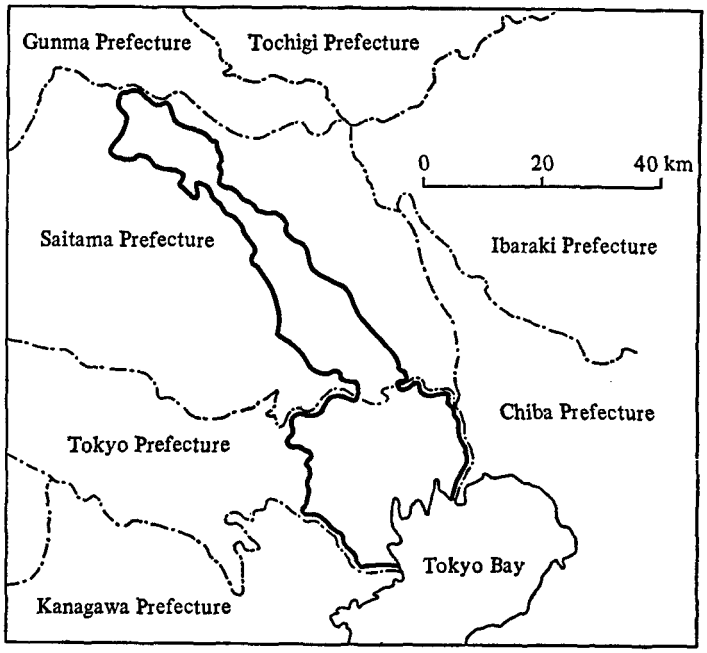


Figure 5 Geographical Boundary of the Takasaki Line Region

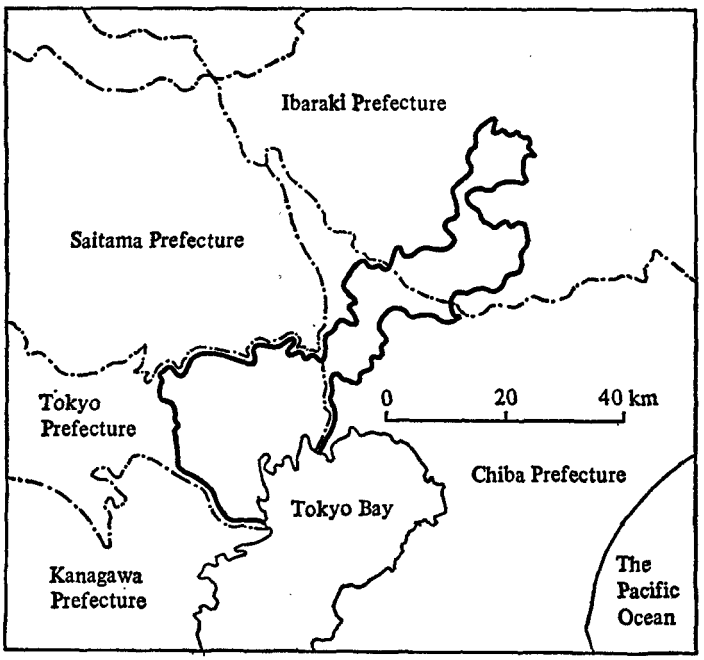


Figure 6 Geographical Boundry of the Joban Line Region

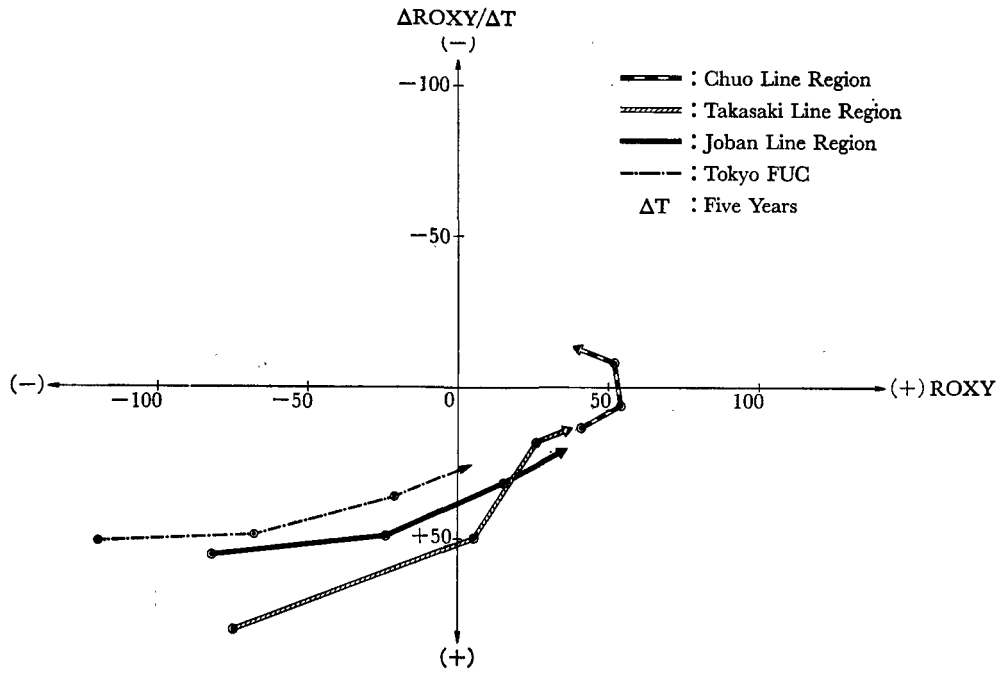


Figure 7 ROXY Index and Its Marginal Change for Population

Table 8 The Value of ROXY Index and Its Marginal Change for Population of Tokyo FUC and Three Railway-line Regions

Spatial Unit	1960–65		1965–70		1970–75		1975–80	
	ROXY	$\frac{\triangle ROXY}{\triangle T}$	ROXY	$\frac{\triangle ROXY}{\triangle T}$	ROXY	$\frac{\triangle ROXY}{\triangle T}$	ROXY	$\frac{\triangle ROXY}{\triangle T}$
Tokyo FUC	−120.39	51.4	−68.99	49.22	−21.96	36.16	3.32	25.28
Chuo Line Region	38.37	14.99	53.72	6.57	51.86	−8.03	37.66	−14.20
Takasaki Line Region	−75.63	79.58	3.95	50.71	25.79	17.50	38.94	13.15
Joban Line Region	−82.28	56.54	−25.74	49.17	16.05	30.90	36.05	20.00

(Note) △T: Five Years

developed clockwise in general. Interestingly enough to notice, Table 7 and Figure 7 clearly show that Tokyo FUC had been suburbanizing clockwise during the 1960-80 period; the suburbanization first started before or around 1960 in the Chuo Line region extending westwards, then the Takasaki Line region extending northwards reached the stage of suburbanization around 1965, and around 1970 the suburbanization started in the Joban Line region extending northeastwards[7].

4. SUBURBANIZATION OF JOB MARKETS BY INDUSTRY

The number of employed persons (15 years of age and over) counted by *place of work* in the Chuo Line region for the four period of 1960-65, 65-70, 70-75 and 75-80, its five-year growth rate and annual growth ratio, are shown in Table A-2 for the secondary industry and in Table A-3 for the tertiary industery. The same kind of information is provided in Tables A-4 and A-5 for the Takasaki Line region and in Tables A-6 and A-7 for the Joban Line region. From those six tables, we can construct Table 9 for the Chuo Line region, Table 11 for the Takasaki Line region and Table 13 for the Joban Line region, each table showing the value of ROXY index for the secondary and tertiary industries. The six tables also show the value of ROXY index for population and, merely for reference, the value of ROXY index for employed persons (counted by *place of residence*) of the secondary and tertiary industries.

4.1 CHUO LINE REGION

Concentrating our attention to the ROXY index for the employed persons by place of work in Table 9, we can see that the secondary industry of the Chuo Line region shows a general tendency of decelerating suburbanization in the two decade period 1960 though 1980, though it is somewhat queer that the value of ROXY index dropped rather sharply for the 1970-75 period and went up again for 1975-80. One of the major causes for this weird movement of the value of ROXY index would be that the unfavoureble economic climate which temporarily coverd Japan just after the "1973 oil-shock" did adversely effect the secondary industry in the inner distance-zones of the Chuo Line region more seriously than the secondary industry in the outer distance-zones of that region. Taking into consideration this oil-shock factor which was substantially effective in the Chuo Line region in comparison with the other two railway-line regions, it is recognized from Table 9 that the tertiary industry of the Chuo Line region had been in the stage of decelerating suburbanization during the 1970s. In the decade of the 1960s, the tertiary industry had been acceleratingly suburbanazed. Therefore, it can be said that, in the Chuo Line region, the secondary industry had been ahead of the tertiary industry along the dynamic path of the spatial cycle scheme.

As already discussed, the spatial redistribution process of the population in the Chuo Line region had been acceleratingly suburbanized till the late 1960s around which the deceleration of the speed of suburbanization started just like as the tertiary industry of that region. However, it seems that the population of the Chuo Line region had been deceleratingly suburbanized a slightly behind the tertiary industry in the 1970s because of the fact that in the 1970s the value of ROXY index for the population was always higher than that for the tertiary industry.

In short, the secondary industry had been taking the lead in the "spatial cycle race"

Table 9 ROXY Index for the Chuo Line Region

Category		Persons in 1980 (Mil.)	ROXY Index			
			1960–65	1965–70	1970–75	1975–80
Population		9.78	38.73	53.72	51.86	37.66
R	Secondary Industry	1.53	62.22	67.19	41.62	39.19
	Tertiary Industry	3.30	34.88	55.83	42.32	40.23
W	Secondary Industry	2.10	67.72	46.32	16.23	25.08
	Tertiary Industry	4.61	35.24	52.35	14.98	27.23

(Note) 1. R : Employed Persons (15 Years of Age and Over) by Place of Residence
2. W : Employed Persons (15 Years of Age and Over) by Place of Work
3. The Chuo Line region has ten component localities.

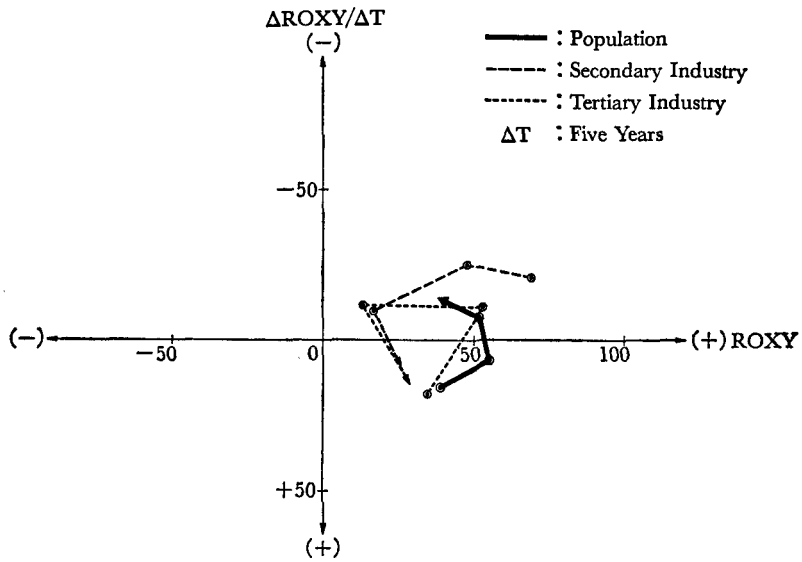


Figure 8 ROXY Index and Its Marginal Change for Chuo Line Region

Table 10 Value of ROXY Index and Its Marginal Change for the Chuo Line Region

Category		1960–65		1965–70		1970–75		1975–80	
		ROXY	$\frac{\triangle ROXY}{\triangle T}$	ROXY	$\frac{\triangle ROXY}{\triangle T}$	ROXY	$\frac{\triangle ROXY}{\triangle T}$	ROXY	$\frac{\triangle ROXY}{\triangle T}$
Population		38.73	14.99	53.72	6.57	51.86	− 8.03	37.66	−14.20
W	Secondary Industry	67.72	−21.40	46.32	−25.75	16.23	−10.62	25.08	8.85
	Tertiary Industry	35.24	17.11	52.35	−10.13	14.98	−12.56	27.23	12.25

(Note) 1. W : Employed Persons (15 Years of Age and Over) by Place of Work
2. $\triangle T$: Five Years

significantly ahead of the tertiary indusry, while the people in the Chuo Line region had been suburbanized somewhat behind the tertiary industry. This phenomena are depicted by Figure 8 which we can draw based on Table 10 that is constructed from Table 9.

4.2 TAKASAKI LINE REGION

Table 11 tells to us that the secondary industry of the Takasaki Line region had been in the stage of accelerating suburbanization till the late 1960s. After that, it entered the stage of decelerating suburbanization with this decelerating tendency continuing throughout the 1970s. From the same table, it can also be seen that the tertiary industry of the Takasaki Line region had been deceleratingly centralized during 1960-70. Around 1970, the tertiary industry entered the stage of suburbanization with the speed of suburbanization continuously accelerating throughout the 1970s.

As already examined, the spatial redistribution process of the population in the Takasaki Line region had been deceleratingly centralizing during 1960-65. In the midde of the 1960s, however, the population entered the stage of suburbanization with the speed of suburbanization constantly accelerating afterwards.

Therefore in the Takasaki Line region, during the whole two-decade period 1960-80, people had been following the job market created by the secondary industry while the tertiary industry had been following the people. This relationship of the "spatial cycle race" among the people and two kinds of industries in the Takasaki Line region, is graphically expressed in Figure 9 which we can draw based on Table 12 that is constructed from Table 11.

4.3 JOBAN LINE REGION

From Table 13, we can notice that the secondary industry of tne Joban Line region had been in the stage of accelerating suburbanization until the early 1970s. Then, it started decelerting the speed of suburbanization. The table also indicates that the tertiary industry of the Joban region experienced the decelerating centralization throughout the 1960s. Around 1970, the spatial redistribution process for the jobs created by the tertiary industry reached the suburbanization stage with its speed of suburbanization accelerating afterwards.

As previously investigated, the spatial redistribution process of the population in the Joban Line region had been in the stage of accelerating centralization in the 1960s. Around 1970, the spatial redistribution process of the population entered the stage of suburbanization with the speed of suburbanization accelerating throughout the 1970s just like as the spatial redistribution process of the tertiary industry in the region. However, it seems that the population of the Joban Line region had been acceleratingly suburbanized in the 1970s reasonably ahead of the region's tertiary industry since the value of ROXY index for the population was always higher during the 1970s than that for the tertiary industry.

本論文目次

Table 11 ROXY Index for the Takasaki Line Region

Category		Persons in 1980 (Mil.)	ROXY Index			
			1960–65	1965–70	1970–75	1975–80
Population		10.21	−75.63	3.95	25.79	38.94
R	Secondary Industry	1.65	12.10	26.29	137.08	42.90
	Tertiary Industry	3.37	−57.30	9.34	25.71	45.34
W	Secondary Industry	2.21	62.39	115.27	30.41	18.57
	Tertiary Industry	4.65	−60.05	−19.35	16.56	28.11

(Note) 1. R : Employed Persons (15 Years of Age and Over) by Place of Residence
2. W : Employed Persons (15 Years of Age and Over) by Place of Work
3. The Takasaki Line region has fourteen component localities.

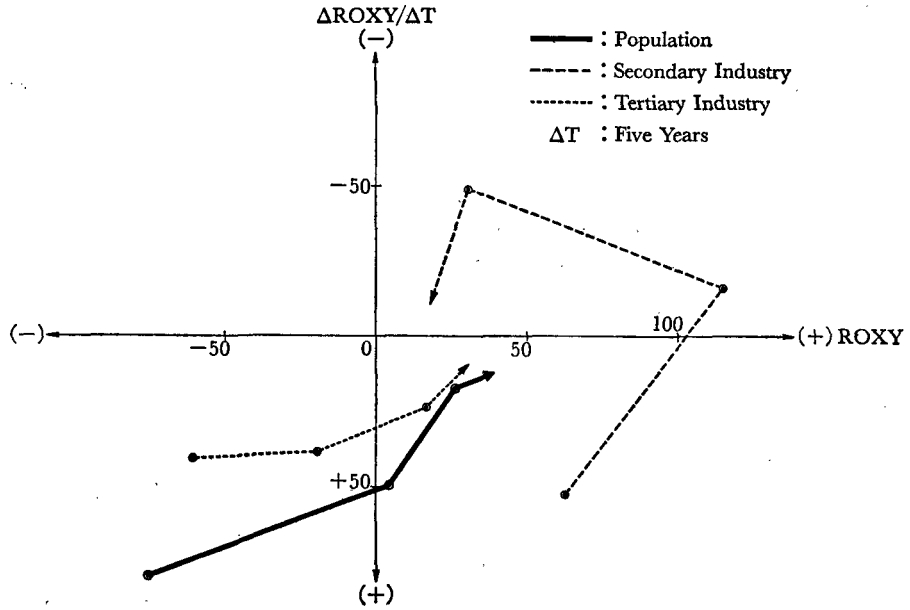


Figure 9 ROXY Index and Its Marginal Change for Takasaki Line Region

Table 12 Value of ROXY Index and Its Marginal Change for the Takasaki Line Region

Category		1960–65		1965–70		1970–75		1975–80	
		ROXY	$\frac{\Delta ROXY}{\Delta T}$	ROXY	$\frac{\Delta ROXY}{\Delta T}$	ROXY	$\frac{\Delta ROXY}{\Delta T}$	ROXY	$\frac{\Delta ROXY}{\Delta T}$
Population		−75.63	79.58	3.95	50.71	25.79	17.50	38.94	13.15
W	Secondary Industry	62.39	52.88	115.27	−15.99	30.41	−48.35	18.57	−11.84
	Tertiary Industry	−60.05	40.70	−19.35	38.31	16.56	23.7	28.11	11.55

(Note) 1 W : Employed Persons (15 Years of Age and Over) by Place of work
2. ΔT : Five Years

Table 13 ROXY Index for the Joban Line Region

Category		Persone in 1980 (Mil.)	ROXY Index			
			1960–65	1965–70	1970–75	1975–80
Population		9.38	−82.28	−25.74	16.05	36.05
R	Secondary Industry	1.47	18.45	44.96	63.43	44.77
	Tertiary Industry	3.16	−73.86	− 4.53	16.46	41.15
W	Secondary Industry	2.05	2.04	56.42	85.61	7.72
	Tertiary Industry	4.46	−58.06	−21.76	1.18	19.37

(Note) 1. R : Employed Persons (15 Years of Age and Over) by Place of Residence
2. W : Employed Persons (15 Years of Age and Over) by Place of Work
3. The Joban Line region has nine component localities.

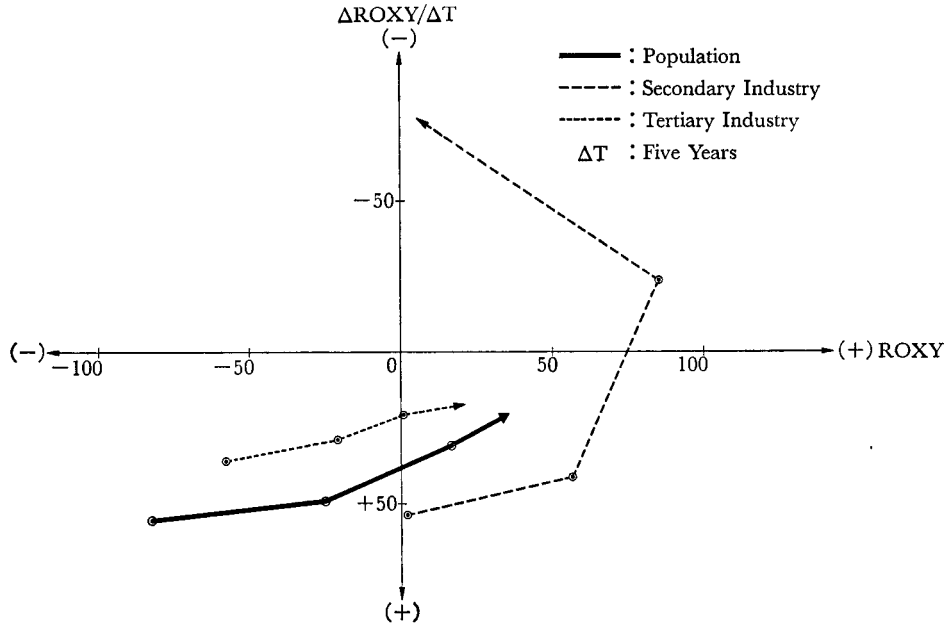


Figure 10 ROXY Index and Its Marginal Change for Joban Line Region

Table 14 Value of ROXY Index and Its Marginal Change for the Joban Line Region

Category		1960–65		1965–70		1970–75		1975–80	
		ROXY	$\frac{\Delta ROXY}{\Delta T}$	ROXY	$\frac{\Delta ROXY}{\Delta T}$	ROXY	$\frac{\Delta ROXY}{\Delta T}$	ROXY	$\frac{\Delta ROXY}{\Delta T}$
Population		−82.28	56.54	−25.74	49.17	16.05	30.90	36.05	20.00
W	Secondary Industry	2.04	54.38	56.42	41.79	85.61	−24.35	7.72	−77.89
	Tertiary Industry	−58.06	36.30	−21.76	29.64	1.18	20.57	19.37	18.19

(Note) 1. W : Employed Persons (15 Years of Age and Over) by Place of Work
2. ΔT : Five Ycars

Summing up, in the Joban Line region, the people had followed the job market of the secondary industry for the twenty years from 1960 through 1980, while the tertiary industry had come after the people during the same period. Among the population and two kinds of job markets in the Joban Line region, the movements of relative positions along the dynamic path in the spatial cycle scheme are diagrammatically visualized in Figure 10 which we can produce on the basis of Table 14 that is constructed from Table 13.

5. CONCLUSION

Through the examination of the spatial redistribution patterns of population (by place of residence) and employed persons (by place of work) by means of the spatial cycle concept and the ROXY index analysis, in the present study we have tried to shed a light on some basic characteristics of the labour and job markets in Tokyo metropolitan area. Precisely, we have learned in Section 3 that Tokyo metropolitan area had been clockwisely developed with respect to the agglomeration of population. This goes for the industrial development pattern too; the close comparison of spatial cycle paths of the secondary and tertiary industries of the Chuo Line, Takasaki Line and Joban Line regions which are respectively illustrated in Figures 8, 9 and 10, would lead us to recognize that, geographically speaking, Tokyo metropolitan area has been developed clockwilsely with respect to both secondary and tertiary industries. At the same time in section 4, we have noticed a general tendency that, in Tokyo metropolitan area, the people follow the secondary industry while the tertiary industry follows the people.

In short, the present study has provided empirical evidences for the existence of statistical regularities which would reasonably support the spatial cycle hypothesis, suggesting us that the "spatial cycle/ROXY index" approach may become a more potentially promissing instrument for the investigation of intra- and inter-metropolitan shifts of labour and job markets once appropriate series of researches have been stepwisely carried out to improve the scheme of spatial cycle concept and to enrich the method of ROXY index analysis.

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NOTES

1) The boundaries of FUCs have been delineated by T. Kawashima and N. Glickman. They are those boundaries as of 1970 and fixed over time. See Kawashima (1982) for the details of the definition of FUCs.
2) For a discussion of the type-β and type-γ spatial cycle schemes, see Kawashima (1986b).
3) Strictly speaking, the ROXY index defined in this manner, is the ROXY index (Type II) which is a slightly revised version of the original (Type I) developed by Kawashima (1982). For a further discussion of the basic features and applications of ROXY index, see Kawashima (1985, 1986a).
4) Note that stages of decelerating centralization, accelerating suburbanization, decelerating suburbanization and accelerating centralization in Figure 2, would respectively correspond to the stages of urbanization, suburbanization, disurbanization and reurbanization in Figure 1.
5) Centralization in the context of this sentence means the situation where population grows faster in inner distance-zones of a metropolitan area as compared with its outer distance-zones, provided that the inner distance-zones are roughly defined as those distance-zones inside the critical circular-line which divides the constituent localities of the metropolitan area into two parts, each part containing approximately the same amount of localities. As its logical consequence, suburbanization means the phenomenon that population generally grows faster in outer distance-zones than inner distance-zones.
6) The stage of decelerating centralization corresponds to the phenomenon that population generally grows faster in the inner distance-zones of a metropolitan area than in its outer distance-zones, but that the discrepancy in population growth rates between inner and outer distance-zones is narrowing. The decelerating centerlization could also correspond to the phenomenon that the population growth rates are dominantly positive for localities in inner distance-zones and dominantly negative for localities in outer distance-zones; the difference, however, in the rates between the distance-zone groups is narrowing. It should be noted that the decelerating centralization could additionally mean that population declines slower in inner distance-zones than in outer distance-zones, but that the discrepancy in population decline rates is narrowing.
7) Note that, in Tokyo FUC, there are two other primary railway-line rgeions; the Tokaido Line region extending southwards and the Sobu Line region extending eastwards. They were excluded from our analysis, partly because each of them is bi-centric in the density of economic and residential activities and partly because the number of localities comprising each region is relatively small. If we had included them in our analysis, then we might not have got such a clear "clockwise suburbanization tendency" for Tokyo FUC as we got in our analysis. In this sense, the terminology of "clockwise suburbanization" should be carefully interpreted in the present paper to avoid the misunderstanding of its implications.

APPENDIX

Table A-1 Five-year Growth Rate of Population for Localities of Three Railway-line Regions in Tokyo FUC (%)

(a) Chuo Line Region

Code Number	Distance	1960-65	1965-70	1970-75	1975-80
13100	7.4	7.02	−0.59	−2.24	−3.40
13204	18.5	38.59	14.59	5.88	−0.24
13203	18.5	10.95	2.58	1.85	−1.86
13210	23.7	66.94	23.70	8.74	−0.28
13206	25.8	53.76	29.26	11.77	5.26
13214	27.5	66.02	25.19	8.49	3.24
13215	29.2	33.33	37.33	7.86	−0.39
13202	31.0	22.88	16.24	17.97	3.26
13212	33.2	56.66	44.98	28.61	14.72
13201	40.3	26.20	22.03	27.23	20.03

(b) Takasaki Line Region

Code Number	Distance	1960-65	1965-70	1970-75	1975-80
13100	7.4	7.02	−0.59	−2.24	−3.40
11203	14.8	43.42	22.79	12.97	9.78
11226	17.2	80.59	37.36	10.35	−1.31
11223	18.0	36.82	10.77	−1.18	−7.12
11204	23.2	26.88	21.72	22.92	8.16
11220	26.0	26.70	21.37	13.13	1.80
11205	28.0	26.85	24.64	21.92	8.05
11219	36.5	40.85	102.26	32.10	13.59
11231	40.2	31.91	37.74	24.06	16.06
11233	44.0	32.89	54.06	47.11	9.13
11217	48.0	14.62	14.96	22.96	10.56
11304	54.5	19.74	19.09	8.86	20.40
11202	61.7	11.62	10.28	8.81	4.05
11218	72.5	2.28	11.17	9.48	8.57

(c) Joban Line Region

Code Number	Distance	1960-65	1965-70	1970-75	1975-80
13100	7.4	7.02	−0.59	−2.24	−3.40
12207	17.8	85.25	58.49	35.87	16.35
12217	28.6	71.37	37.89	34.80	17.80
12222	31.7	22.74	48.24	54.79	32.59
8217	36.5	15.93	53.89	31.11	34.88
8563	41.4	3.14	25.43	25.13	29.68
8208	45.6	3.98	6.73	8.86	6.32
8444	48.0	6.65	12.61	42.86	45.15
8203	58.5	10.64	13.91	15.64	8.16

本論文目次

Table A-2 Employed Persons (15 Years of Age and Over) by Place of Work for the Chuo Line Region: Secondary Industry

(a) Employed Persons (unit: person)

Code Number	Distance	1960	1965	1970	1975	1980
13100	7.4	1,992,935	2,280,820	2,228,595	2,058,836	1,940,383
13204	18.5	18,358	21,883	24,544	21,130	20,762
13203	18.5	10,132	12,208	12,509	11,408	11,439
13210	23.7	4,033	5,957	6,630	6,068	6,008
13206	25.8	10,701	21,706	30,417	29,580	31,831
13214	27.5	3,653	4,060	5,129	4,940	5,213
13215	29.2	1,542	2,397	3,075	3,259	3,540
13202	31.0	9,013	11,817	14,268	13,168	14,693
13212	33.2	10,806	18,752	21,693	22,009	21,666
13201	40.3	25,448	39,766	48,993	45,718	49,239
Total	255.1	2,086,621	2,419,366	2,395,853	2,216,116	2,104,774

(b) Five-year Growth Rate (%)

Code Number	Distance	1960-65	1965-70	1970-75	1975-80
13100	7.4	14.45	−2.29	−7.62	−5.75
13204	18.5	19.20	12.16	−13.91	−1.74
13203	18.5	20.49	2.47	−8.80	0.27
13210	23.7	47.71	11.30	−8.48	−0.99
13206	25.8	102.84	40.13	−2.75	7.61
13214	27.5	11.14	26.33	−3.68	5.53
13215	29.2	55.45	28.29	5.98	8.62
13202	31.0	31.11	20.74	−7.71	11.58
13212	33.2	73.53	15.68	1.46	−1.58
13201	40.3	56.26	23.20	−6.68	7.70

(c) Annual Growth Ratio

Code Number	Distance	1960-65	1965-70	1970-75	1975-80
13100	7.4	1.0274	0.9954	0.9843	0.9882
13204	18.5	1.0358	1.0232	0.9705	0.9965
13203	18.5	1.0380	1.0049	0.9817	1.0005
13210	23.7	1.0811	1.0216	0.9824	0.9980
13206	25.8	1.1519	1.0698	0.9944	1.0148
13214	27.5	1.0214	1.0479	0.9925	1.0108
13215	29.2	1.0922	1.0511	1.0117	1.0167
13202	31.0	1.0557	1.0384	0.9841	1.0222
13212	33.2	1.1165	1.0296	1.0029	0.9969
13201	40.3	1.0934	1.0426	0.9863	1.0149
Total	255.1	10.7134	10.3245	9.8908	10.0595

本論文目次

Table A-3 Employed Persons (15 Years of Age and Over) by Place of Work for the Chuo Line Region: Tertiary Industry

(a) Employed Persons (unit: person)

Code Number	Distance	1960	1965	1970	1975	1980
13100	7.4	2,513,984	3,224,223	3,628,847	4,011,682	4,263,541
13204	18.5	13,234	19,644	26,906	31,167	34,358
13203	18.5	23,357	29,793	33,852	40,475	46,947
13210	23.7	6,356	11,630	15,800	17,695	20,036
13206	25.8	18,085	22,218	32,706	38,006	45,322
13214	27.5	6,828	11,403	14,916	17,224	19,078
13215	29.2	4,620	7,195	10,851	12,732	15,061
13202	31.0	32,633	40,200	46,219	47,862	52,796
13212	33.2	3,805	7,857	15,245	18,505	23,372
13201	40.3	28,257	39,850	53,703	68,483	85,671
Total	255.1	2,651,159	3,414,013	3,879,045	4,303,831	4,606,182

(b) Five-year Growth Rate (%)

Code Number	Distance	1960-65	1965-70	1970-75	1975-80
13100	7.4	28.25	12.55	10.55	6.28
13204	18.5	48.44	36.97	15.84	10.24
13203	18.5	27.55	13.62	19.56	15.99
13210	23.7	82.98	35.86	11.99	13.23
13206	25.8	22.85	47.20	16.20	19.25
13214	27.5	67.00	30.81	15.47	10.76
13215	29.2	55.74	50.81	17.33	18.29
13202	31.0	23.19	14.97	3.55	10.31
13212	33.2	106.49	94.03	21.38	26.30
13201	40.3	41.03	34.76	27.52	25.10

(c) Annual Growth Ratio

Code Number	Distance	1960-65	1965-70	1970-75	1975-80
13100	7.4	1.0510	1.0239	1.0203	1.0123
13204	18.5	1.0822	1.0649	1.0298	1.0197
13203	18.5	1.0499	1.0259	1.0364	1.0301
13210	23.7	1.1284	1.0632	1.0229	1.0252
13206	25.8	1.0420	1.0804	1.0305	1.0358
13214	27.5	1.1080	1.0552	1.0292	1.0207
13215	29.2	1.0926	1.0856	1.0325	1.0342
13202	31.0	1.0426	1.0283	1.0070	1.0198
13212	33.2	1.1561	1.1418	1.0395	1.0478
13201	40.3	1.0712	1.0615	1.0498	1.0458
Total	255.1	10.8240	10.6307	10.2979	10.2913

本論文目次

Table A-4 Employed Persons (15 Years of Age and Over) by Place of Work for the Takasaki Line Region: Secondary Industry

(a) Employed Persons (unit: person)

Code Number	Distance	1960	1965	1970	1975	1980
13100	7.4	1,992,935	2,280,820	2,228,595	2,058,836	1,940,383
11203	14.8	52,210	67,183	78,883	72,142	74,353
11226	17.2	4,420	4,438	7,927	7,993	8,175
11223	18.0	6,955	11,481	12,192	10,141	10,190
11204	23.2	15,934	25,388	31,349	33,009	34,628
11220	26.0	9,250	11,099	12,433	10,901	10,656
11205	28.0	16,133	29,401	37,431	38,303	40,874
11219	36.5	7,040	13,705	20,314	23,044	26,491
11231	40.2	3,148	5,069	7,313	6,697	6,997
11233	44.0	810	1,922	4,322	4,882	5,471
11217	48.0	2,284	4,105	5,105	6,295	7,158
11304	54.5	3,818	4,318	6,086	5,089	4,893
11202	61.7	10,690	16,108	19,151	18,426	20,058
11218	72.5	5,414	7,634	14,521	14,902	15,016
Total	492.0	2,131,041	2,482,671	2,485,622	2,310,660	2,205,343

(b) Five-year Growth Rate (%)

Code Number	Dis tance	1960-65	1965-70	1970-75	1975-80
13100	7.4	14.45	−2.29	−7.62	−5.75
11203	14.8	28.68	17.42	−8.55	3.06
11226	17.2	0.41	78.62	0.83	2.28
11223	18.0	65.08	6.19	−16.82	0.48
11204	23.2	59.33	23.48	5.30	4.90
11220	26.0	19.99	12.02	−12.32	−2.25
11205	28.0	82.24	27.31	2.33	6.71
11219	36.5	94.67	48.22	13.44	14.96
11231	40.2	61.02	44.27	−8.42	4.48
11233	44.0	137.28	124.87	12.96	12.06
11217	48.0	79.73	24.36	23.31	13.71
11304	54.5	13.10	40.94	−16.38	−3.85
11202	61.7	50.68	18.89	−3.79	8.86
11218	72.5	41.00	90.21	2.62	0.76

Table A-4 (Continued)

(c) Annual Growth Ratio

Code Number	Distance	1960–65	1965–70	1970–75	1975–80
13100	7.4	1.0274	0.9954	0.9843	0.9882
11203	14.8	1.0517	1.0326	0.9823	1.0061
11226	17.2	1.0008	1.1230	1.0017	1.0045
11223	18.0	1.1054	1.0121	0.9638	1.0010
11204	23.2	1.0976	1.0431	1.0104	1.0096
11220	26.0	1.0371	1.0230	0.9740	0.9955
11205	28.0	1.1275	1.0495	1.0046	1.0131
11219	36.5	1.1425	1.0819	1.0255	1.0283
11231	40.2	1.1000	1.0761	0.9826	1.0088
11233	44.0	1.1886	1.1759	1.0247	1.0230
11217	48.0	1.1244	1.0446	1.0428	1.0260
11304	54.5	1.0249	1.0711	0.9649	0.9922
11202	61.7	1.0855	1.0352	0.9923	1.0171
11218	72.5	1.0711	1.1372	1.0052	1.0015
Total	492.0	15.1847	14.9006	13.9590	14.1149

Table A-5 Employed Persons (15 Years of Age and Over) by Place of Work for the Takasaki Line Region: Tertiary Industry

(a) Employed Persons (unit: person)

Code Number	Distance	1960	1965	1970	1975	1980
13100	7.4	2,513,984	3,224,223	3,628,847	4,011,682	4,263,541
11203	14.8	21,504	33,986	47,447	59,320	71,382
11226	17.2	2,050	3,436	5,592	7,016	7,981
11223	18.0	5,269	8,530	11,422	13,107	13,947
11204	23.2	29,626	41,314	54,333	67,621	82,818
11220	26.0	5,192	7,424	9,664	11,656	14,433
11205	28.0	30,133	41,914	60,245	76,196	90,108
11219	36.5	3,674	5,817	11,589	17,978	24,550
11231	40.2	2,150	2,966	4,718	6,195	7,821
11233	44.0	1,159	1,790	2,894	5,089	6,722
11217	48.0	3,845	4,807	5,900	7,613	9,008
11304	54.5	1,100	1,429	1,766	2,306	2,882
11202	61.7	19,004	26,951	32,797	36,767	41,920
11218	72.5	7,534	8,652	10,668	12,288	14,956
Total	492.0	2,646,224	3,413,239	3,887,882	4,334,834	4,652,069

本論文目次

Table A-5 (Continued)

(b) Five-year Growth Rate (%)

Code Number	Distance	1960-65	1965-70	1970-75	1975-80
13100	7.4	28.25	12.55	10.55	6.28
11203	14.8	58.05	39.61	25.02	20.33
11226	17.2	67.61	62.75	25.46	13.75
11223	18.0	61.89	33.90	14.75	6.41
11204	23.2	39.45	31.51	24.46	22.47
11220	26.0	42.99	30.17	20.61	23.82
11205	28.0	39.10	43.73	26.48	18.26
11219	36.5	58.33	99.23	55.13	36.56
11231	40.2	37.95	59.07	31.31	26.25
11233	44.0	54.44	61.68	75.85	32.09
11217	48.0	25.02	22.74	29.03	18.32
11304	54.5	29.91	23.58	30.58	24.98
11202	61.7	41.82	21.69	12.10	14.02
11218	72.5	14.84	23.30	15.19	21.71

(c) Annual Growth Ratio

Code Number	Distance	1960-65	1965-70	1970-75	1975-80
13100	7.4	1.0510	1.0239	1.0203	1.0123
11203	14.8	1.0959	1.0690	1.0457	1.0377
11226	17.2	1.1088	1.1023	1.0464	1.0261
11223	18.0	1.1011	1.0601	1.0279	1.0125
11204	23.2	1.0688	1.0563	1.0447	1.0414
11220	26.0	1.0741	1.0542	1.0382	1.0437
11205	28.0	1.0682	1.0753	1.0481	1.0341
11219	36.5	1.0963	1.1478	1.0918	1.0643
11231	40.2	1.0665	1.0973	1.0560	1.0477
11233	44.0	1.0908	1.1009	1.1195	1.0572
11217	48.0	1.0457	1.0418	1.0523	1.0342
11304	54.5	1.0537	1.0433	1.0548	1.0456
11202	61.7	1.0724	1.0400	1.0231	1.0266
11218	72.5	1.0281	1.0428	1.0287	1.0401
Total	492.0	15.0214	14.9549	14.6975	14.5235

本論文目次

Table A-6 Employed Persons (15 Years of Age and Over) by Place of Work for the Joban Line Region: Secondary Industry

(a) Employed Persons (unit: person)

Code Number	Distance	1960	1965	1970	1975	1980
13100	7.4	1,992,935	2,280,820	2,228,595	2,058,836	1,940,383
12207	17.8	5,411	20,352	35,202	34,802	39,076
12217	28.6	2,877	9,072	18,774	22,497	25,726
12222	31.7	2,006	3,007	4,493	4,725	5,848
8217	36.5	1,387	3,619	5,569	6,418	7,257
8563	41.4	312	1,282	1,981	2,375	2,457
8208	45.6	2,369	3,665	5,533	6,385	6,446
8444	48.0	613	1,334	2,016	2,646	3,254
8203	58.5	5,591	9,278	15,030	19,538	19,547
Total	315.5	2,013,501	2,332,429	2,317,193	2,158,222	2,049,994

(b) Five-year Growth Rate (%)

Code Number	Distance	1960–65	1965–70	1970–75	1975–80
13100	7.4	14.45	−2.29	−7.62	−5.75
12217	17.8	276.12	72.97	−1.14	12.28
12207	28.6	215.33	106.94	19.83	14.35
12222	31.7	49.90	49.42	5.16	23.77
8217	36.5	160.92	53.88	15.25	13.07
8563	41.4	310.90	54.52	19.89	3.45
8208	45.6	54.71	50.97	15.40	0.96
8444	48.0	117.62	51.12	31.25	22.98
8203	58.5	65.95	62.00	29.99	0.05

(c) Annual Growth Ratio

Code Number	Distance	1960–65	1965–70	1970–75	1975–80
13100	7.4	1.0274	0.9954	0.9843	0.9882
12207	17.8	1.3034	1.1158	0.9977	1.0234
12217	28.6	1.2582	1.1566	1.0368	1.0272
12222	31.7	1.0843	1.0836	1.0101	1.0436
8217	36.5	1.2114	1.0900	1.0288	1.0249
8563	41.4	1.3266	1.0909	1.0369	1.0068
8208	45.6	1.0912	1.0859	1.0291	1.0019
8444	48.0	1.1683	1.0861	1.0559	1.0422
8203	58.5	1.1066	1.1013	1.0539	1.0001
Total	315.5	10.5774	9.8056	9.2335	9.1583

Table A-7 Employed Persons (15 Years of Age and Over) by Place of Work for the Joban Line Region: Tertiary Industry

(a) Employed Persons (unit: person)

Code Number	Distance	1960	1965	1970	1975	1980
13100	7.4	2,513,984	3,224,223	3,628,847	4,011,682	4,263,541
12207	17.8	11,824	19,425	35,235	50,646	67,990
12217	28.6	6,979	13,231	22,074	33,098	44,677
12222	31.7	3,095	3,636	5,605	8,574	12,442
8217	36.5	3,098	3,597	5,330	8,033	10,929
8563	41.4	1,121	1,185	1,723	2,495	3,358
8208	45.6	4,767	5,549	7,116	8,000	9,115
8444	48.0	1,357	1,800	2,422	3,345	5,142
8203	58.5	17,375	21,750	27,717	34,271	40,256
Total	315.5	2,563,600	3,294,396	3,736,069	4,160,144	4,457,450

(b) Five-year Growth Rate (%)

Code Number	Distance	1960-65	1965-70	1970-75	1975-80
13100	7.4	28.25	12.55	10.55	6.28
12207	17.8	64.28	81.39	43.74	34.25
12217	28.6	89.58	66.84	49.94	34.98
12222	31.7	17.48	54.15	52.97	45.11
8217	36.5	16.11	48.18	50.71	36.05
8563	41.4	5.71	45.40	44.81	34.59
8208	45.6	16.40	28.24	12.42	13.94
8444	48.0	32.65	34.56	38.11	53.72
8203	58.5	25.18	27.43	23.65	17.46

(c) Annual Growth Ratio

Code Number	Distance	1960-65	1965-70	1970-75	1975-80
13100	7.4	1.0510	1.0239	1.0203	1.0123
12207	17.8	1.1044	1.1265	1.0753	1.0607
12217	28.6	1.1365	1.1078	1.0844	1.0618
12222	31.7	1.0327	1.0904	1.0887	1.0773
8217	36.5	1.0303	1.0818	1.0855	1.0635
8563	41.4	1.0112	1.0777	1.0769	1.0612
8208	45.6	1.0308	1.0510	1.0237	1.0264
8444	48.0	1.0581	1.0612	1.0667	1.0898
8203	58.5	1.0459	1.0497	1.0434	1.0327
Total	315.5	9.5010	9.6700	9.5648	9.4857