Concentration and deconcentration of Finnish population by age groups in 1975–1995

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1. Introduction

The researchers can find several ideas and methods which favor development tendencies either in urban centers or in periphery. There are ideas which favor the hierarchical structures as the result of development and accordingly lead to even possible divergence of income per capita levels if not the migration helps the equalization of incomes. The scale and agglomeration economies and technological advancement connected to new capital and service industries will benefit large cities (Isard 1956). According to Thirlwall (1994) the principle of circular and cumulative causation is based on the existence of increasing returns in the widest sense. Some researchers have found unrealistic development expectations concerning weak and backward regions (Begg 1992, Amin et al. 1992, Mancha 1991). Also there are researchers who argue that the regional growth forms the mosaic pattern which changes its form according to the local activities and circumstances (Illeris 1995, Stainle 1992, Andersen et al. 1992). Tervo et al. (1994) has found the mosaic pattern when small regions are used.

The data for this study is collected from the population data of Statistics Finland and consists municipal populations by age group in 1975, 1980, 1985, 1990 and 1995. There are now 452 municipalities. For this paper we are using the terminology of "spatial unit" to indicate either Functional Urban Region (FUR) or municipality (Note 1). The geographical size of cities has gradually increased as the consequence of combining the neighboring rural municipalities to the city. There are 433 spatial units in this study. The FURs are defined only for six largest cities and their urbanized, commuting ring in the southern and south-western parts of Finland. The part of Finland where the most of FURs locate has more than 50 % of total population.

The point of view is the national urban system of the country. The spatial units are expected to give a special information about urbanization process of the most urbanized regions in Finland. By investigating the location of people in five year intervals we try to reveal the relative attractiveness of spatial units. Since the data is on the national system of all cities and municipalities it is possible to investigate and compare the growth of population in different aggregations, i.e. the system of centers and its complementary system (Notes 2–3).

2. The Roxy-index method

As a theoretical scheme the spatial-cycle hypothesis originally conceived by Klaassen (1979) and Klaassen et al. (1981) is employed and as a methodological instrument is the Roxy-index approach originally developed by Kawashima (1977, 1985) and Hiraoka and Kawashima (1995) in order to measure the concentration and deconcentration of population. To obtain the Roxy-index values the growth-ratio of the population for each spatial urban unit by each period (and by age group) was calculated. From these figures the annual-growth ratio of population was derived as well as the population level in the middle year of each period (i.e. middle-point population). By using the

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annual-growth ratio of population together with middle-point population which was employed as the weighting factor the Roxy-index value for each period was calculated. On the basis of the Roxy-index values together their marginal values the Figures 1–4 were drawn showing circular-cyclic form of development of population. (Note 4).

3. Empirical results

3.1. Characteristics of data in 1975 – 1995

The Finnish population has increased from 4.720.000 in 1975 to 5.117.000 people in 1995. At the same time the share of aged population (65 years or over) has increased from 10.8 % to 14.3 % . Against this number the corresponding figures of working age people (15–64 years) are 67.4% and 66.7% and shares of children (0–14 years) 21.8% and 19.0 %.

The development of different age groups has diverged by spatial units from 1975 to 1995. The growth of aged people on national level is reflected as strong growth in all systems of spatial units, – both in systems of large spatial units and in their complementary systems. The growth ratios of aged people are very high specially in systems of large spatial units.

The working age groups (15–64 years) have been growing in the systems of large spatial units (rank 1–5, 1–10, 1–20, 1–50) and in the complementary systems of rank 6–433 and 11–433. When large spatial units are left out of the complementary system the growth of working age group is negative. The youngest population (0–14 years) has increased only in systems of large spatial units (rank 1–5 and 1–10). Actually, all age groups have increased only in the systems of rank 1–5 and 1–10. At the same time in the complementary systems (rank 21–433 and 51–433) only age group (65 years or over) has increased.

3.2. System of five largest spatial units and its complementary system

The five largest spatial units consist the cities of Helsinki, Tampere, Turku and Lahti with their functional urban regions and the city of Oulu. In 1995 their population was 1.741.000 or 34% of total population in Finland. The results of Roxy-index analysis show a strong concentration of population into these five largest spatial units in Finland (Figure 1, left hand side). Also, it appears that although the data covers 20 years the period is not long enough to give picture of whole length of spatial cycle.

The development of all age groups together is entering from accelerating concentration to decelerating concentration. The development follows the spatial cyclic path but the changes by time intervals are small since 1980 and the cyclic path happens within the positive values of Roxy-index. Although the development pattern of all population is reaching the peak values in 1990 the concentration still continues as strong in suburban areas (Note 5).

By age groups (0–14, 15–64, 65– years) the population development is not equal. The largest age group (15–64 years) consists 70 % of total population of the five largest spatial units. The concentration of this working age group has reached the maximum values in 1985–90 and turned to decelerating concentration stage. The Roxy-index value is declining.

The age group (0–14 years) is dependable on the age group (15–64 years). The Roxy-index shows a strong concentration which is accelerating specially in 1990–95. The cyclic pattern of 1975–95 is not very clear which may be explained by different development of concentration between the core cities and the peripheral areas of spatial units. It seems that the concentration is strong in suburban areas and weaker in cores of FURs (Note 5).

The concentration pattern of the age group (65 years or over) is still different from that of the previous age groups. The development of oldest age group shows decelerating deconcentration. The deconcentration happens in all periods. The cyclical pattern is unclear in 1975–80–85. During the period 1990–95 the deconcentration rate is declining.

The complementary system of the five largest spatial units consist 427 spatial units, – mainly rural municipalities. Their population is 66 % of total population of Finland. The largest city of this complementary system (rank 6–433) has about 100.000 people. The all population of this system is concentrating in a cyclical pattern (Figure 1, right hand side). During the periods 1975–80–85 the concentration of all population was decelerating and declin-

Figure 1. Roxy-index and its marginal values by age groups in the system of the five largest spatial units and its complementary system.

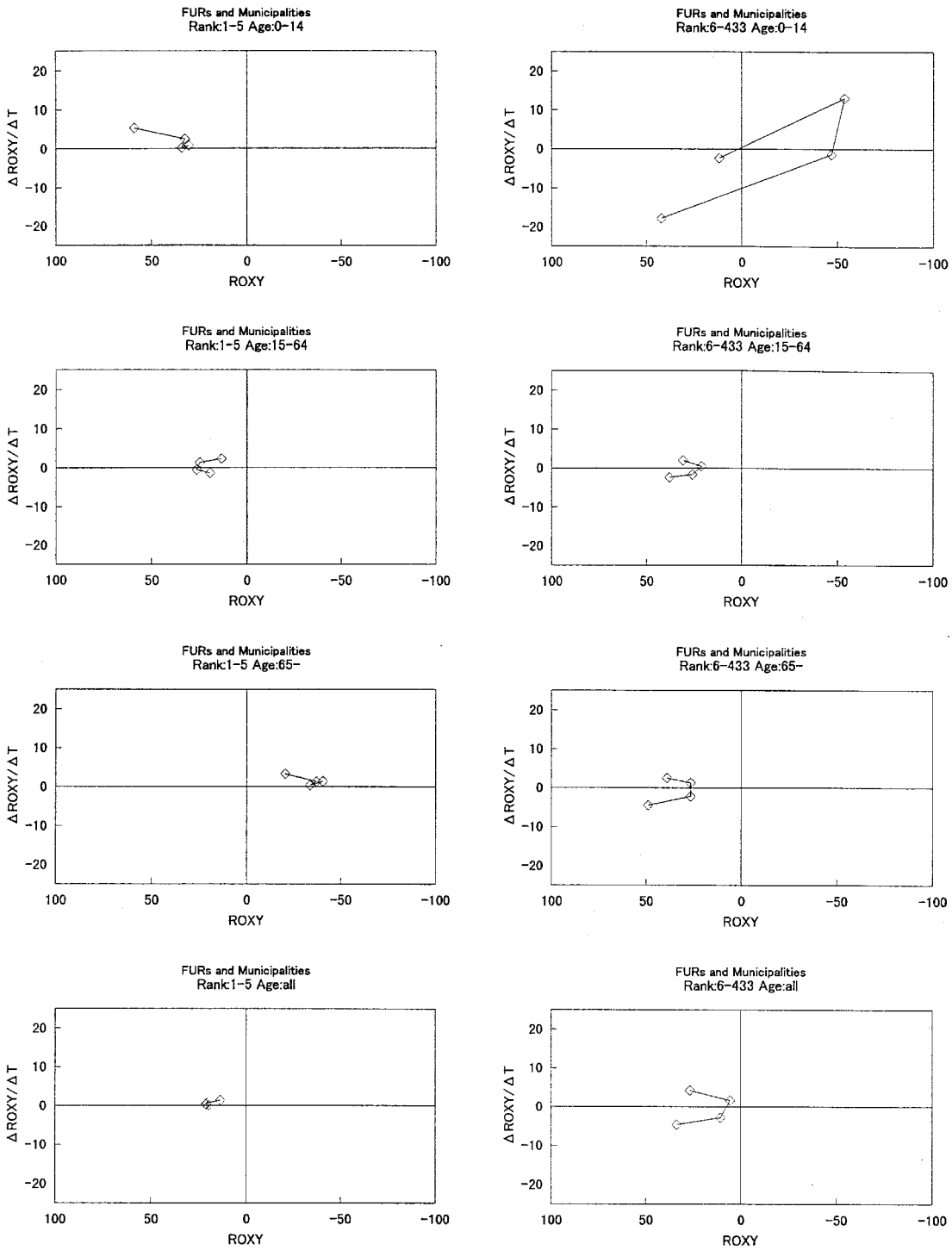


Figure 2. Roxy-index and its marginal values by age groups in the system of the ten largest spatial units and its complementary system.

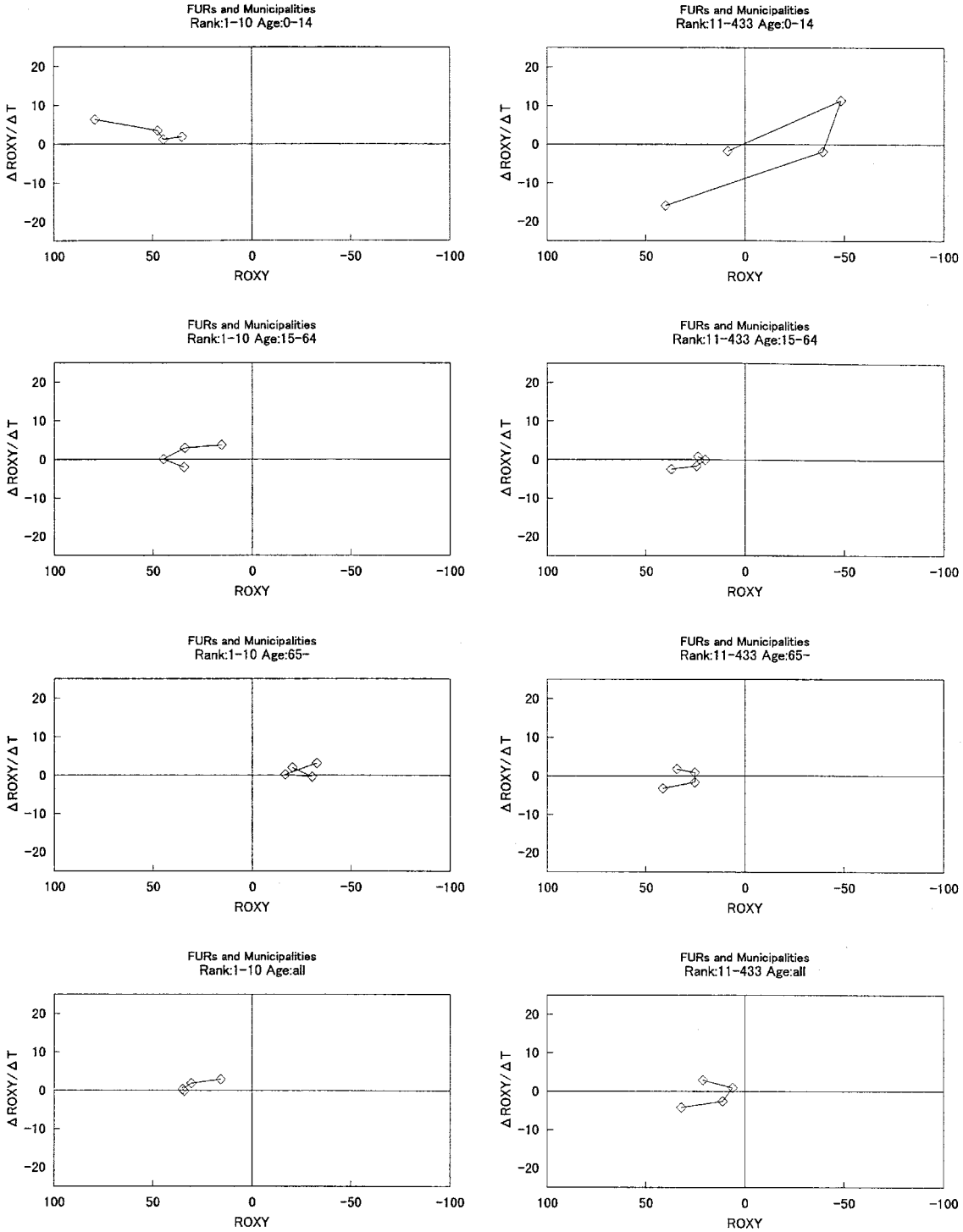


Figure 3. Roxy-index and its marginal values by age groups in the system of the twenty largest spatial units and its complementary system.

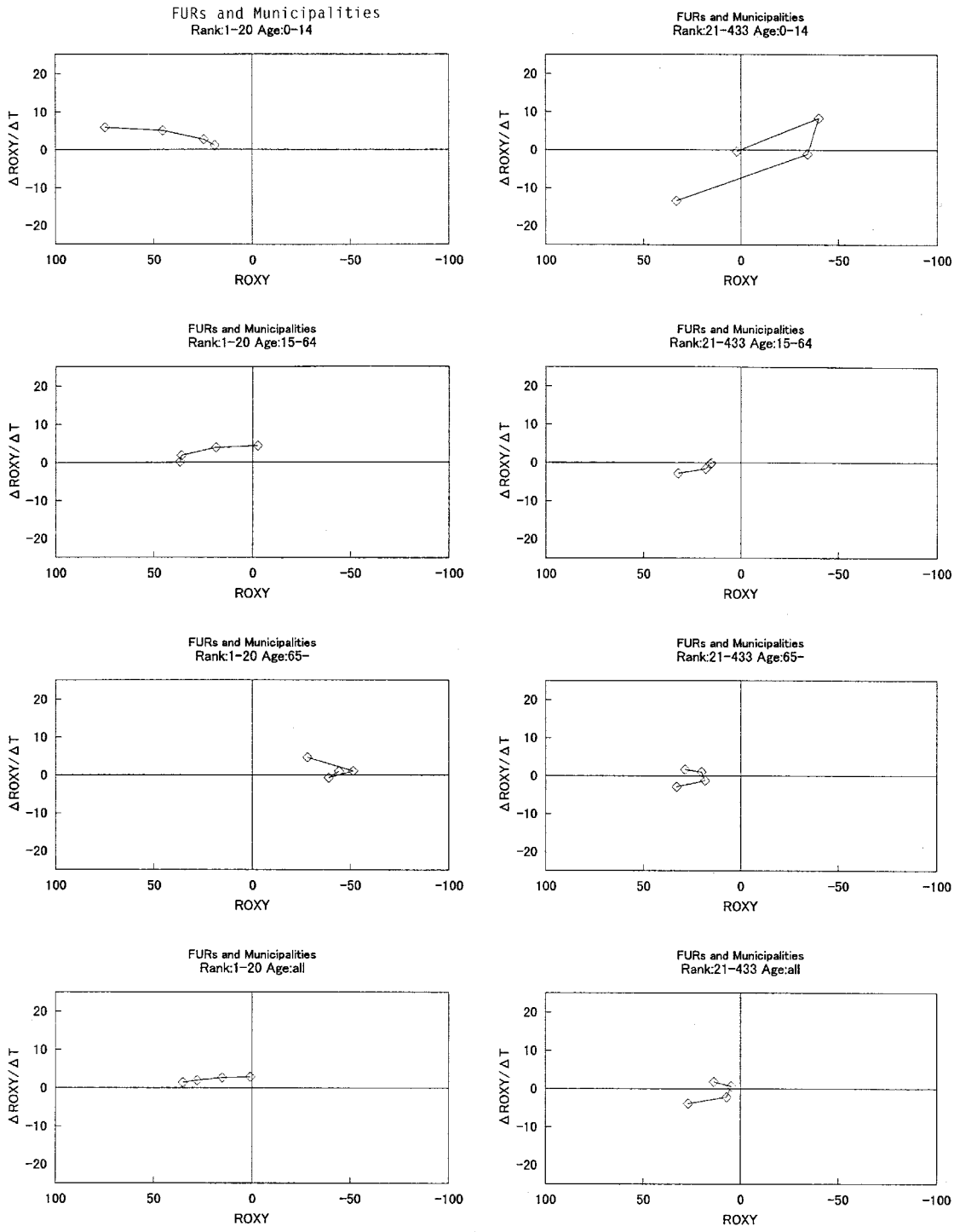
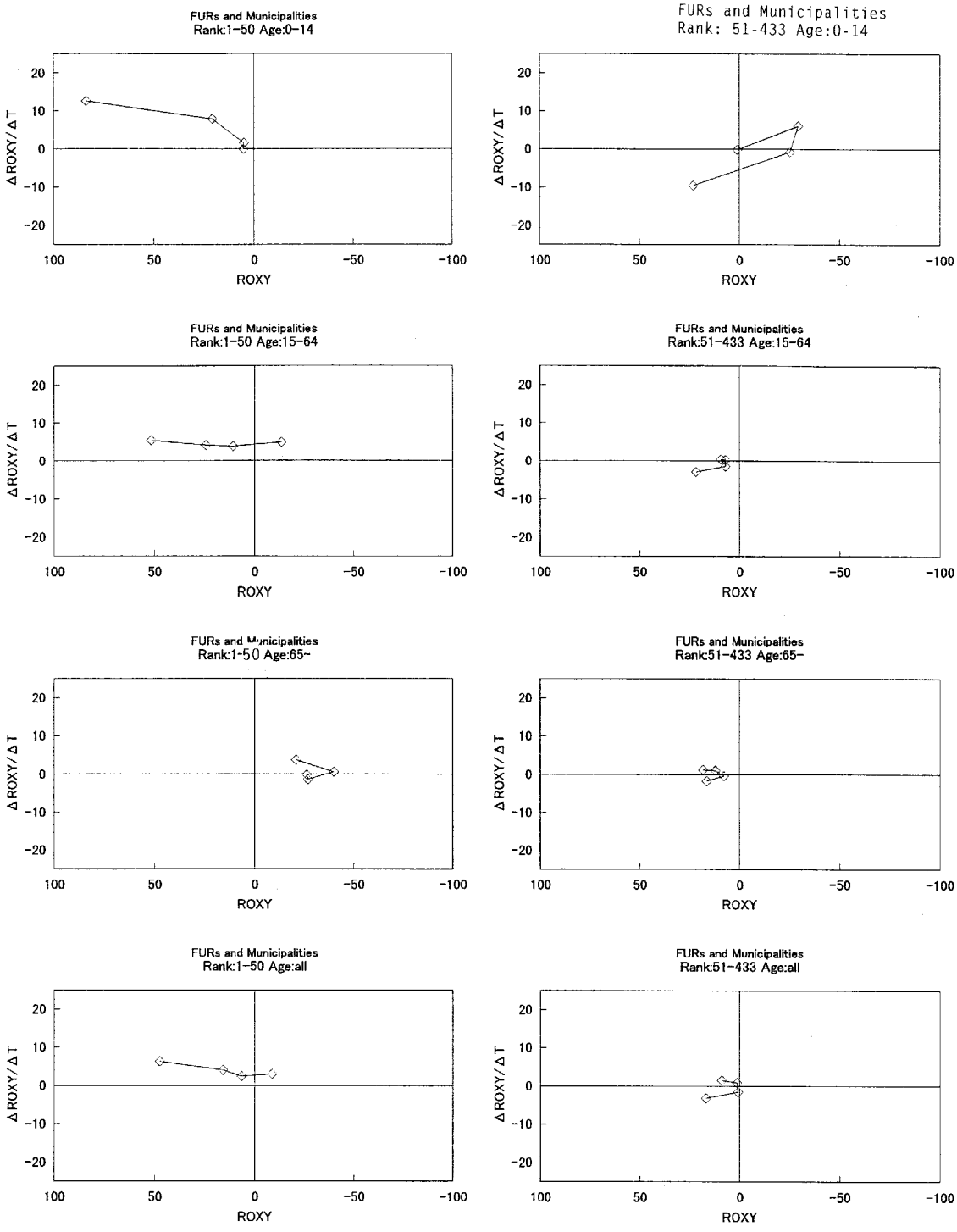


Figure 4. Roxy-index and its marginal values by age groups in the system of the fifty largest spatial units and its complementary system.



ing but turned to accelerating and increasing in 1985–90–95. The spatial cycle may happen altogether within the positive values of Roxy-index while the marginal Roxy-values change the sign.

When the complementary spatial units are investigated by age groups it appears that all age groups are following same cyclical stages. It naturally strengthen the cyclical pattern of all population. The youngest age group has the strongest cyclical pattern. The bottom of the cycle happened in the negative values of Roxy-index during 1980–85–90 and the cycle is probably reaching the peak after 1990–95 -period.

When the population development of the system of five largest spatial units are compared with that of their complementary system some profound differences appear.

The most different pattern is among old people. The old people are deconcentrating in the system of large spatial units. They are concentrating, cyclically, in the complementary system of the five largest spatial units.

3.3. System of the ten largest spatial units and its complementary system

The total population in the system of ten largest spatial units is 2.132.000 people. The range of population is from 1.041.000 (Helsinki FUR) to 56.000 (Kotka). The development of all population of ten largest spatial units shows concentration which is turning from accelerating concentration to decelerating concentration and probably already achieved the peak of the spatial cycle (Figure 2, left hand side).

The population of dominant age group (15–64 years) has already passed its peak value of concentration and since 1990–95 has been decelerating. The youngest age group (0–14 years) is still accelerating in its concentration in ten largest spatial units (Note 3). The oldest age group (65 years or over) shows unclear cyclical pattern but is clearly deconcentrating. The changes of marginal values of Roxy-index are very small in the old age group during the inspection time 1975–95.

In the complementary system (rank 11–433) of ten largest spatial units (rank 1–10) there are similar development pattern than in the system of rank 6–433 (Figure 2, right hand side). The most general difference is that the population development in the complementary system (rank 11–433) is in less advanced stage of cycle compared to that in the complementary system (rank 6–433). The population in each age group has passed the same cyclical stage about the same time and the whole cycle happens within positive values of Roxy-index while marginal values of index change the sign from negative to positive.

3.4. The system of twenty largest spatial units and its complementary system

The total population of the system of twenty largest spatial units (rank 1–20) is 2.547.000 people and its complementary system (rank 21–433) has 2.570.000 people.

When the number of spatial units has increased in the system of large cities to twenty the cyclical pattern of development appears furthermore to be in less advanced cyclical phase (Figure 3, left hand side). In this case of twenty largest spatial units (the population range from 1.040.000 to 34.000) the all population has in 1975–80 entered to concentration stage and is accelerating furthermore. The fastest growing spatial units are not the largest ones. The system of the twenty largest spatial units may reach the peak value of concentration soon after 1995 which is not recorded in the data.

From the age groups only the group (15–64 years) has already reached the concentration peak. The youngest group (0–14 years) still shows strong accelerating concentration (Note 3). Among the aged people the deconcentration appears declining. The development pattern of aged population is similar to that in the system of five largest spatial units.

The complementary system of twenty largest spatial units is very similar in its population development to the complementary system of ten largest spatial units (Figure 3, right hand side). Some small differences can be noticed: the complementary system (rank 21–433) is in less advanced cyclical phase than system (rank 11–433).

The comparison of two systems reveals that in the age groups (0–14 years) the developments seem still to have separate development patterns, the age groups (15–64 years) still are substitutes and in the oldest age groups patterns are

different by systems and in addition in the system of twenty largest spatial units this age group (65 years or over) shows expanding spiral pattern.

3.5. The system of the fifty largest spatial units and its complementary system

The fifty largest spatial units have 3.210.000 people and the population range from 1.040.000 to 15.000 people. In 1975–80 the development of all population in this system of the fifty largest spatial units was in the decelerating deconcentration stage which since then has been increasingly concentrating and accelerating furthermore (Figure 4, left hand side). The concentration does not show any sign of declining over the period 1980–95.

The system (rank 1–50) shows increasingly accelerating concentration. The spatial cycle is in less advanced cyclic stage than previous one (rank 1–20), – similarly as that was in relation to its predecessor. The cyclic patterns in different age groups have developed similarly in 1990–95. When compared with the system of twenty largest spatial units (rank 1–20) the system of fifty largest spatial units is in still less advanced stage of spatial cycle, – it has entered later to accelerating concentration stage and is still growing at increasing rate whereas in the system (rank 1–20) the concentration already shows signs of achieving the peak values (specially in the age group of 15–64 years). That indicates the cities of size between 15.000–34.000 people are still growing fast.

The complementary system of fifty largest spatial units appears to be in less advanced cyclical stage compared with the system (rank 21–433), – all population of system rank (51–433) has just passed the bottom of cycle in concentration and turned to accelerating concentration (Figure 4, left hand side). All population cycle will probably happen within positive values of Roxy-index. When the number of spatial units in complementary systems gets smaller (rank 6–433, 11–433, 21–433, 51–433) the changes of Roxy-index are smaller indicating that the pattern of cycle becomes flatter indicating that people in rural areas like to stay where they are.

When the system (rank 1–50) and the system (rank 51–433) are compared the cyclical patterns by age groups are increasingly different. The patterns seem to be separate even in the age group (15–64 years), – in earlier comparisons the cyclical patterns of working age groups were like substitutes. All age groups have separate cyclical patterns. It refers to the fact that populations by age groups in two systems are developing rather independently but each still following separately more dominant national, spatial cyclical pattern.

4. Policy implications

The Roxy-index method reveals the urbanization tendencies of the system. Since the urbanization in Finland is a young process (Note 2) one of the most interesting results was the existence of spatial cycles and when the spatial cycles exist are those cycles strong enough to have policy implications.

The policy considerations rest on the following conclusions:

- Roxy-index values and marginal Roxy-index values indicated the spatial cycles exist in Finnish population development,
- the concentration of Finnish population to large spatial units is prevalent phenomenon according to the Roxy-index analysis,
- the concentration to the largest spatial units happens through sub-urbanization, the concentration of the total population is counter-cyclical as to the economic cycle and the highest concentration values happen during economic recession periods 1975–80 and 1990–95 and the lowest concentration values during economic growth periods 1980–85–90,
- as an exception to the concentration is the cyclical deconcentration of elderly people into other than the largest centers, or – the elderly population is clearly concentrating in complementary systems of the systems of large spatial units. Their highest concentration values exist during economic recession periods.
- the concentration of working age group (15–64 years) happens along the economical cycle in large spatial units (rank 1–5, 1–10) and is counter-cyclical in their complementary system. This development points out that during economic recession periods the employment opportunities are relatively scarce in the systems of the largest spatial units.

- prevalent concentration of Finnish population does not support the mosaic model.

Consequently, the policy implications can be classified into the two categories:

- economic growth policy including the aspects related to young and working age human capital and
- social welfare policy for the increasing elderly population.

In the growth policy the concentration seems to be inevitable. It means that the equality-weighted regional economic policy with subsidy system cannot compete with concentration forces i.e. agglomeration economies. The concentration is dominant phenomenon also in complementary systems. Purely in material terms the welfare of people can be increased by promoting the concentration specially in systems of large spatial units and also in their complementary systems. However, the concentration has spatial cyclic paths and by age groups the development is different. The growth policy should include the needs of creating human capital as well as social infrastructure in the national urban system. The timing of big investment projects and policy measures is important. The concentration has severe consequences by depleting human resources of small spatial units in rural areas. Therefore the subsidy policy of national government must maintain the supply of basic services in those areas. The necessity to continue the subsidy policy of national government emphasizes the need of policy concerning whole national urban system. The transportation investment should be directed to both intraurban and interurban projects of large and medium size cities. It would mean a change compared to previous policy. Specifically, the Helsinki-FUR should have enough labor and material inputs also during economic booms to dampen its characteristic of being the inflation center of country at the peak of economic activity. The preliminary results from Helsinki-Tampere corridor data reveal that the growth prospects are best in both ends of corridor.

In the welfare policy the concentration of elderly in the complementary systems to medium size cities, requires policy measures. The fastest growth of aged people in those cities happened during the recession periods 1975–1980, 1991–95. The growth cyclically diminished but still continued at fast rate also in 1985–90–95. In the complementary system of smaller than rank (21–433) the concentration has smaller values. This can be explained at least partly by regional age structure of population and by the movement of retired from the sparsely populated rural areas and communities to neighboring cities where the necessary services exist. The welfare policy also emphasizes the need and importance of policy concerning whole national urban system.

Notes

1. The Functional Urban Regions are delineated for six spatial units. Helsinki FUR: Helsinki, Espoo, Vantaa, Kauniainen, Kerava, Tuusula, Kirkkonummi, Järvenpää, Nurmijärvi. Tampere FUR: Tampere, Kangasala, Pirkkala, Ylöjärvi. Turku FUR: Turku, Kaarina, Lieto, Piikkiö, Raisio. Pori FUR: Pori, Ulvila. Lahti FUR: Lahti, Nastola, Hollola. Jyväskylä FUR: Jyväskylä, Jyväskylä mlk. All calculations for this study are made by Noriyuki Hiraoka at the Mitsubishi Research Institute, Tokyo, Japan.
2. The first strong urbanization of Finnish population was observed just after 1870 when the industrialization started. Before that there had been no remarkable increase in the number of urban dwellers. (The Committee for International Coordination of National Research in Demography, CICRED 1974). The concentration of population which started in 1870 continued until the WW I according to the long-term Roxy-index study (Hirvonen-Hiraoka-Kawashima, 1999).
3. Since the population data consists the basic units of administrative system, several aggregations or sub-aggregations are possible. Besides the FURs another subset of data for Helsinki-Tampere corridor were formed. These two largest urban agglomerations have highway, railroad and airport connections. The city of Tampere can be considered as a distant sub-

urb of Helsinki in inter-urban model. For this reason the distance from Helsinki CBD to each municipality were included in data. In this Helsinki-Tampere sub-aggregation of data there are 21 municipalities which are either on the road or railway lines or in the defined corridor.

4. Definition of Roxy-index, period t:

$$R^t = (WAGR^t/SAGR^t - 1.0) \times S$$

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

where

$WAGR^t$: Weighted Average of Annual Growth Ratios of Population

$SAGR^t$: Simple Average of An nual Growth Ratios of Population

S : Scaling Factor

r_i^t : Annual Growth Ratio in Spatial Unit i

d_i : Weighting Factor

n : Number of Spatial Units

5. In order to investigate the whether the population concentration exists in the core of FURs or in the suburb, the Roxy-index values were calculated also from the municipal data. It appeared that the concentration of population was different when the municipal data was used compared to the results of the spatial units data. While the concentration of population in the systems of large spatial units (rank 1–5, 1–10, 1–20, 1–50) were cyclically already reaching the highest values, the concentration in the systems of large municipals was in less advanced cyclic stage and still accelerating and increasing. The results indicated that the concentration of population in the largest spatial units happens through sub-urbanization in large municipalities of ring-zone. In the complementary systems there were no corresponding differences in results because the data consists almost same municipalities.

Implications of Roxy-index values for study of dynamic spatial redistribution of population

A	B	C	D
Sign of Roxy-index value	Pattern of spatial redistribution of populatton among spatial units	State of changes in Roxy-index value	Speed of spatial redistribution process of population among spatial units
Positive	Concentration	Increasing Leveling-off Decreasing	Acclerating Constant Decelerating
Zero	Neutrality from both concentration and deconcentration (symmetric growth of decline)	Increasing Leveling-off Decreasing	Start of Acceler. Concentration Continuation of neutrality Start of Acceler. Deconcentration
Negative	Deconcentration	Increasing Leveling-off Decreasing	Decelerating Constant Accelerating

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Johtaja Olavi Koivukangas luovutti heinäkuussa 1999 Hibbingissä, Minnesotassa, Siirtolaisuusinstituutin 25-vuotisjuhlaveistoksen *Maailmalle lähtö* Robert Schmidille kiitokseksi tämän instituutille tekemistä palveluista.