

## **Aged Population in Spatial Cycles: ROXY Index Analysis for Chuo-line Region in Tokyo Metropolitan Area**

Tatsuhiko Kawashima\*

Noriyuki Hiraoka\*

### **Contents**

- 1 Introduction
- 2 ROXY Index for Continuous-linear Region
- 3 Aged Population in Chuo-line Region
- 4 Conclusion
- Notes
- References
- Appendix

### **Abstract**

The stages of the centralization and decentralization of aged population in the Chuo-line region of the Tokyo metropolitan area are investigated. The ROXY-index method and the spatial-cycle hypothesis are applied to the investigations. The aged population seems to have been less advanced, along the spatial-cycle path, than the productive-age population in terms of the population level. The aged population seems to have been stickier to the urban core of the Tokyo metropolitan area than the productive-age population in terms of the population share.

### **Key Words**

Aged population, Centralization, Continuous-linear region, Decentralization,  
ROXY index, Spatial cycles, Tokyo

---

\* Kawashima is associated with the Economics Department of Gakushuin University in Tokyo, and Hiraoka with the National Infrastructure Department of Mitsubishi Research Institute in Tokyo. Kawashima gratefully acknowledges the research support from the Grant-in-Aid for General Scientific Research of the Ministry of Education, Science and Culture.

## 1 Introduction

In 1990, the national population of Japan amounts to 123,611,000. Against this number, the share of the aged population which shall be defined as the number of persons who are at the age of 65 years or over, is 12.0% as compared with 4.9% in 1950, 5.7% in 1960, 7.1% in 1970 and 9.1% in 1980. Meanwhile, the population of the Tokyo prefecture in 1990 totals 11,856,000, 10.5% of which is shared by the aged population as compared with 3.2% in 1950, 3.8% in 1960, 5.2% in 1970 and 7.7% in 1980. For both of the national population and Tokyo prefectural population, the share of the aged population shows a steady increase over the past four decades. At the same time, it can be reasonably expected that this tendency would last in future for a considerably long period. This structural change in the age distribution of population would inevitably requires on the long-run basis that the national, regional and urban policies for the years to come should meet the new types of social needs generated through the growing share of the aged population.

The above understanding would make us become interested in comparing the relative stages of spatial centralization (*i.e.*, urbanization) and decentralization (*i.e.*, suburbanization)<sup>1)</sup> in the Tokyo metropolitan area, among the three age-specific classes of population; (i) younger population (*i.e.*, the number of persons who are under 14 years old), (ii) productive-age population (*i.e.*, the number of persons who are 15 years old or over but under 65 years), and (iii) aged population (*i.e.*, the number of persons who are 65 years old or over). In order to investigate this theme, we choose as the object of our study the Chuo-line region which is one of the major railway-line regions extending in the Tokyo metropolitan area from its CBD to outskirts. We apply in our investigation the ROXY-index method<sup>2)</sup> as its analytical instrument and the spatial-cycle hypothesis<sup>3)</sup> developed by Klaassen as its theoretical framework.

## 2 ROXY-Index for Continuous-linear Region

Among the possible regional-form systems conceived for the ROXY-index analysis on the spatial redistribution processes within a metropolitan area, are (i) the system of the discrete-linear region, (ii) the system of the continuous-linear-region, and (iii) the system of the fan-shaped region<sup>4)</sup>. For each of the systems, as a weighing factor in the calculation of the ROXY-index value, we can employ either the CBD distance or the reversed CBD distance. Picking up the system of the continuous-linear region for our analysis, we have the mathematical formulation of the ROXY index  $R_L$  with the weighing factor of the reversed CBD distance, as follows ;

$$R_L = \frac{(d_1 - d_0) \cdot \int_{d_0}^{d_1} w(x) r_L^{t,t+1}(x) dx}{\int_{d_0}^{d_1} w(x) dx \cdot \int_{d_0}^{d_1} r_L^{t,t+1}(x) dx} - 1.0$$

where

$r_L^{t,t+1}(x)$  : Population growth ratio at distance  $x$  in the one-dimensional continuous-linear region for the period between time  $t$  and  $t+1$ , that is,

$$r_L^{t,t+1}(x) \equiv \frac{n_L^{t+1}(x)}{n_L^t(x)}$$

$n_L^t(x)$  : Population density at the distance  $x$  in the one-dimensional continuous-linear region at time  $t$

$n_L^{t+1}(x)$  : Population density at distance  $x$  in the one-dimensional continuous-linear region at time  $t+1$

$x$  : Distance to the CBD of the central city of a metropolitan area

$d_0$  : Nearest distance to the center

$d_1$  : Farthest distance from the center

### 3 Aged Population in Chuo-line Region

The Chuo-line region consists of sixteen (16) localities in the disaggregated case<sup>5)</sup> and eleven (11) localities in the aggregated case<sup>6)</sup> as shown in Table A-1 in Appendix. From this table which furnishes us with the information on the population level of each locality by age-specific class, we know that the share of the aged population in the Chuo-line region has continuously increased from 4.6% in 1960 to 11.0% in 1990. Using Tables A-1 and A-2, we get Tables A-3 through A-6 showing both five-year and annual growth ratios by locality for the age-specific population and its share against the total population.

Here is a point of concern as to Fujino-machi (Fujino town). Even though this town is included in the Tokyo metropolitan area delineated in Kawashima *et al.* (1993) as a functional urban region, it is the remotest locality of the Chuo-line region and distantly (by 15.2km) separated by a mountain from Hachioji-shi (Hachioji city) which is included in the Chuo-line region and which is the nearest neighboring member locality (of the Chuo-line region) to Fujino-machi. Moreover, Fujino-machi carries a rather basic rural characteristics as to the pattern of the changes in the share of the aged population. In the light of the aforementioned, and due to the fact that the disaggregated case would be more precise than the aggregated case in formulating a realistic railway-line region, from now on we focus our attention upon the disaggregated case which excludes Fujino-machi.

Tables 1 and 2 show the ROXY-index values for the age-specific population and its share for the disaggregated case without Fujino-machi. The similar pair of values are provided by Tables 3 and 4 for the aggregated case without Fujino-machi, by Tables 5 and 6 for the disaggregated case with Fujino-machi, and by Tables 7 and 8 for the aggregated case with Fujino-machi. We obtain Figures 1 and 2 from Tables 1 and 2 respectively. We also obtain, for reference, Figures A-1 through A-6 in Appendix from Tables 3 through 8 respectively.

From Table 1, the followings can be pointed out as to the ROXY-index values and their marginal changes for the level of population by age-specific class.

**Table 1 ROXY Index in Disaggregated Case without Fujino-machi: Population**

Class of ages		1960-65	1965-70	1970-75	1975-80	1980-85	1985-90
14 and under	ROXY	-228.00	-205.38	-142.31	-90.64	-29.79	-60.93
	$\Delta$ ROXY/ $\Delta$ T	4.52	8.57	11.47	11.25	2.97	-6.23
Over 14 and under 65	ROXY	-226.65	-205.00	-140.94	-114.55	-67.48	-114.60
	$\Delta$ ROXY/ $\Delta$ T	4.33	8.57	9.04	7.35	0.00	-9.42
65 and over	ROXY	-96.38	-130.39	-93.26	-77.43	-66.63	-80.72
	$\Delta$ ROXY/ $\Delta$ T	-13.04	0.31	5.30	2.66	-0.33	-2.82
All ages	ROXY	-213.98	-201.74	-138.98	-100.60	-51.88	-93.15
	$\Delta$ ROXY/ $\Delta$ T	-20.17	7.50	10.11	8.71	0.75	-8.25

**Table 2 ROXY Index in Disaggregated Case without Fujino-machi: Population Share**

Class of ages		1960-65	1965-70	1970-75	1975-80	1980-85	1985-90
14 and under	ROXY	-14.10	-2.97	-2.30	10.22	22.64	38.34
	$\Delta$ ROXY/ $\Delta$ T	2.23	1.18	1.32	2.49	2.81	3.14
Over 14 and under 65	ROXY	-13.04	-3.52	-2.33	-13.97	-15.11	-25.75
	$\Delta$ ROXY/ $\Delta$ T	1.90	1.07	-1.05	-1.28	-1.18	-2.13
65 and over	ROXY	121.01	72.19	45.76	22.58	-14.95	7.92
	$\Delta$ ROXY/ $\Delta$ T	-9.77	-7.53	-4.96	-6.07	-1.47	4.57

**Table 3 ROXY Index in Aggregated Case without Fujino-machi: Population**

Class of ages		1960-65	1965-70	1970-75	1975-80	1980-85	1985-90
14 and under	ROXY	-184.63	-165.49	-122.96	-74.48	-184.63	-9.31
	$\Delta$ ROXY/ $\Delta$ T	3.83	6.17	9.10	-6.17	6.52	35.06
Over 14 and under 65	ROXY	-175.73	-166.24	-110.21	-89.70	-43.88	-53.74
	$\Delta$ ROXY/ $\Delta$ T	1.90	6.55	7.65	6.63	3.60	-1.97
65 and over	ROXY	-83.67	-97.46	-53.17	-27.05	-18.35	-35.71
	$\Delta$ ROXY/ $\Delta$ T	-9.75	3.05	7.04	3.48	-0.87	-3.47
All ages	ROXY	-170.06	265.81	321.92	351.66	411.06	403.40
	$\Delta$ ROXY/ $\Delta$ T	26.58	49.20	8.58	8.91	5.17	-1.53

**Table 4 ROXY index in Aggregated Case without Fujino-machi: Population Share**

Class of ages		1960-65	1965-70	1970-75	1975-80	1980-85	1985-90
14 and under	ROXY	-13.78	-1.14	-10.87	6.18	12.14	30.43
	$\Delta$ ROXY/ $\Delta$ T	2.53	0.29	0.73	2.30	2.43	3.66
Over 14 and under 65	ROXY	-6.06	-2.20	1.30	-9.28	-11.00	-13.79
	$\Delta$ ROXY/ $\Delta$ T	0.77	0.74	-0.71	-1.23	-0.45	-0.56
65 and over	ROXY	87.00	67.51	58.53	53.69	14.64	4.41
	$\Delta$ ROXY/ $\Delta$ T	-3.90	-2.85	-1.38	-4.39	-4.93	-2.05

Aged Population in Spatial Cycles: ROXY Index Analysis for Chuo-line Region  
in Tokyo Metropolitan Area (Kawashima, Hiraoka)

**Table 5 ROXY Index in Disaggregated Case: Population**

Class of ages		1960-65	1965-70	1970-75	1975-80	1980-85	1985-90
14 and under	ROXY	12.33	4.73	-13.48	-46.99	-32.90	12.91
	$\Delta$ ROXY/ $\Delta$ T	-1.52	-2.58	-5.17	-1.94	5.99	9.16
Over 14 and under 65	ROXY	-25.23	-67.08	-110.92	-104.07	-60.89	-122.08
	$\Delta$ ROXY/ $\Delta$ T	-8.37	-8.57	-3.70	5.00	-1.80	-12.24
65 and over	ROXY	22.58	13.19	-10.69	-43.50	-30.97	13.30
	$\Delta$ ROXY/ $\Delta$ T	1.32	-3.33	-5.67	-2.03	5.68	8.85
All ages	ROXY	-1.97	-26.88	-91.99	-95.82	-51.76	-87.12
	$\Delta$ ROXY/ $\Delta$ T	-2.69	-9.00	-6.89	4.02	0.87	-7.07

**Table 6 ROXY Index in Disaggregated Case: Population Share**

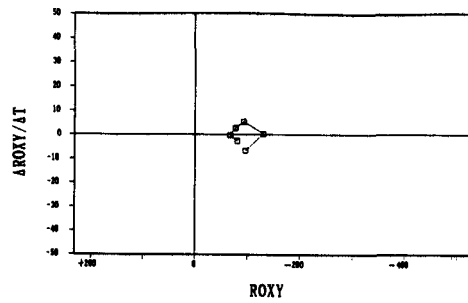
Class of ages		1960-65	1965-70	1970-75	1975-80	1980-85	1985-90
14 and under	ROXY	-14.13	42.17	9.60	-21.42	-11.51	5.71
	$\Delta$ ROXY/ $\Delta$ T	11.26	2.37	-6.36	-2.11	2.71	3.44
Over 14 and under 65	ROXY	-4.74	-16.97	-9.81	-1.16	-6.34	-37.92
	$\Delta$ ROXY/ $\Delta$ T	-2.45	-0.51	1.58	0.35	-3.68	-6.32
65 and over	ROXY	30.26	41.84	81.58	51.92	20.67	86.57
	$\Delta$ ROXY/ $\Delta$ T	2.32	5.13	1.01	-6.09	3.47	13.18

**Table 7 ROXY Index in Aggregated Case: Population**

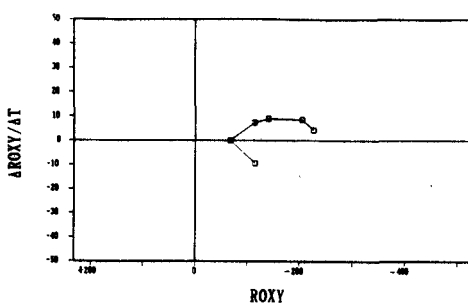
Class of ages		1960-65	1965-70	1970-75	1975-80	1980-85	1985-90
14 and under	ROXY	48.09	76.27	-49.74	-93.69	48.09	-53.15
	$\Delta$ ROXY/ $\Delta$ T	5.64	-9.78	-17.00	9.78	4.05	-20.25
Over 14 and under 65	ROXY	53.78	9.32	-65.40	-68.56	-36.15	-50.11
	$\Delta$ ROXY/ $\Delta$ T	-8.89	-11.92	-7.79	2.92	1.85	-2.79
65 and over	ROXY	51.76	51.59	20.95	-15.07	0.22	-6.74
	$\Delta$ ROXY/ $\Delta$ T	5.16	-3.08	-6.67	-2.07	0.83	-1.39
All ages	ROXY	58.36	-41.52	-130.42	-147.68	-105.14	-113.54
	$\Delta$ ROXY/ $\Delta$ T	-4.15	-18.88	-10.62	2.53	3.41	-1.68

**Table 8 ROXY Index in Aggregated Case: Population Share**

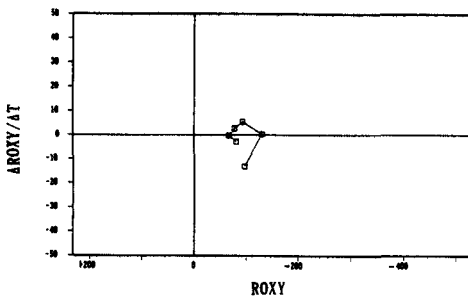
Class of ages		1960-65	1965-70	1970-75	1975-80	1980-85	1985-90
14 and under	ROXY	-9.89	49.20	8.99	-21.37	-20.65	-10.45
	$\Delta$ ROXY/ $\Delta$ T	11.82	1.89	-7.06	-2.96	1.09	2.04
Over 14 and under 65	ROXY	-5.02	-18.57	-7.54	3.56	-1.78	-7.44
	$\Delta$ ROXY/ $\Delta$ T	-2.71	-0.25	2.21	0.58	-1.10	-1.13
65 and over	ROXY	-10.26	24.71	79.68	57.18	34.72	36.17
	$\Delta$ ROXY/ $\Delta$ T	6.99	8.99	3.25	-4.50	-2.10	0.29



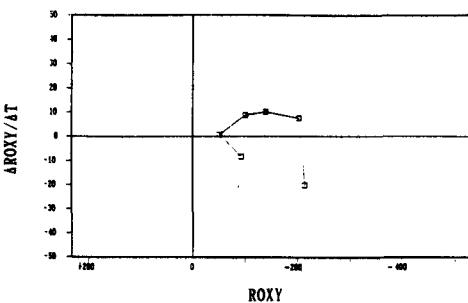
(a) 14 and under



(b) Over 14 and under 65



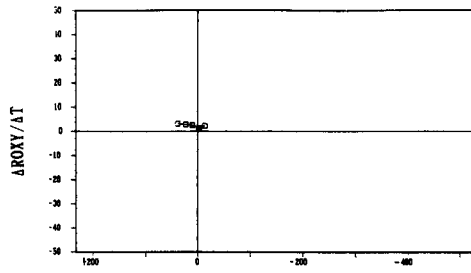
(c) 65 and Over



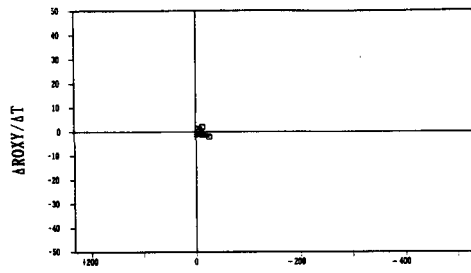
(d) All ages

Figure 1 Values of ROXY and Their Marginal Changes for Chuo-line Region excluding Fujino-machi: For Absolute Number of Population in Disaggregated Case

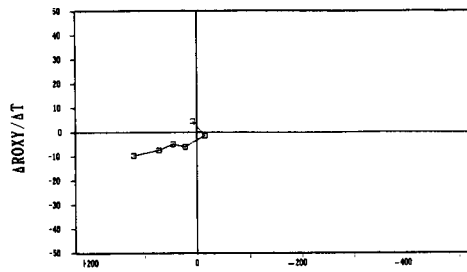
Aged Population in Spatial Cycles : ROXY Index Analysis for Chuo-line Region  
in Tokyo Metropolitan Area (Kawashima, Hiraoka)



(a) 14 and under



(b) Over 14 and under 65



(c) 65 and Over

Figure 2 Values of ROXY and Their Marginal Changes for Chuo-line Region excluding Fujino-machi: For Population Share in Disaggregated Case

- (1-0) For the total population of the Chuo-line region (without Fujino-machi), the value of the ROXY index increases from  $-213.98$  for the 1960-65 period to  $-51.88$  for the 1980-85 period. Then it turns to decrease to  $-93.15$  for the 1985-90 period. The marginal change in the value of the ROXY index,  $\Delta\text{ROXY}/\Delta T$ , increases from  $-20.17$  for the 1960-65 period to  $10.11$  for the 1970-75 period, and then turns to decrease to  $-8.25$  for the 1985-90 period.
- (1-1) For the younger population, the value of the ROXY index increases from  $-228.00$  for the 1960-65 period to  $-29.79$  for the 1980-85 period. Then it turns to decrease to  $-60.93$  for the 1980-85 period. The marginal change in the value of the ROXY index increases from  $4.52$  for the 1960-65 period to  $11.47$  for the 1970-75 period, and then turns to decreases to  $-6.23$  for the 1985-90 period.
- (1-2) For the productive-age population, the value of the ROXY index increases from  $-226.65$  for the 1960-65 period to  $-67.48$  for the 1980-85 period. Then it turns to decrease to  $-114.60$  for the 1985-90 period. The marginal change in the value of the ROXY index increases from  $4.33$  for the 1960-65 period to  $9.04$  for the 1970-75 period, and then turns to decrease to  $-9.42$  for the 1985-90 period.
- (1-3) For the aged population, the value of the ROXY index decreases from  $-96.38$  for the 1960-65 period to  $-130.39$  for the 1965-70 period. Then it turns to increase to  $-66.63$  for the 1980-85 period. After that it again decreases to show  $-80.72$  for the 1985-90 period. The marginal change in the value of the ROXY index increases from  $-13.04$  for the 1960-65 period to  $5.30$  for the 1970-75 period, and then turns to decrease to  $-2.82$  for the 1985-90 period.

The ROXY-index values and their marginal changes for the population level mentioned above, enable us to draw the circular-cyclic paths as illustrated in Figure 1 which would diagrammatically demonstrate the following implications with respect to the spatial-cycle stages of the population level for each of the age-specific classes.

- (2-0) The total population of the Chuo-line region was at the stages of the accelerating decentralization for the 1960-65 period, the decelerating decentralization for the 1965-85 period, and the accelerating re-decentralization for the 1985-90 period.
- (2-1) The younger population was at the stage of the decelerating decentralization for the 1960-85 period, and the accelerating re-decentralization for the 1985-90 period.
- (2-2) The productive-age population was at the stages of the decelerating decentralization for the 1960-80 period, and the accelerating re-decentralization for the 1980-90 period.
- (2-3) The aged population was at the stage of the accelerating decentralization for the 1960-65 period, the decelerating decentralization for the 1965-80 period, and the accelerating re-decentralization for the 1980-90 period.



From Table 2, meanwhile, the followings can be pointed out as to the ROXY-index values and their marginal changes for the population share by age-specific class.

- (3-1) For the younger population, the value of the ROXY index for its share constantly increases from  $-14.10$  for the 1960-65 period to  $38.34$  for the 1985-90 period. The marginal change in the value of the ROXY index decreases from  $2.23$  for the 1960-65 period to  $1.18$  for the 1965-70 period, and then turns to increase to  $3.14$  for the 1985-90 period.
- (3-2) For the productive-age population, the value of the ROXY index for its share increases from  $-13.04$  for the 1960-65 period to  $-2.33$  for the 1970-75 period, and then turns to decrease to  $-25.75$  for the 1985-90 period. The marginal change in the value of the ROXY index decreases from  $1.90$  for the 1960-65 period to  $-1.28$  for the 1975-80 period. Then it turns to increase to  $-1.18$  for the 1980-85 period. After that it again decreases to show  $-2.13$  for the 1985-90 period.
- (3-3) For the aged population, the value of the ROXY index for its share decreases from  $121.01$  for the 1960-65 period to  $-14.95$  for the 1980-85 period, and then turns to increase to  $7.92$  for the 1985-90 period. The marginal change in the value of the ROXY index increases from  $-9.77$  for the 1960-65 period to  $-4.96$  for the 1970-75 period. Then it turns to decrease to  $-6.07$  for the 1975-80 period. After that it again increases to show  $4.57$  for the 1985-90 period.

The ROXY-index values and their marginal changes for the population share mentioned above, enable us to draw the circular-cyclic paths as illustrated in Figure 2 which would diagrammatically demonstrate the following implications with respect to the spatial-cycle stages of the population share for each of the age-specific classes.

- (4-1) The share of the younger population of the Chuo-line region against the total regional population was at the stage of the decelerating decentralization for the 1960-75 period, and the accelerating re-centralization for the 1975-90 period.
- (4-2) The share of the productive-age population was at the stages of the decelerating decentralization for the 1960-70 period, and the accelerating re-decentralization for the 1970-90 period.
- (4-3) The share of the aged population was at the stages of the decelerating centralization for the 1960-80 period, the accelerating decentralization for the 1980-85 period, and the accelerating re-centralization for the 1985-90 period.

#### 4 Conclusion

It can be seen on the basis of the above investigation that, in terms of the population level, the aged population which was at the stage of the accelerating re-decentralization for the 1980-90 period seems to have been a slightly less advanced than the productive-age

population along the spatial-cycle path. It can also be noticed that, in terms of the population share, the aged population seems to have stucked themselves to the urban core area of the Tokyo metropolitan area more densely than the productive-age population.

The aforementioned would perhaps be partially reflecting the fact that it would never be so easy at all for the productive-age population to possess their own houses in the central part of Tokyo unless in general they inherit houses from their parents, as compared with the relatively aged persons who have been holding their own houses there to reside over a rather long period of time at least since those days when the residential units could be purchased with less difficulty than today.

### Notes

- 1) For the discussion on the basic concept of "centralization and decentralization" *vis-à-vis* "concentration and deconcentration," see for example Kawashima (1987b) and Kawashima, Azis and Tene (1994).
- 2) For the discussion on the ROXY-index method, see Hiraoka and Kawashima (1993), Kawashima (1978, 1985, 1986a, 1986b, 1986c, 1987a, 1987b, 1989), and Kawashima and Hiraoka (1993a, 1993b).
- 3) For the discussion on the spatial-cycle hypothesis, see Klaassen (1978) and Klaassen *et al.* (1981) as well as Hiraoka and Kawashima (*op. cit.*), Kawashima (*op. cit.*) and Kawashima and Hiraoka (*op. cit.*).
- 4) For the discussion on these three systems, see Hiraoka and Kawashima (1993).
- 5) In the disaggregated case, each *ku* (special ward) is considered as an independent spatial unit.
- 6) In the aggregated case, all *ku*'s are combined into a spatial unit of Tokyo *tokubetsu-kubu* (Tokyo city).

### References

- Hiraoka N and T. Kawashima, 1993, "Mathematical Characteristics of ROXY Index (II): Periods of Intra-metropolitan Spatial-cycle Paths and Theoretically-ideal Formulations of ROXY Index," *Gakushuin Economic Papers*, Vol.30, No.3, Gakushuin University, Tokyo, November, pp.317-422.
- Kawashima T, 1978, "Recent Urban Evolution Processes in Japan: Analysis of Functional Urban Regions," presented at the Twenty-fifth North American Meetings of the Regional Science Association, Chicago, Illinois, USA, November.
- Kawashima T, 1985, "ROXY Index: An Indicative Instrument to Measure the Speed of Spatial Concentration and Deconcentration of Population," *Gakushuin Economic Papers*, Vol.22, No.2, Gakushuin University, Tokyo, September, pp.183-213.
- Kawashima T, 1986a, "Speed of Suburbanization: ROXY Index Analysis for Intra-metropolitan Spatial Redistribution of Population in Japan," *Gakushuin Economic Papers*, Vol.22, No.3, Gakushuin University, Tokyo, March, pp.243-304.

- Kawashima T, 1986b, "People Follow Jobs in Japan? : Suburbanization of Job Markets," *Gakushuin Economic Papers*, Vol.23, No.1&2, Gakushuin University, Tokyo, October, pp.157-183.
- Kawashima T, 1986c, "Spatial Cycle Race 1985 : ROXY Index Analysis of the 1985 Population Census for Three Railway-line Regions in the Tokyo Metropolitan Area," *Gakushuin Economic Papers*, Vol.23, No.3, Gakushuin University, Tokyo, December, pp.53-70.
- Kawashima T, 1987a, "Is Disurbanization Foreseeable in Japan? : A Comparison between U.S. and Japanese Urbanization Processes" in L. van de Berg, L.S. Burns and L. Klaassen (eds.) *Spatial Cycles*, Gower Publishing Company, Hants, England, pp.100-126.
- Kawashima T, 1987b, "ROXY Index Analysis of Population Changes in Japan for 1960-85 : Spatial (De)centralization and (De)concentration," *Gakushuin Economic Papers*, Vol.24, No.3, Gakushuin University, Tokyo, December, pp.11-39.
- Kawashima T, 1989, "Basic Concepts of the Nature of ROXY Index," *GEM Bulletin*, Vol.3, Gakushuin University Research Institute of Economics and Management, Tokyo, October, pp.81-94 (in Japanese).
- Kawashima T, *et al.*, 1993, "Metropolitan Analyses : Boundary Delineations and Future Population Changes of Functional Urban Regions," *Gakushuin Economic Papers*, Vol.29, No.3&4, Gakushuin University, Tokyo, January, pp.205-248.
- Kawashima T, I. Azis and M. Tene, 1994, "Chronological Time-lags over Spatial-cycle Path : Comparative Analyses on Inter-city Agglomeration and Deglomeration of Population in Indonesia, Japan, Sweden and USA," *GEM Bulletin*, Vol.7, Gakushuin University Research Institute of Economics and Management, Tokyo (forthcoming).
- Kawashima T and N. Hiraoka, 1993a, "Centralization and Suburbanization : ROXY Index Analysis for Five Railway-line Regions in Tokyo Metropolitan Area," *Gakushuin Economic Papers*, Vol.30, No.1, Gakushuin University, Tokyo, March, pp.203-230.
- Kawashima T and N. Hiraoka, 1993b, "Mathematical Characteristics of ROXY Index (I) : Distance and Reversed Distance Used as Weighing Factors," *Gakushuin Economic Papers*, Vol.30, No.2, Gakushuin University, Tokyo, July, pp.255-297.
- Klaassen L H, 1979, "The Future of Large Towns," *Environment and Planning A*, 10 : pp.1095-1104.
- Klaassen L H *et al.*, 1981, *Transport and Reurbanization*, Gower Publishing Company, Hants, England.

## Appendix

Table A-1 Population of Three Age-specific Classes for Each Locality

Code and locality	Class of ages	1960	1965	1970	1975	1980	1985	1990
13100 Tokyo-tokubetsu-kubu	14 and under	1,868,031	1,736,147	1,762,645	1,780,998	1,606,749	1,404,541	1,118,981
	Over 14 and under 65	6,135,017	6,773,042	6,605,018	6,280,532	6,043,156	6,149,561	6,069,665
	65 and over	306,979	383,905	473,279	573,292	686,438	792,607	910,507
	All ages	8,310,027	8,893,094	8,840,942	8,634,822	8,336,343	8,346,709	8,099,153
13102 Chuo-ku	14 and under	26,759	18,427	16,071	16,239	14,478	12,639	9,001
	Over 14 and under 65	127,892	102,098	79,060	63,919	57,200	56,157	48,193
	65 and over	6,648	7,492	8,719	9,886	10,986	11,140	10,427
	All ages	161,299	128,017	103,850	90,044	82,664	79,936	67,621
13101 Chiyoda-ku	14 and under	18,804	12,865	10,953	10,153	8,673	7,540	4,751
	Over 14 and under 65	93,578	74,998	57,475	44,889	38,850	35,742	28,012
	65 and over	4,562	5,184	5,757	6,588	7,254	7,311	6,542
	All ages	116,944	93,047	74,185	61,630	54,777	50,593	39,305
13104 Shinjuku-ku	14 and under	79,608	67,064	62,546	61,356	54,650	46,862	34,749
	Over 14 and under 65	319,023	328,618	306,567	279,709	258,034	251,640	219,627
	65 and over	15,059	18,228	21,544	25,487	30,040	34,062	36,776
	All ages	413,690	413,910	390,657	366,552	342,724	332,564	291,152
13113 Shibuya-ku	14 and under	55,420	46,355	45,304	43,549	38,417	33,148	23,566
	Over 14 and under 65	216,218	224,121	214,297	200,817	186,633	184,947	152,542
	65 and over	11,049	13,254	15,790	18,654	21,669	24,321	25,454
	All ages	282,687	283,730	275,391	263,020	246,719	242,416	201,562
13114 Nakano-ku	14 and under	73,516	67,465	67,348	66,507	57,464	48,801	37,524
	Over 14 and under 65	284,515	292,340	290,486	280,359	257,977	252,983	236,486
	65 and over	13,329	16,892	20,889	25,245	29,853	33,716	37,780
	All ages	351,360	376,697	378,723	372,111	345,294	335,500	311,790
13115 Suginami-ku	14 and under	104,071	96,267	99,692	101,948	92,017	79,891	63,796
	Over 14 and under 65	361,229	412,875	418,924	416,836	400,693	404,213	400,054
	65 and over	21,910	27,650	34,400	40,991	48,185	54,485	61,993
	All ages	487,210	536,792	553,016	559,775	540,895	538,589	525,843
13203 Musashino-shi	14 and under	26,943	26,049	26,871	27,351	25,676	23,394	19,306
	Over 14 and under 65	88,610	101,483	102,613	102,643	99,622	101,988	103,131
	65 and over	4,784	5,984	7,475	9,237	11,208	13,216	15,672
	All ages	120,337	133,516	136,959	139,231	136,506	138,598	138,109
13204 Mitaka-shi	14 and under	24,597	29,225	33,582	35,565	32,447	28,505	23,076
	Over 14 and under 65	69,958	101,731	115,547	119,837	119,858	123,471	123,390
	65 and over	3,483	4,917	6,564	8,866	11,569	14,209	17,187
	All ages	98,038	135,873	155,693	164,288	163,874	166,185	163,653
13210 Koganei-shi	14 and under	11,288	17,453	21,000	22,393	20,523	18,611	15,479
	Over 14 and under 65	32,727	56,153	69,474	74,789	74,524	77,414	78,907
	65 and over	1,719	2,717	3,974	5,296	7,031	8,576	10,405
	All ages	45,734	76,323	94,448	102,478	102,078	104,601	104,791
13206 Fuchuh-shi	14 and under	22,537	30,314	39,144	44,445	43,017	39,413	32,925
	Over 14 and under 65	56,646	91,734	117,586	128,816	136,715	147,807	156,223
	65 and over	2,915	4,471	6,443	8,828	11,650	14,742	18,415
	All ages	82,098	126,519	163,173	182,089	191,382	201,962	207,563
13214 Kokubunji-shi	14 and under	9,965	14,419	18,516	19,627	18,376	16,937	14,746
	Over 14 and under 65	27,648	47,802	59,182	63,566	66,298	70,919	76,104
	65 and over	1,485	2,424	3,561	4,836	6,146	7,542	9,313
	All ages	39,098	64,645	81,259	88,029	90,820	95,398	100,163
13215 Kunitachi-shi	14 and under	8,801	9,806	14,404	15,806	14,295	12,591	10,199
	Over 14 and under 65	22,646	32,082	42,941	45,244	45,787	47,299	48,372
	65 and over	1,162	1,589	2,364	3,080	3,902	4,854	6,029
	All ages	32,609	43,477	59,709	64,130	63,984	64,744	64,600
13202 Tachikawa-shi	14 and under	21,682	23,345	28,151	36,006	35,056	30,556	24,974
	Over 14 and under 65	57,387	73,335	83,562	94,622	97,897	104,154	112,263
	65 and over	2,866	4,039	5,344	7,166	9,454	11,744	14,197
	All ages	81,935	100,719	117,057	137,794	142,407	146,454	151,434
13212 Hino-shi	14 and under	12,254	16,864	25,215	34,660	36,648	33,024	26,660
	Over 14 and under 65	29,581	48,717	69,517	86,372	100,883	112,985	125,928
	65 and over	1,559	2,398	3,825	5,651	7,877	9,992	13,044
	All ages	43,394	67,979	98,557	126,683	145,408	156,001	165,632
13201 Hachioji-shi	14 and under	46,271	50,863	61,877	83,783	97,505	93,007	78,528
	Over 14 and under 65	109,806	145,796	176,855	218,205	262,620	299,825	342,804
	65 and over	8,545	11,094	14,795	20,354	26,888	33,731	42,899
	All ages	164,622	207,753	253,527	322,342	387,013	426,563	464,231
14424 Fujino-machi	14 and under	3,094	2,631	2,161	2,024	2,120	2,208	2,106
	Over 14 and under 65	4,928	5,138	5,322	5,656	6,207	6,691	7,116
	65 and over	637	704	812	891	1,143	1,284	1,501
	All ages	8,659	8,473	8,295	8,571	9,470	10,183	10,723
Total for disaggregated case	14 and under	545,610	529,412	572,835	621,412	591,362	527,127	421,386
	Over 14 and under 65	1,882,392	2,139,021	2,209,408	2,226,279	2,209,798	2,278,235	2,259,152
	65 and over	101,712	129,037	162,256	201,076	244,855	284,925	327,634
	All ages	2,529,714	2,797,470	2,944,499	3,048,767	3,046,015	3,090,287	3,008,172

Aged Population in Spatial Cycles: ROXY Index Analysis for Chuo-line Region  
in Tokyo Metropolitan Area (Kawashima, Hiraoka)

Table A-2 Population Shares of Three Age-specific Classes for Each Locality

Code and locality	Class of ages	1960	1965	1970	1975	1980	1985	1990
13100 Tokyo-tokubetsu-kubu	14 and under	0.2248	0.1952	0.1994	0.2083	0.1927	0.1683	0.1382
	Over 14 and under 65	0.7383	0.7616	0.7471	0.7273	0.7249	0.7368	0.7494
	65 and over	0.0369	0.0432	0.0535	0.0664	0.0823	0.0950	0.1124
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13102 Chuo-ku	14 and under	0.1659	0.1439	0.1548	0.1803	0.1751	0.1581	0.1331
	Over 14 and under 65	0.7929	0.7975	0.7613	0.7099	0.6920	0.7025	0.7127
	65 and over	0.0412	0.0585	0.0840	0.1098	0.1329	0.1394	0.1542
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13101 Chiyoda-ku	14 and under	0.1608	0.1383	0.1476	0.1647	0.1583	0.1490	0.1209
	Over 14 and under 65	0.8002	0.8080	0.7748	0.7284	0.7092	0.7065	0.7127
	65 and over	0.0390	0.0557	0.0776	0.1069	0.1324	0.1445	0.1664
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13104 Shinjuku-ku	14 and under	0.1924	0.1620	0.1601	0.1674	0.1595	0.1409	0.1194
	Over 14 and under 65	0.7712	0.7939	0.7847	0.7631	0.7529	0.7567	0.7543
	65 and over	0.0364	0.0440	0.0551	0.0695	0.0877	0.1024	0.1263
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13113 Shibuya-ku	14 and under	0.1960	0.1634	0.1645	0.1656	0.1557	0.1367	0.1169
	Over 14 and under 65	0.7649	0.7899	0.7782	0.7635	0.7565	0.7629	0.7568
	65 and over	0.0391	0.0467	0.0573	0.0709	0.0878	0.1003	0.1263
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13114 Nakano-ku	14 and under	0.2092	0.1791	0.1778	0.1787	0.1664	0.1455	0.1204
	Over 14 and under 65	0.7528	0.7761	0.7670	0.7534	0.7471	0.7540	0.7585
	65 and over	0.0379	0.0448	0.0552	0.0678	0.0865	0.1005	0.1212
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13115 Suginami-ku	14 and under	0.2136	0.1793	0.1803	0.1821	0.1701	0.1483	0.1213
	Over 14 and under 65	0.7414	0.7692	0.7575	0.7446	0.7408	0.7505	0.7608
	65 and over	0.0450	0.0515	0.0622	0.0732	0.0891	0.1012	0.1179
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13203 Musashino-shi	14 and under	0.2239	0.1951	0.1962	0.1964	0.1881	0.1688	0.1398
	Over 14 and under 65	0.7363	0.7601	0.7492	0.7372	0.7298	0.7359	0.7467
	65 and over	0.0398	0.0448	0.0546	0.0663	0.0821	0.0954	0.1135
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13204 Mitaka-shi	14 and under	0.2509	0.2151	0.2157	0.2165	0.1980	0.1715	0.1410
	Over 14 and under 65	0.7136	0.7487	0.7421	0.7294	0.7314	0.7430	0.7540
	65 and over	0.0355	0.0362	0.0422	0.0541	0.0706	0.0855	0.1050
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13210 Koganei-shi	14 and under	0.2468	0.2287	0.2223	0.2185	0.2011	0.1779	0.1477
	Over 14 and under 65	0.7156	0.7357	0.7356	0.7298	0.7301	0.7401	0.7530
	65 and over	0.0376	0.0356	0.0421	0.0517	0.0689	0.0820	0.0993
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13206 Fuchuh-shi	14 and under	0.2745	0.2396	0.2399	0.2441	0.2248	0.1952	0.1586
	Over 14 and under 65	0.6900	0.7251	0.7206	0.7074	0.7144	0.7319	0.7527
	65 and over	0.0355	0.0353	0.0395	0.0485	0.0609	0.0730	0.0887
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13214 Kokubunji-shi	14 and under	0.2549	0.2230	0.2279	0.2230	0.2023	0.1775	0.1472
	Over 14 and under 65	0.7071	0.7395	0.7283	0.7221	0.7300	0.7434	0.7598
	65 and over	0.0380	0.0375	0.0438	0.0549	0.0677	0.0791	0.0930
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13215 Kunitachi-shi	14 and under	0.2699	0.2255	0.2412	0.2465	0.2234	0.1945	0.1579
	Over 14 and under 65	0.6945	0.7379	0.7192	0.7055	0.7156	0.7306	0.7488
	65 and over	0.0356	0.0385	0.0396	0.0480	0.0610	0.0750	0.0933
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13202 Tachikawa-shi	14 and under	0.2646	0.2318	0.2405	0.2613	0.2462	0.2086	0.1649
	Over 14 and under 65	0.7004	0.7281	0.7139	0.6887	0.6874	0.7112	0.7413
	65 and over	0.0350	0.0401	0.0457	0.0520	0.0664	0.0802	0.0938
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13212 Hino-shi	14 and under	0.2824	0.2481	0.2558	0.2736	0.2520	0.2117	0.1610
	Over 14 and under 65	0.6817	0.7166	0.7053	0.6818	0.6938	0.7243	0.7603
	65 and over	0.0359	0.0353	0.0388	0.0446	0.0542	0.0641	0.0788
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13201 Hachioji-shi	14 and under	0.2811	0.2448	0.2441	0.2599	0.2519	0.2180	0.1692
	Over 14 and under 65	0.6670	0.7018	0.6978	0.6769	0.6796	0.7029	0.7364
	65 and over	0.0519	0.0534	0.0584	0.0631	0.0695	0.0791	0.0924
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
14424 Fujino-machi	14 and under	0.3573	0.3105	0.2605	0.2361	0.2239	0.2168	0.1964
	Over 14 and under 65	0.5691	0.6064	0.6416	0.6599	0.6554	0.6571	0.6636
	65 and over	0.0736	0.0831	0.0979	0.1040	0.1207	0.1261	0.1400
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total for disaggregated case	14 and under	0.2157	0.1829	0.1945	0.2038	0.1941	0.1706	0.1401
	Over 14 and under 65	0.7441	0.7646	0.7504	0.7302	0.7255	0.7372	0.7510
	65 and over	0.0402	0.0481	0.0551	0.0660	0.0804	0.0922	0.1089
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table A-3 Five-year Growth Ratios of Population for Each Locality

Code and locality	Class of ages	1960-65	1965-70	1970-75	1975-80	1980-85	1985-90
13100 Tokyo-tokubetsu-kubu	14 and under	0.9294	1.0153	1.0104	0.9022	0.8742	0.7967
	Over 14 and under 65	1.1040	0.9752	0.9509	0.8622	1.0176	0.9870
	65 and over	1.2506	1.2328	1.2113	1.1974	1.1547	1.1487
	All ages	1.0702	0.9941	0.9767	0.9654	1.0012	0.9703
13102 Chuo-ku	14 and under	0.6886	0.8721	1.0105	0.8916	0.8730	0.7122
	Over 14 and under 65	0.7983	0.7744	0.8085	0.8949	0.9818	0.8582
	65 and over	1.1270	1.1638	1.1338	1.1113	1.0140	0.9360
	All ages	0.7937	0.8112	0.8671	0.9180	0.9670	0.8459
13101 Chiyoda-ku	14 and under	0.6842	0.8514	0.9270	0.8542	0.8694	0.6301
	Over 14 and under 65	0.8014	0.7664	0.7810	0.8655	0.9200	0.7837
	65 and over	1.1363	1.1105	1.1443	1.1011	1.0079	0.8948
	All ages	0.7957	0.7973	0.8308	0.8888	0.9236	0.7769
13104 Shinjuku-ku	14 and under	0.8424	0.9326	0.9810	0.8907	0.8575	0.7415
	Over 14 and under 65	1.0301	0.9329	0.9124	0.9225	0.9752	0.8728
	65 and over	1.2104	1.1819	1.1830	1.1786	1.1339	1.0797
	All ages	1.0005	0.9438	0.9393	0.9350	0.9704	0.8755
13113 Shibuya-ku	14 and under	0.8364	0.9773	0.9613	0.8822	0.8628	0.7109
	Over 14 and under 65	1.0366	0.9562	0.9371	0.9294	0.9910	0.8248
	65 and over	1.1996	1.1913	1.1814	1.1616	1.1224	1.0466
	All ages	1.0037	0.9706	0.9551	0.9380	0.9826	0.8315
13114 Nakano-ku	14 and under	0.9177	0.9983	0.9875	0.8640	0.8492	0.7689
	Over 14 and under 65	1.1052	0.9937	0.9651	0.9202	0.9806	0.9348
	65 and over	1.2673	1.2366	1.2085	1.1825	1.1294	1.1205
	All ages	1.0721	1.0054	0.9825	0.9279	0.9716	0.9293
13115 Suginami-ku	14 and under	0.9250	1.0356	1.0226	0.9026	0.8682	0.7985
	Over 14 and under 65	1.1430	1.0147	0.9950	0.9613	1.0088	0.9897
	65 and over	1.2620	1.2441	1.1916	1.1755	1.1307	1.1378
	All ages	1.1018	1.0302	1.0122	0.9663	0.9957	0.9763
13203 Musashino-shi	14 and under	0.9668	1.0316	1.0179	0.9388	0.9111	0.8253
	Over 14 and under 65	1.1453	1.0111	1.0003	0.9706	1.0237	1.0112
	65 and over	1.2508	1.2492	1.2357	1.2134	1.1792	1.1858
	All ages	1.1095	1.0258	1.0166	0.9804	1.0153	0.9665
13204 Mitaka-shi	14 and under	1.1882	1.1491	1.0590	0.9123	0.8785	0.8095
	Over 14 and under 65	1.4542	1.1358	1.0371	1.0002	1.0301	0.9993
	65 and over	1.4117	1.3350	1.3537	1.3019	1.2282	1.2096
	All ages	1.3859	1.1459	1.0552	0.9975	1.0141	0.9848
13210 Koganei-shi	14 and under	1.5482	1.2032	1.0663	0.9165	0.9068	0.8317
	Over 14 and under 65	1.7158	1.2372	1.0765	0.9965	1.0388	1.0193
	65 and over	1.5806	1.4626	1.3327	1.3276	1.2197	1.2133
	All ages	1.6688	1.2375	1.0850	0.9961	1.0247	1.0018
13206 Fuchuh-shi	14 and under	1.3451	1.2913	1.1354	0.9679	0.9162	0.8354
	Over 14 and under 65	1.6194	1.2818	1.0955	1.0613	1.0811	1.0569
	65 and over	1.5338	1.4411	1.3702	1.3197	1.2654	1.2492
	All ages	1.5411	1.2897	1.1159	1.0510	1.0553	1.0277
13214 Kokubunji-shi	14 and under	1.4470	1.2841	1.0600	0.9363	0.9217	0.8706
	Over 14 and under 65	1.7289	1.2381	1.0741	1.0430	1.0697	1.0731
	65 and over	1.6323	1.4691	1.3580	1.2709	1.2271	1.2348
	All ages	1.6534	1.2570	1.0833	1.0317	1.0504	1.0499
13215 Kunitachi-shi	14 and under	1.1142	1.4689	1.0973	0.9044	0.8808	0.8100
	Over 14 and under 65	1.4187	1.3385	1.0536	1.0120	1.0330	1.0227
	65 and over	1.3675	1.4877	1.3029	1.2669	1.2440	1.2421
	All ages	1.3333	1.3733	1.0740	0.9977	1.0119	0.9978
13202 Tachikawa-shi	14 and under	1.0767	1.2059	1.2790	0.9736	0.8716	0.8173
	Over 14 and under 65	1.2779	1.1395	1.1324	1.0346	1.0639	1.0779
	65 and over	1.4093	1.3231	1.3409	1.3193	1.2422	1.2089
	All ages	1.2293	1.1622	1.1772	1.0335	1.0284	1.0340
13212 Hino-shi	14 and under	1.3762	1.4952	1.3746	1.0574	0.9011	0.8073
	Over 14 and under 65	1.6469	1.4270	1.2425	1.1680	1.1200	1.1146
	65 and over	1.5382	1.5951	1.4774	1.3939	1.2685	1.3054
	All ages	1.5666	1.4498	1.2854	1.1478	1.0729	1.0617
13201 Hachioji-shi	14 and under	1.0992	1.2165	1.3540	1.1638	0.9539	0.8443
	Over 14 and under 65	1.3278	1.2130	1.2338	1.2035	1.1417	1.1433
	65 and over	1.2983	1.3336	1.3757	1.3210	1.2545	1.2718
	All ages	1.2620	1.2203	1.2714	1.2006	1.1022	1.0883
14424 Fujino-machi	14 and under	0.8504	0.8214	0.9366	1.0476	1.0415	0.9538
	Over 14 and under 65	1.0426	1.0358	1.0628	1.0974	1.0780	1.0635
	65 and over	1.1052	1.1534	1.0973	1.2828	1.1234	1.1690
	All ages	0.9785	0.9790	1.0333	1.1049	1.0753	1.0530
Total for disaggregated case	14 and under	0.9703	1.0820	1.0848	0.9516	0.8914	0.7994
	Over 14 and under 65	1.1363	1.0329	1.0076	0.9926	1.0310	0.9916
	65 and over	1.2687	1.2574	1.2393	1.2177	1.1636	1.1499
	All ages	1.1058	1.0526	1.0354	1.0007	1.0145	0.9734

Aged Population in Spatial Cycles: ROXY Index Analysis for Chuo-line Region  
in Tokyo Metropolitan Area (Kawashima, Hiraoka)

**Table A-4 Five-year Growth Ratios of Population Shares for Each Locality**

Code and locality	Class of ages	1960-65	1965-70	1970-75	1975-80	1980-85	1985-90
13100 Tokyo-tokubetsu-kubu	14 and under	0.8685	1.0213	1.0345	0.9345	0.8731	0.8210
	Over 14 and under 65	1.0316	0.9809	0.9736	0.9967	1.0163	1.0172
	65 and over	1.1686	1.2401	1.2402	1.2402	1.1532	1.1839
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13102 Chuo-ku	14 and under	0.8677	1.0751	1.1854	0.9712	0.9028	0.8419
	Over 14 and under 65	1.0059	0.9546	0.9324	0.9748	1.0153	1.0145
	65 and over	1.4199	1.4346	1.3077	1.2105	1.0486	1.1065
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13101 Chiyoda-ku	14 and under	0.8599	1.0678	1.1158	0.9811	0.9413	0.8111
	Over 14 and under 65	1.0073	0.9612	0.9401	0.9737	0.9961	1.0088
	65 and over	1.4282	1.3929	1.3775	1.2388	1.0912	1.1518
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13104 Shinjuku-ku	14 and under	0.8420	0.9881	1.0455	0.9526	0.8837	0.8470
	Over 14 and under 65	1.0295	0.9884	0.9724	0.9866	1.0050	0.9969
	65 and over	1.2098	1.2523	1.2808	1.2606	1.1685	1.2332
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13113 Shibuya-ku	14 and under	0.8334	1.0069	1.0065	0.9404	0.8782	0.8550
	Over 14 and under 65	1.0327	0.9851	0.9812	0.9908	1.0086	0.9920
	65 and over	1.1952	1.2274	1.2369	1.2384	1.1423	1.2587
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13114 Nakano-ku	14 and under	0.8560	0.9929	1.0051	0.9311	0.8740	0.8274
	Over 14 and under 65	1.0309	0.9883	0.9823	0.9916	1.0093	1.0059
	65 and over	1.1821	1.2300	1.2300	1.2744	1.1624	1.2057
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13115 Suginami-ku	14 and under	0.8396	1.0052	1.0103	0.9341	0.8719	0.8179
	Over 14 and under 65	1.0374	0.9849	0.9830	0.9948	1.0131	1.0137
	65 and over	1.1454	1.2076	1.1772	1.2165	1.1356	1.1654
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13203 Musashino-shi	14 and under	0.8714	1.0056	1.0013	0.9575	0.8974	0.8282
	Over 14 and under 65	1.0322	0.9857	0.9840	0.9899	1.0083	1.0148
	65 and over	1.1274	1.2178	1.2156	1.2376	1.1614	1.1900
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13204 Mitaka-shi	14 and under	0.8573	1.0028	1.0036	0.9146	0.8663	0.8221
	Over 14 and under 65	1.0492	0.9912	0.9829	1.0027	1.0158	1.0148
	65 and over	1.0186	1.1650	1.2829	1.3052	1.2111	1.2283
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13210 Koganei-shi	14 and under	0.8285	0.9723	0.9828	0.9201	0.8850	0.8302
	Over 14 and under 65	1.0281	0.9998	0.9922	1.0004	1.0137	1.0174
	65 and over	0.9471	1.1820	1.2282	1.3328	1.1903	1.2111
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13206 Fuchuh-shi	14 and under	0.8728	1.0012	1.0175	0.9209	0.8682	0.8128
	Over 14 and under 65	1.0508	0.9939	0.9817	1.0098	1.0245	1.0284
	65 and over	0.9953	1.1174	1.2278	1.2556	1.1991	1.2154
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13214 Kokubunji-shi	14 and under	0.8751	1.0216	0.9785	0.9075	0.8775	0.8292
	Over 14 and under 65	1.0457	0.9849	0.9915	1.0109	1.0184	1.0221
	65 and over	0.9872	1.1887	1.2536	1.2318	1.1683	1.1761
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13215 Kunitachi-shi	14 and under	0.8357	1.0696	1.0217	0.9065	0.8705	0.8118
	Over 14 and under 65	1.0625	0.9746	0.9810	1.0143	1.0209	1.0250
	65 and over	1.0256	1.0833	1.2131	1.2698	1.2294	1.2448
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13202 Tachikawa-shi	14 and under	0.8759	1.0376	1.0865	0.9421	0.8475	0.7904
	Over 14 and under 65	1.0396	0.9804	0.9619	1.0011	1.0345	1.0424
	65 and over	1.1485	1.1384	1.1391	1.2765	1.2079	1.1691
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13212 Hino-shi	14 and under	0.8785	1.0313	1.0694	0.9212	0.8399	0.7604
	Over 14 and under 65	1.0513	0.9842	0.9666	1.0176	1.0439	1.0497
	65 and over	0.9819	1.1002	1.1494	1.2144	1.1824	1.2295
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13201 Hachioji-shi	14 and under	0.8710	0.9969	1.0650	0.8693	0.8654	0.7758
	Over 14 and under 65	1.0521	0.9940	0.9704	1.0024	1.0358	1.0506
	65 and over	1.0288	1.0928	1.0820	1.1003	1.1382	1.1686
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
14424 Fujino-machi	14 and under	0.8690	0.8390	0.9064	0.9480	0.9686	0.9058
	Over 14 and under 65	1.0655	1.0580	1.0285	0.9932	1.0025	1.0100
	65 and over	1.1294	1.1782	1.0620	1.1810	1.0447	1.1101
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total for disaggregated case	14 and under	0.8771	1.0280	1.0478	0.9524	0.8789	0.8212
	Over 14 and under 65	1.0276	0.9814	0.9731	0.9936	1.0161	1.0109
	65 and over	1.1488	1.1952	1.1996	1.2163	1.1468	1.1811
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table A-5 Annual Growth Ratios of Population for Each Locality

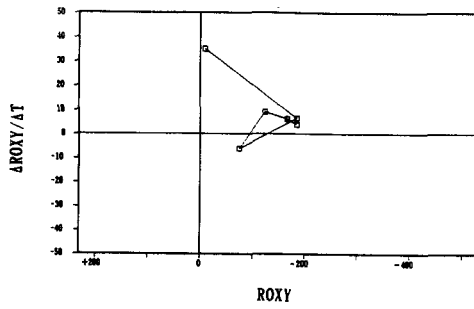
Code and locality	Class of ages	1960-65	1965-70	1970-75	1975-80	1980-85	1985-90
13100 Tokyo-tokubetsu-kubu	14 and under	0.9855	1.0030	1.0021	0.9798	0.9735	0.9558
	Over 14 and under 65	1.0200	0.9950	0.9900	0.9923	1.0035	0.9974
	65 and over	1.0457	1.0427	1.0391	1.0367	1.0292	1.0281
	All ages	1.0137	0.9988	0.9953	0.9930	1.0002	0.9940
13102 Chuo-ku	14 and under	0.9281	0.9730	1.0021	0.9773	0.9732	0.9344
	Over 14 and under 65	0.9559	0.9501	0.9584	0.9780	0.9963	0.9699
	65 and over	1.0242	1.0308	1.0254	1.0213	1.0028	0.9869
	All ages	0.9548	0.9590	0.9719	0.9830	0.9933	0.9671
13101 Chiyoda-ku	14 and under	0.9269	0.9683	0.9849	0.9690	0.9724	0.9118
	Over 14 and under 65	0.9567	0.9482	0.9518	0.9715	0.9835	0.9524
	65 and over	1.0259	1.0212	1.0273	1.0194	1.0016	0.9780
	All ages	0.9553	0.9557	0.9636	0.9767	0.9842	0.9508
13104 Shinjuku-ku	14 and under	0.9663	0.9861	0.9962	0.9771	0.9697	0.9419
	Over 14 and under 65	1.0059	0.9862	0.9818	0.9840	0.9950	0.9732
	65 and over	1.0389	1.0340	1.0342	1.0334	1.0254	1.0155
	All ages	1.0001	0.9885	0.9873	0.9866	0.9940	0.9738
13113 Shibuya-ku	14 and under	0.9649	0.9954	0.9921	0.9752	0.9709	0.9340
	Over 14 and under 65	1.0072	0.9911	0.9871	0.9855	0.9982	0.9622
	65 and over	1.0371	1.0356	1.0339	1.0304	1.0234	1.0091
	All ages	1.0007	0.9941	0.9908	0.9873	0.9965	0.9638
13114 Nakano-ku	14 and under	0.9830	0.9997	0.9975	0.9712	0.9678	0.9488
	Over 14 and under 65	1.0202	0.9987	0.9929	0.9835	0.9961	0.9866
	65 and over	1.0485	1.0434	1.0386	1.0341	1.0246	1.0230
	All ages	1.0140	1.0011	0.9965	0.9852	0.9943	0.9854
13115 Suginami-ku	14 and under	0.9845	1.0070	1.0045	0.9797	0.9721	0.9560
	Over 14 and under 65	1.0271	1.0029	0.9990	0.9921	1.0018	0.9979
	65 and over	1.0476	1.0447	1.0357	1.0329	1.0249	1.0262
	All ages	1.0196	1.0060	1.0024	0.9932	0.9991	0.9952
13203 Musashino-shi	14 and under	0.9933	1.0062	1.0035	0.9874	0.9816	0.9623
	Over 14 and under 65	1.0275	1.0022	1.0001	0.9940	1.0047	1.0022
	65 and over	1.0458	1.0455	1.0432	1.0394	1.0335	1.0347
	All ages	1.0210	1.0051	1.0033	0.9961	1.0030	0.9993
13204 Mitaka-shi	14 and under	1.0351	1.0282	1.0115	0.9818	0.9744	0.9586
	Over 14 and under 65	1.0778	1.0258	1.0073	1.0000	1.0060	0.9999
	65 and over	1.0714	1.0595	1.0624	1.0542	1.0420	1.0388
	All ages	1.0675	1.0276	1.0108	0.9995	1.0028	0.9969
13210 Koganei-shi	14 and under	1.0911	1.0377	1.0129	0.9827	0.9806	0.9638
	Over 14 and under 65	1.1140	1.0435	1.0149	0.9993	1.0076	1.0038
	65 and over	1.0959	1.0790	1.0591	1.0583	1.0405	1.0394
	All ages	1.1079	1.0435	1.0165	0.9992	1.0049	1.0004
13206 Fuchuh-shi	14 and under	1.0611	1.0525	1.0257	0.9935	0.9827	0.9647
	Over 14 and under 65	1.1012	1.0509	1.0184	1.0120	1.0157	1.0111
	65 and over	1.0893	1.0758	1.0650	1.0570	1.0482	1.0455
	All ages	1.0903	1.0522	1.0222	1.0100	1.0108	1.0055
13214 Kokubunji-shi	14 and under	1.0767	1.0513	1.0117	0.9869	0.9838	0.9727
	Over 14 and under 65	1.1157	1.0436	1.0144	1.0085	1.0136	1.0142
	65 and over	1.1030	1.0800	1.0631	1.0491	1.0418	1.0431
	All ages	1.1058	1.0468	1.0161	1.0063	1.0099	1.0098
13215 Kunitachi-shi	14 and under	1.0219	1.0799	1.0188	0.9801	0.9749	0.9587
	Over 14 and under 65	1.0721	1.0600	1.0105	1.0024	1.0065	1.0045
	65 and over	1.0646	1.0827	1.0543	1.0484	1.0446	1.0443
	All ages	1.0592	1.0655	1.0144	0.9995	1.0024	0.9996
13202 Tachikawa-shi	14 and under	1.0149	1.0381	1.0505	0.9947	0.9729	0.9605
	Over 14 and under 65	1.0503	1.0265	1.0252	1.0068	1.0125	1.0151
	65 and over	1.0710	1.0576	1.0604	1.0570	1.0443	1.0387
	All ages	1.0421	1.0305	1.0332	1.0066	1.0056	1.0067
13212 Hino-shi	14 and under	1.0659	1.0838	1.0657	1.0112	0.9794	0.9581
	Over 14 and under 65	1.1049	1.0737	1.0444	1.0315	1.0229	1.0219
	65 and over	1.0899	1.0979	1.0812	1.0687	1.0487	1.0548
	All ages	1.0939	1.0771	1.0515	1.0280	1.0142	1.0121
13201 Hachioji-shi	14 and under	1.0191	1.0400	1.0625	1.0308	0.9906	0.9667
	Over 14 and under 65	1.0583	1.0394	1.0429	1.0377	1.0269	1.0272
	65 and over	1.0536	1.0593	1.0659	1.0573	1.0464	1.0493
	All ages	1.0476	1.0406	1.0492	1.0372	1.0197	1.0171
14424 Fujiino-machi	14 and under	0.9681	0.9614	0.9870	1.0093	1.0082	0.9906
	Over 14 and under 65	1.0084	1.0071	1.0122	1.0188	1.0151	1.0124
	65 and over	1.0202	1.0290	1.0187	1.0511	1.0235	1.0317
	All ages	0.9957	0.9958	1.0066	1.0201	1.0146	1.0104



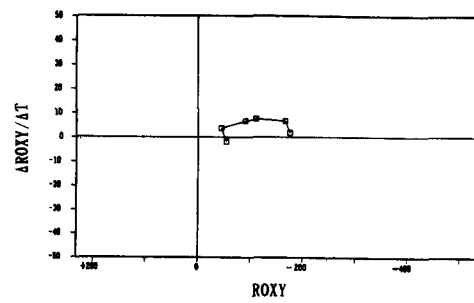
Aged Population in Spatial Cycles: ROXY Index Analysis for Chuo-line Region  
in Tokyo Metropolitan Area (Kawashima, Hiraoka)

**Table A-6 Annual Growth Ratios of Population Shares for Each Locality**

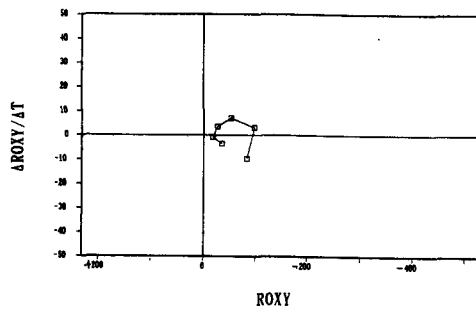
Code and locality	Class of ages	1960-65	1965-70	1970-75	1975-80	1980-85	1985-90
13100 Tokyo-tokubetsu-kubu	14 and under	0.9722	1.0042	1.0068	0.9885	0.9732	0.9613
	Over 14 and under 65	1.0062	0.9982	0.9947	0.9993	1.0032	1.0034
	65 and over	1.0317	1.0440	1.0440	1.0440	1.0289	1.0343
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13102 Chuo-ku	14 and under	0.9720	1.0146	1.0311	0.9942	0.9798	0.9662
	Over 14 and under 65	1.0012	0.9907	0.9861	0.9949	1.0030	1.0029
	65 and over	1.0726	1.0748	1.0551	1.0389	1.0095	1.0204
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13101 Chiyoda-ku	14 and under	0.9703	1.0132	1.0222	0.9921	0.9880	0.9590
	Over 14 and under 65	1.0015	0.9921	0.9877	0.9947	0.9992	1.0018
	65 and over	1.0739	1.0685	1.0661	1.0438	1.0176	1.0287
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13104 Shinjuku-ku	14 and under	0.9662	0.9976	1.0089	0.9903	0.9756	0.9673
	Over 14 and under 65	1.0058	0.9977	0.9944	0.9973	1.0010	0.9994
	65 and over	1.0388	1.0460	1.0474	1.0474	1.0316	1.0428
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13113 Shibuya-ku	14 and under	0.9642	1.0014	1.0013	0.9878	0.9744	0.9692
	Over 14 and under 65	1.0065	0.9970	0.9962	0.9981	1.0017	0.9984
	65 and over	1.0363	1.0418	1.0434	1.0437	1.0270	1.0471
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13114 Nakano-ku	14 and under	0.9694	0.9986	1.0010	0.9858	0.9734	0.9628
	Over 14 and under 65	1.0061	0.9977	0.9964	0.9983	1.0018	1.0012
	65 and over	1.0340	1.0423	1.0423	1.0497	1.0305	1.0381
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13115 Suginami-ku	14 and under	0.9656	1.0010	1.0020	0.9885	0.9730	0.9606
	Over 14 and under 65	1.0074	0.9970	0.9966	0.9990	1.0026	1.0027
	65 and over	1.0275	1.0385	1.0332	1.0400	1.0258	1.0311
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13203 Musashino-shi	14 and under	0.9728	1.0011	1.0003	0.9914	0.9786	0.9630
	Over 14 and under 65	1.0064	0.9971	0.9968	0.9980	1.0017	1.0029
	65 and over	1.0243	1.0402	1.0398	1.0436	1.0304	1.0354
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13204 Mitaka-shi	14 and under	0.9697	1.0006	1.0007	0.9823	0.9717	0.9616
	Over 14 and under 65	1.0097	0.9982	0.9966	1.0005	1.0031	1.0029
	65 and over	1.0037	1.0310	1.0511	1.0547	1.0391	1.0420
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13210 Koganei-shi	14 and under	0.9848	0.9944	0.9965	0.9835	0.9759	0.9635
	Over 14 and under 65	1.0058	1.0000	0.9984	1.0001	1.0027	1.0035
	65 and over	0.9892	1.0340	1.0420	1.0591	1.0355	1.0390
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13206 Fuchuh-shi	14 and under	0.9732	1.0002	1.0035	0.9836	0.9721	0.9594
	Over 14 and under 65	1.0100	0.9988	0.9963	1.0019	1.0049	1.0056
	65 and over	0.9991	1.0224	1.0419	1.0466	1.0370	1.0398
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13214 Kokubunji-shi	14 and under	0.9737	1.0043	0.9957	0.9808	0.9742	0.9632
	Over 14 and under 65	1.0090	0.9970	0.9983	1.0022	1.0036	1.0044
	65 and over	0.9974	1.0317	1.0462	1.0426	1.0316	1.0330
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13215 Kunitachi-shi	14 and under	0.9647	1.0135	1.0043	0.9806	0.9726	0.9592
	Over 14 and under 65	1.0122	0.9949	0.9962	1.0028	1.0041	1.0049
	65 and over	1.0051	1.0161	1.0394	1.0489	1.0422	1.0448
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13202 Tachikawa-shi	14 and under	0.9738	1.0074	1.0167	0.9881	0.9675	0.9541
	Over 14 and under 65	1.0078	0.9961	0.9923	1.0002	1.0068	1.0083
	65 and over	1.0277	1.0263	1.0284	1.0500	1.0385	1.0317
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13212 Hino-shi	14 and under	0.9744	1.0062	1.0135	0.9837	0.9657	0.9467
	Over 14 and under 65	1.0101	0.9968	0.9932	1.0035	1.0086	1.0098
	65 and over	0.9963	1.0193	1.0282	1.0396	1.0341	1.0422
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
13201 Hachioji-shi	14 and under	0.9728	0.9994	1.0127	0.9938	0.9715	0.9505
	Over 14 and under 65	1.0102	0.9988	0.9940	1.0005	1.0071	1.0099
	65 and over	1.0057	1.0179	1.0159	1.0193	1.0262	1.0317
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
14424 Fujino-machi	14 and under	0.9723	0.9655	0.9805	0.9894	0.9836	0.9804
	Over 14 and under 65	1.0128	1.0113	1.0056	0.9986	1.0005	1.0020
	65 and over	1.0248	1.0333	1.0121	1.0303	1.0088	1.0211
	All ages	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000



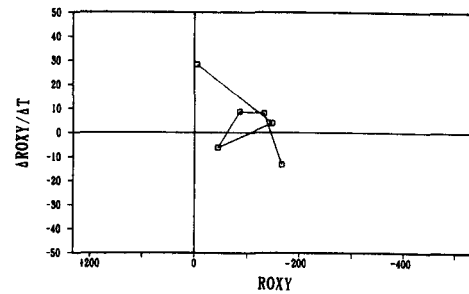
(a) 14 and under



(b) Over 14 and under 65



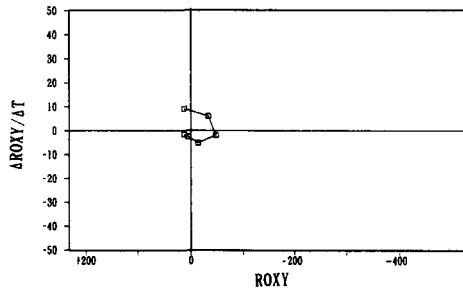
(c) 65 and Over



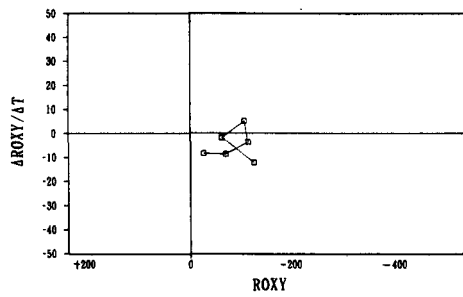
(d) All ages

Figure A-1 Values of ROXY and Their Marginal Changes for Chuo-line Region excluding Fujino-machi: For Absolute Number of Population in Aggregated Case

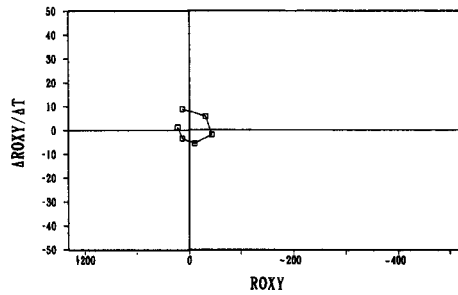
Aged Population in Spatial Cycles: ROXY Index Analysis for Chuo-line Region  
in Tokyo Metropolitan Area (Kawashima, Hiraoka)



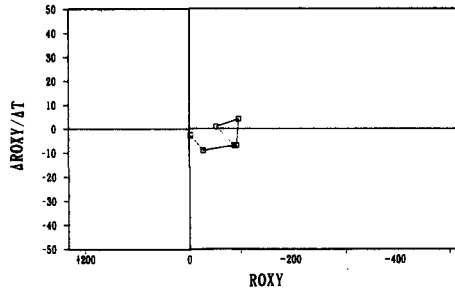
(a) 14 and under



(b) Over 14 and under 65

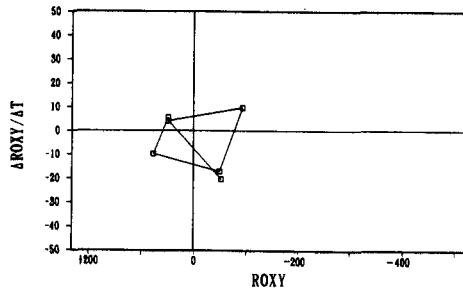


(c) 65 and Over

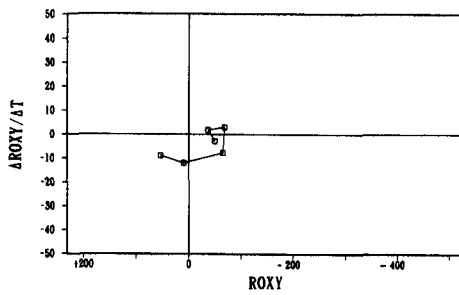


(d) All ages

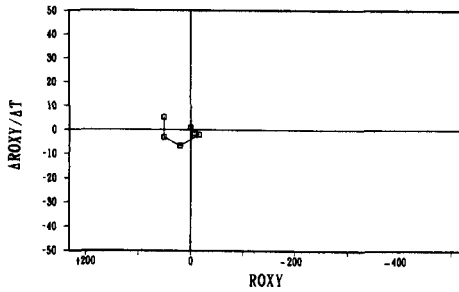
Figure A—2 Values of ROXY and Their Marginal Changes for Chuo-line Region including Fujino-machi: For Absolute Number of Population in Disaggregated Case



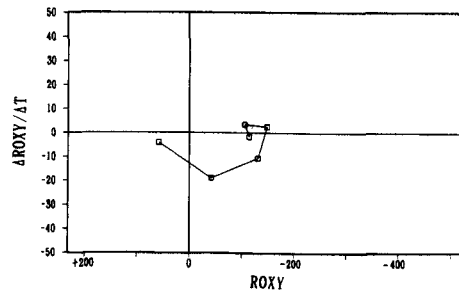
(a) 14 and under



(b) Over 14 and under 65



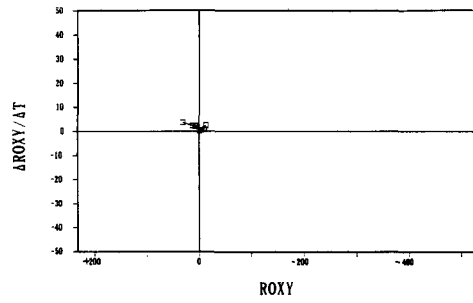
(c) 65 and Over



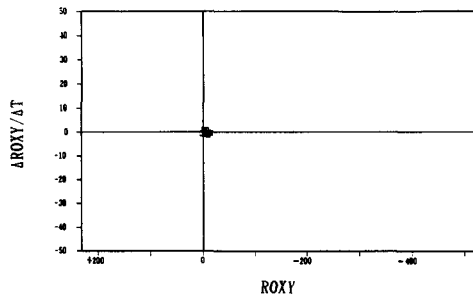
(d) All ages

Figure A-3 Values of  $ROXY$  and Their Marginal Changes for Chuo-line Region including Fujino-machi: For Absolute Number of Population in Aggregated Case

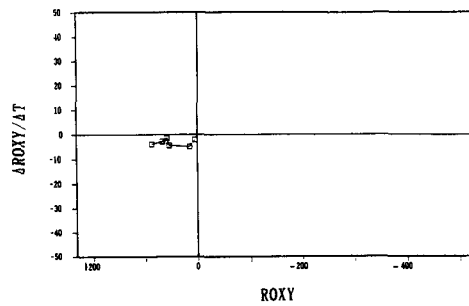
Aged Population in Spatial Cycles: ROXY Index Analysis for Chuo-line Region  
in Tokyo Metropolitan Area (Kawashima, Hiraoka)



(a) 14 and under

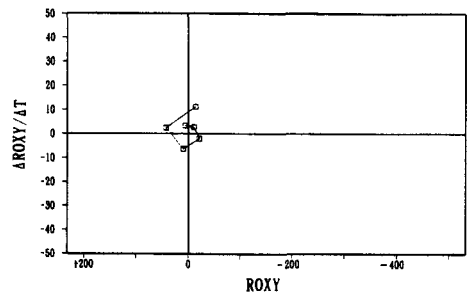


(b) Over 14 and under 65

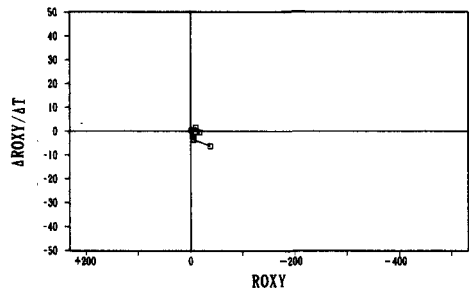


(c) 65 and Over

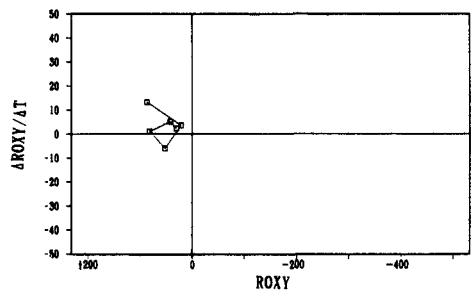
Figure A-4 Values of ROXY and Their Marginal Changes for Chuo-line Region excluding Fujino-machi: For Population Share in Aggregated Case



(a) 14 and under



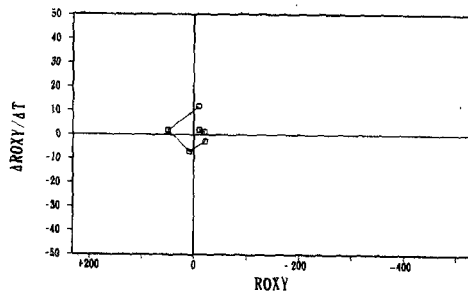
(b) Over 14 and under 65



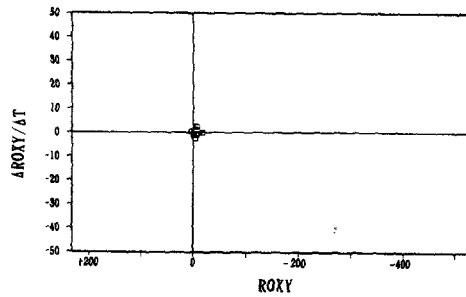
(c) 65 and Over

Figure A-5 Values of ROXY and Their Marginal Changes for Chuo-line Region including Fujino-machi: For Population Share in Disaggregated Case

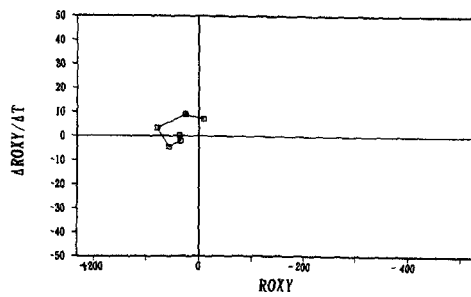
Aged Population in Spatial Cycles : ROXY Index Analysis for Chuo-line Region  
in Tokyo Metropolitan Area (Kawashima, Hiraoka)



(a) 14 and under



(b) Over 14 and under 65



(c) 65 and Over

Figure A-6 Values of ROXY and Their Marginal Changes for Chuo-line Region including Fujino-machi: For Population Share in Aggregated Case