UrbanScope Vol.3 (2012) 55-71

UrbanScope
e-Journal of the Urban-Culture Research Center, OCU

A Comparative Analysis of Changes in the Characteristics of Urban Residents in Tokyo and Osaka, 1995-2005

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Keywords: urban residents, population recovery, geodemographics, Tokyo, Osaka

Abstract

This study aims to grasp the trends in the characteristics of the residents of Japan's two major cities – Tokyo and Osaka – using the approach of geodemographics, which is expected to play a key role in future urban research. In addition, based on the relative situations of the two cities from 1995 to 2005, this paper examines how the characteristics of the residents have changed in conjunction with the population recovery in urban areas, and, from a comparative viewpoint, the direction of changes in the two cities and the disparities between them will be considered.

The findings are summarized as follows: 1) The characteristics of foreigners were not uniform, and changes took place in response to the surrounding social circumstances. 2) Child-rearing households became a new feature of urban residents, and the lopsided tendency of child-rearing generations in Osaka weakened. 3) Regarding the housing characteristics of urban residents, in 2005 the owned housing indicator appeared along with public housing. 4) White-collar occupational characteristics became more pronounced. 5) While on one hand Tokyo gave added traction to the continuously strengthening tendency towards white-collarization, no particular classification was predominant in Osaka where the proportional makeup remained mixed.

Since the latter half of the 1990s, the internal areas of the cities changed drastically, the nature of urban residents became diversified as populations recovered, and the situation has become more complicated. White-collarization rapidly advanced in Tokyo, which employed deregulation in order to rely on the principles of the real estate market. In comparison, the movements for urban renewal in Osaka have not been sufficient to change the characteristics of the residents across the city as a whole, and the disparities between the two cities have been proceeding in an ever-widening direction.

I. Introduction

Since the late 1990s, the net outflow of population from the major cities of Japan has gradually changed to a net inflow, and a return to the cities has become apparent. Changes are visible in urban planning as well. There is a growing recognition that the exurban-dispersal type of city planning mainly practiced up until now by the developed countries of Europe and North America, i.e. constructing new suburbs and sprawl, leads to the waste of existing resources, increases the social and environmental burden, and restricts the alternative choices for the communities of the future (OECD: 1996). In Japan as well, the reorganization of the urban space is rapidly proceeding, beginning with urban renewal projects. Since the collapse of the bubble economy, housing policy reforms have been carried out one after another. Also, along with the changes in population structure and living conditions, such as the continuing drop in land prices, the return of population to urban areas, and the aging of the suburban population, there has been an undeniable advance in the diversification of the residents and the patterns of residence in the major cities. These changes in population movement have brought about differentiation in housing in relation to the attributes of the residents in urban areas, e.g., family composition and social class (Miyazawa, et al.: 2005), and have led to changes in the spatial characteristics of areas within cities.

In these circumstances, it is becoming increasingly more important to grasp the changes in the composition of the residents in connection with this return to the cities, as well as the effects this is having on local communities,

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and also to lead the way in issues of local policy. Against that background, much research has been carried out on what is bringing about the changes in population movements occurring in metropolitan areas and in cities. Among the factors indicated as causes of local differences in the movement of population are changes in land use, improvements in transportation infrastructure, and the trend towards a supply of condominium apartments, etc. (Horiuchi: 2009; Ushigaki: 2006; Nakayama and Oe:2003).

In the past, the differences between the major cities and regional cities were focused on, and both national land policies and industrial location policies promoted the equalization of disparities between core and the peripheral regions and also of policy for dispersal of industrial zones. In contrast, in recent years, an emphasis has been put on strengthening the international competitiveness between cities, and the disparities between them have grown. However, most of the previous research has only dealt with one particular city, and so even if such studies have described in detail what is occurring in their respective regions, they have been lacking in a perspective that can explain to what extent that city is either a unique case or part of a general trend.

To give an overview of the methodology, research on the spatial patterns of the characteristics of the residents within the city and the type classification of districts has developed mainly focused around social area analysis and factorial ecology. The method of social area analysis is a means of comparatively analyzing the social structure of the city by classifying small area units within the city using the criteria of social indicators. Factorial ecology research, on the other hand, performs factor analysis on groups of social indicator variables, pulls out underlying factors from the mutual correlations between variables, and takes these as social dimensions, then cluster analysis and other means are employed to attempt to reveal spatial patterns. These methods came to be widely used in the 1960s and 1970s, against the background of the development of information processing technology. Moreover, factorial ecology has come to be used frequently as a typical methodology in research on residential structure, such as in Asai et al.'s project employing the methods and viewpoint of factorial ecology in creating a neighborhood classification for small areas across all of Japan based on either geodemographics or residents' characteristics (Asai et al.: 2001).

On the other hand, a number of new methods have been proposed as refinements of this method of analysis. Yano and Kato, in considering the residential structure of Tokyo's wards, have compared factorial ecology methods with canonical trend surface analysis. Canonical trend surface analysis is a method developed based on canonical correlation analysis, and trend surfaces of canonical variables and the spatial distribution of their residuals allows analysts to grasp the spatial characteristics of groups of input variables. This is seen as allowing simultaneous and holistic analysis of the structure and spatial pattern of factors (Yano and Kato: 1988). Also, Nakaya has utilized neural networks called Self-Organizing Maps (SOM) and attempted a social area analysis of Kyoto City. SOM are algorithms modeled on the self-organizing capability of the brain, and by repeated sampling of input samples, one can study the structure of groups of input variables. Through this process, analysts can visually grasp the correlations between variables and at the same time can make separate classifications based on the results obtained. Making use of this feature, Nakaya, as a result of adapting SOM to data on the residents' characteristics of Kyoto City, indicated that the processing done previously by the factorial analysis method was processed at the same time using SOM (Nakaya: 2003). Based on this, Kirimura, after comparing and examining the two methods applied to actual data on the characteristics of residents, showed that in SOM the effect of the variable structure on the analysis results was less than in factor analysis, and it was a method that facilitated understanding of characteristics from even a small number of variables. However, he explained that the nature of SOM is such that caution is necessary because even when applied to the same kind of data, the results of the analysis will not necessarily be the same, and he goes only so far as to say that SOM holds the possibility of presenting a new viewpoint (Kirimura: 2006).

Geodemographics is widely defined as "analyses of people by where they live," and is constructed by linking classified neighborhoods (Harris, et al.: 2005) with some indices of interest such as the economy, health, crime, or education. One of the commonly used commercial geodemographics tools is Mosaic, which was originally developed in the UK. In recent years, its use in applied research can be seen as well, such as in the research by Kimura et al. that elucidated the relationships between outbreaks of influenza and the characteristics of neighborhoods (Kimura et al.: 2011) and once again garnered attention for geodemographics.

Taking that into account, this paper will explore the trends in the characteristics of the residents of Japan's two

major cities – Tokyo and Osaka – using the approach of geodemographics, which is expected to play a major role in future urban research. Going further, based on the relative situations of the two cities, this paper will examine the way in which the characteristics of the residents are changing in conjunction with the return to the urban cores, and, from a comparative viewpoint, the direction of changes in the two cities and the disparities between them will be considered.

II. Data and Methodology

A comparison between the cities using the methodology of geodemographics, combining principal component analysis and cluster analysis, was conducted on the selected study areas of the 23 wards of Tokyo, the 24 wards of Osaka City plus adjoining cities (Figure 1). In comparing Tokyo's 23 wards with Osaka City's 24 wards, the difference in land area and population size is too wide, and so the cities adjacent to Osaka City have been included in the analysis. Basic information on the areas chosen for analysis is shown in Table 1.

Table 1. Basic information on the study areas

		Tokyo	Osaka
	area	23 wards (564.4 km²)	24 wards + 10 cities (547.0 km²)
1995	# of districts	3027	4682
	population	7,955,937	5,591,153
2000	# of districts	3033	4791
	population	8,118,002	5,580,894
2005	# of districts	3036	4794
	population	8,487,063	5,597,750

For the analysis, the methods of geodemographics that combine principal component analysis (PCA) and cluster analysis were utilized. These modes of analysis have the distinct advantage of treating proportional change as continuous. Data reduction, and thus descriptive power, is achieved by an empirical classification derived from the directions found in the dynamics of change. This analysis is based on the data for the three years 1995, 2000, and 2005 from

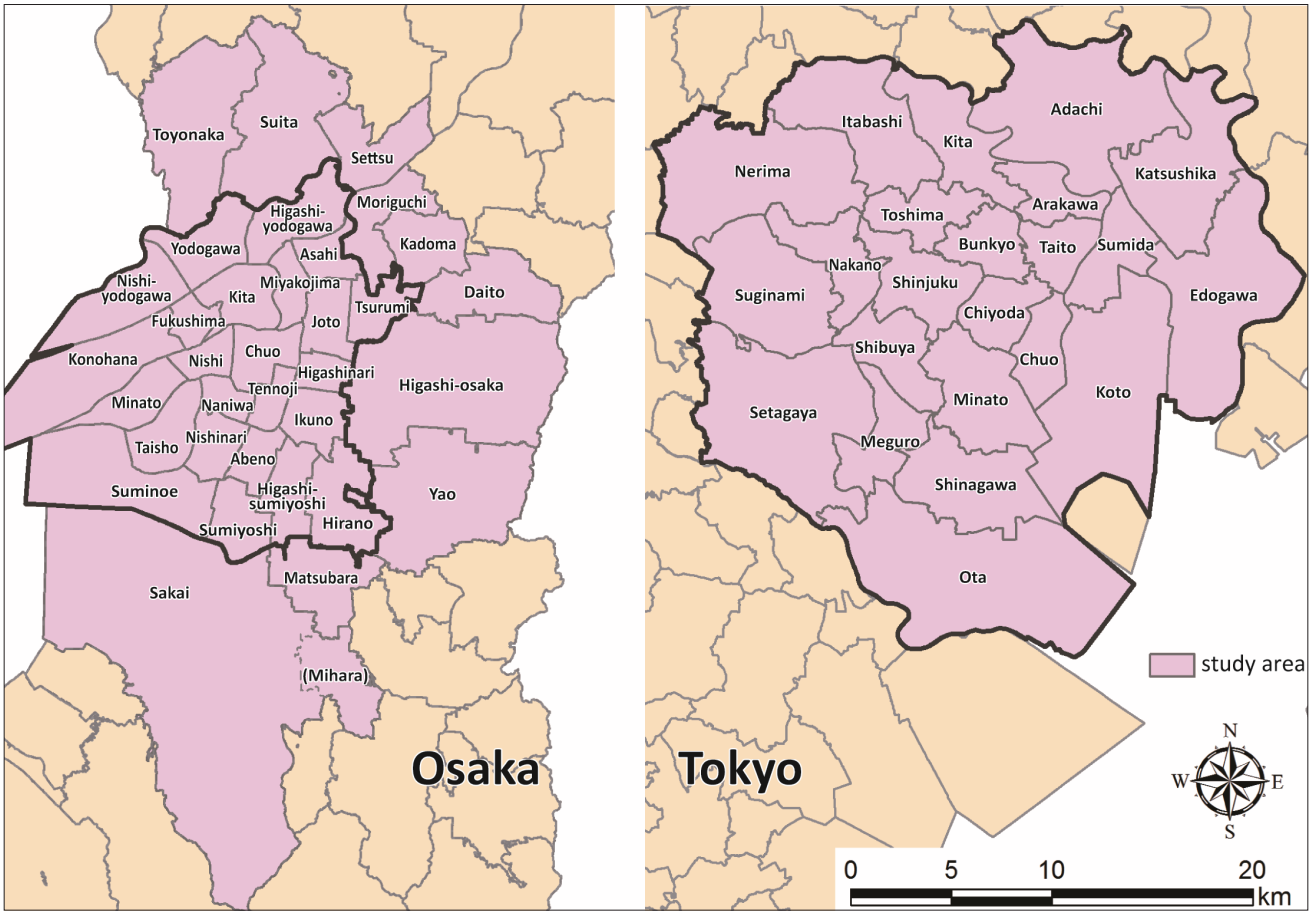

Figure 1. Study Areas

the Japan statistics bureau. Census data for enormous items were collected at the small-area level.[1] Since datasets were collected here by small-area level, some extreme values were eliminated. For example, districts which had less than 10 people or less than 5 households and with no residents were omitted from the analysis. Consequently, the parameters of this analysis consisted of 7,754 districts for 1995, 7,824 districts for 2000, and 7,830 districts for 2005. First, 45 variables related to population density, age, household composition, marital status, housing quality, labor force, occupation, and other categories were set up (see Table 2).

To briefly outline the steps of the analysis: 1) For each variable, a mean value and standard deviation were calculated, and standard scores were assigned to each variable. 2) PCA was conducted using the standardized scores of the variables in order to find the component matrix of principal components (PCs) with eigenvalues of 1.0 or greater. 3) In order to make interpretation of the PCs easier, varimax rotation was carried out to obtain a new component matrix, and the cumulative contribution rate of each PC in response to that was obtained. 4) For each PC, components with scores ±0.3 or greater were used as indicators explaining the PC, and each PC was thus defined. 5) In order to conduct classification of the area units, the PCs scores obtained above were used as variables, and a cluster analysis by the K-means method was carried out on 2 to 10 clusters, adding one cluster at a time and carrying out analysis. 6) For each cluster number obtained using the K-means method, clusters were mapped and given a name. 7) Additionally, for each of the larger category clusters, in order to grasp the differences within clusters, the process in step 6) was repeated, and they were divided into smaller category clusters. 8) These steps were carried out for each of the three years, and their respective results were compiled as a comparison. In these analyses, the software used was SPSS Statistics 18 (IBM Corp.), Excel 2010 (Microsoft Corp.), and Arc View 10 (ESRI Corp.).

As a result of the PCA, for each of the three years, 11 PCs with eigenvalues of 1.0 or greater were collected, and their levels of cumulative contribution rates[2] were 74.82% for 1995, 73.99% for 2000, and 74.80% for 2005. The contribution rates for each PC are as shown in Table 3. In Section III below, using component scores of ±0.3 or more as explanatory indicators of the PCs, how the characteristics of the urban residents can be summarized, and how they are changing can be deduced from the changes in the composition of each of the PCs. Accordingly, while referring to the aggregate values of each variables and the distribution maps of the component scores,[3] this paper aims to obtain a comparative understanding of the movements within the urban areas.

Next, in Section IV, using the scores given by previous PCA, cluster analysis was conducted with the K-means method, and the study areas were classified into 2 to 10 districts. Referring to Asai, et al. (2001) and Kimura, et al. (2002), for each cluster, the means of the standardized scores of the 45 variables and the populations of the districts belonging to the cluster were calculated, and each respective cluster was interpreted in combination with the distribution maps. As a result, dividing each of the years of the study area units into 7 major categories was judged to be the most appropriate classification. Next, in order to make differences stand out more within each of the major categories, clustering was performed on the units within each major category, and after repeating the previous step for 1995 and 2000, dividing into 11 category types for the area units were judged to be most appropriate, and for 2005, 12 category types were selected. The following paragraphs will point out what was suggested by interpreting the changes in clustering for each of the years.

Finally, Section V contains a consideration the direction of changes in the two major metropolitan areas based on the results of these analyses.

1. The results tabulated by such small areas as subdivision of municipalities by *cho* and *aza*.
2. The rate of cumulative contribution shows the extent to which each PC reflects the information of the original variable.
3. Component score distribution maps were made using the standard deviation method using all effective area units of the study area as the parameter.

Table 2. Variables used in the analysis and component matrix after rotation

	Principal Component(1995)											Principal Component(2000)											Principal Component(2005)									
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5	6	7	8	9	10
Var. 01 population density		-0.34						-0.35		0.55			-0.33								-0.57				-0.31				-0.54			
Var. 02 ratio of population under 15 yrs. old	-0.90											0.92											0.90									
Var. 03 ratio of population 15-24 yrs. old					-0.76					-0.30								-0.84														-0.83
Var. 04 ratio of population 25-34 yrs. old		-0.34					-0.59						-0.35				-0.50		-0.38					-0.73								
Var. 05 ratio of population 35-44 yrs. old	-0.48									0.49		0.49	-0.31	0.40									0.40	-0.55								0.38
Var. 06 ratio of population 45-64 yrs. old							0.37	-0.54						-0.33			0.43			-0.43				0.38					0.53	-0.34		
Var. 07 ratio of population 65 yrs. old or older	0.64				0.55							-0.59						0.51	0.40				-0.43	0.74								
Var. 08 ratio of population 75 yrs. old or older	0.57				0.42				-0.34			-0.51						0.38	0.43				-0.41	0.58					-0.34			
Var. 09 ratio of foreigners in population				0.43							0.62				0.46						0.32	0.44										
Var. 10 ratio of single-person households	0.68	-0.42			-0.30		-0.35					-0.68	-0.44				-0.42						-0.80	-0.48								
Var. 11 ratio of couples-only with no children households					0.75												0.38	0.55					0.43	0.62								
Var. 12 ratio of households of couples with children	-0.83											0.82	0.31										0.89									
Var. 13 ratio of nuclear families with children under 6 yrs. old	-0.87											0.89											0.87									
Var. 14 ratio of nuclear families with children under 18 yrs. old	-0.94											0.94											0.94									
Var. 15 ratio of three-generation households		0.68											0.66											0.37		0.36	0.33					
Var. 16 ratio of aged-single-person households	0.55				0.45							-0.53						0.39	0.33				-0.48	0.46								
Var. 17 ratio of aged-couple households	0.31				0.69								0.35				0.42	0.54						0.83								
Var. 18 ratio of households with relatives 65 yrs. or older	0.32	0.53			0.53								0.60				0.39	0.43						0.83								
Var. 19 Floor space per person for regular households living in housing (㎡)		0.49	0.48										0.49	0.39							0.49				-0.31		0.35		0.64			
Var. 20 ratio of households in detached houses		0.88											0.89											0.44			0.60					
Var. 21 ratio of households living in *nagaya* row houses (tenement houses)			-0.46						-0.32		0.41			-0.39								0.56		0.31			0.39		-0.38			
Var. 22 ratio of households living in apartment houses or flats		-0.82											-0.87											-0.50			-0.66					
Var. 23 ratio of households in owned housing		0.84											0.82										0.40	0.38			0.58					
Var. 24 ratio of households in public rental housing		-0.53					0.62						-0.53				0.65										-0.87					
Var. 25 ratio of households in private rental housing							-0.81										-0.79						-0.47	-0.57								
Var. 26 ratio of households in benefit-supplied housing								0.70												0.67											0.73	
Var. 27 Male labor force									0.79										-0.79										0.76			
Var. 28 Female labor force	0.49								0.57			-0.46							-0.63										0.76			
Var. 29 Total unemployment rate		-0.38	-0.31					-0.42						-0.49						-0.33					0.35				-0.41			
Var. 30 ratio of employed people (including officials)				-0.88											-0.89											-0.91						
Var. 31 ratio of self-employed people (including home workers)				0.82											0.81											0.84						
Var. 32 ratio of people employed by families				0.80											0.83											0.85						
Var. 33 ratio of people employed in construction			-0.36			-0.37		-0.37						-0.53						-0.33					0.50			-0.32				
Var. 34 ratio of people employed in manufacturing			-0.58			-0.38					0.37			-0.48		-0.44						0.35			0.54			-0.31				
Var. 35 ratio of people employed in wholesale, retail trades, and restaurant						0.85									0.31	0.83										0.31		0.82				
Var. 36 ratio of people employed in finance, insurance, and real estate			0.53			0.34								0.48		0.31					0.44				-0.37			0.32	0.50			
Var. 37 ratio of people employed in services industry			0.82											0.77											-0.84							
Var. 38 ratio of specialist and technical workers			0.85											0.82											-0.86							
Var. 39 ratio of administrative and managerial workers			0.54			0.32								0.38							0.67				-0.30				0.71			
Var. 40 ratio of clerical workers			0.32	-0.48						0.50				0.58	-0.33										-0.49	-0.42						
Var. 41 ratio of sales workers						0.80										0.82												0.80				
Var. 42 ratio of service workers	0.42			0.36		0.38						-0.41			0.35	0.46							-0.37			0.36		0.46				
Var. 43 ratio of security workers								0.52												0.65											0.74	
Var. 44 ratio of transport and communication workers			-0.40			-0.34					-0.32			-0.47		-0.36						-0.38			0.53			-0.36				
Var. 45 ratio of production process and related workers			-0.75			-0.48								-0.76		-0.45									0.74			-0.40				

Note: Only those with absolute value factor loadings of 0.3 or greater are shown.

Table 3. Rotation sums of squared loadings

Principal Component	1995			2000			2005		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.26	13.91	13.91	6.03	13.40	13.40	6.13	13.62	13.62
2	5.02	11.16	25.07	5.19	11.52	24.93	5.84	12.97	26.59
3	4.24	9.43	34.50	4.45	9.88	34.80	4.10	9.11	35.69
4	3.46	7.68	42.18	3.37	7.49	42.29	3.52	7.82	43.52
5	3.16	7.01	49.19	2.71	6.02	48.31	2.80	6.21	49.73
6	2.89	6.43	55.61	2.49	5.54	53.85	2.62	5.83	55.56
7	2.19	4.86	60.48	2.34	5.21	59.05	2.38	5.28	60.84
8	1.98	4.40	64.87	2.14	4.76	63.81	2.01	4.45	65.29
9	1.92	4.27	69.14	1.63	3.61	67.43	1.61	3.57	68.86
10	1.29	2.86	72.00	1.61	3.58	71.01	1.41	3.14	72.00
11	1.27	2.82	74.82	1.34	2.98	73.99	1.26	2.81	74.80

III. Tendencies within the Cities Seen from the Composition of Principal Components and Their Spatial Distribution

1. Changes of Principal Components Related to Population and Individual Attributes

For each of the three years, PCs in which the proportion of foreigners in the population has a positive significance were collected (PC4 and PC11 for 1995; PC4, PC10, and PC11 for 2000; and PC11 for 2005), but concerning their numbers and their combination with other variables, different results were obtained for each year. PC4 for both 1995 and 2000 had almost the same composition, a combination of proportion of self-employed including those working at home (Var. 31), proportion of those working in family business (Var. 32), and proportion of service workers (Var.42), as did PC11, collected from a combination of proportion of households in *nagaya* row houses (Var. 21) and proportion of those working in manufacturing industries (Var. 34). However, as compared the standard scores for proportion of households in *nagaya* row houses (Var. 21) between Tokyo and Osaka, for all three years the values for Tokyo are extremely low, and so it can be said that this component strongly reflects the values of Osaka.

From the results for the year 2000, PC10 was newly obtained as a combination of Var. 19, 36, and 39, variables with strong white-collar characteristics. Looking at the map of the distribution of its scores, it can be seen that in addition to Tokyo's Minato Ward and Shibuya Ward, they have spread to the margins of Setagaya Ward and to the bayside area of Koto Ward. These areas are different for the distribution pattern of PC4 and 11 for the same year. However, in 2005, there were no multiple extractions of PCs in which this variable was positively significant, and the PC was obtained with almost the same combination of variables as PC11 from 1995 and 2000. In both 1995 and 2000, PC4 showed a positive significance of +0.27 with the proportion of foreigners (Var. 9), but it was below the threshold of ±0.3. Thus, in 2005 things ultimately returned to the same situation as in 1995.

The trend regarding the indicator of foreigners can be summarized as follows: The proportion of foreigners in the population continued to increase from 1995 to 2005, and the characteristic of foreigners became one of the features of the urban residents. In addition to the characteristic of "oldcomer" resident aliens that had been conspicuous in the past, in the year 2000 the characteristic of newcomer foreigners appeared, thus, it can be said that the characteristics of foreigners who live in the cities have diversified. Consequently, in 2005 things returned to the same kind of situation as in 1995, but the characteristics of foreigners which could encapsulate the features of urban residents were not the same, and it could be seen that they were changing in response to the surrounding social circumstances.

2. Changes in Principal Components Related to Household Attributes

While in 1995 no PC could be collected with a positive correlation to the characteristics of generations raising children such as Var. 2 and Var. 12 through 14, in both 2000 and 2005 this was obtained as PC1. Additionally, in 2005, this same PC showed a high positive correlation with proportion of owner-occupied housing (Var. 23). Begin-

ning in 1995, in conjunction with the return of population to the cities, the number of households of child-rearing generation buying their own homes in urban centers and areas around urban centers increased and became the main PC for explaining the characteristics of urban residents.

Using the median for the component scores of each of the administrative units, if one examines the ranking of changes in the order for the study areas in 2000 and 2005, the three highest places are Chiyoda Ward , Abeno Ward, and Koto Ward in that order.[4] Concerning the increase in households raising children, during this five years the places where the average value of the proportion of the population under 15 years old (Var. 2) increased were, in Tokyo, only Chiyoda Ward (+0.6 points) and Edogawa Ward (+0.2 points). Conversely, in Osaka, both Abeno Ward and Settsu City increased by +0.4 points, and Kadoma City increased by +0.3 points. The absolute quantity of total floor space of apartment housing in Chiyoda Ward is small, but it is clear that from 1991 to 2001 the rate of increase was the highest among the 23 wards of Tokyo (Tanaka: 2008), and this can be seen as one of the factors causing such a great change in its relative ranking. In Koto Ward, land prices continued falling after the end of the bubble and the supply of condominium apartments, which were meant to yield quick returns on investments, became active. Because the land prices were cheap, these apartments were not expensive, which allowed them to be sold to families. Additionally, this result reflects the fact that housing units were supplied for families since their proximity to the urban core made them comparatively desirable locations (Miyazawa, et al.: 2005).

In contrast, in Osaka for both years the medians for Tsurumi Ward in Osaka City are conspicuously high. It is noticeable, however, that Abeno Ward, which in 2000 had fallen below the surrounding wards, saw its median change to the plus side in 2005 and it rose up to the top ranking for change, exceeding seven other wards and Moriguchi City. Tokuda et al. (2009) point out the fact that, compared to the return to the urban core in Tokyo, in the case of Osaka, “the proportion that were families raising children was certainly not high,” and “in the urban core area, the younger generation has certainly not increased.” In the changes over each five year period since 1995, it is true that in the 6 wards designated as Osaka’s urban core (Kita, Chuo, Nishi, Tennoji, Naniwa, Fukushima), there was no increase in the proportion of the population under 15 years old (Var. 2) to be seen. However, if one combines this with the movement in the immediately surrounding area and examines it comparatively, in spite of the declining proportion in the adjoining cities to Osaka (except in the cities of Sakai, Kadoma, and Settsu), in 2005 the decline changed into an increase in Konohana Ward, Nishi Yodogawa Ward, and Abeno Ward in Osaka City, indicating that the lopsided movement of households with children weakened. Even for the generation that formerly moved to the suburbs to raise children, it has become possible to choose the urban core or the area surrounding the core as alternative places to live, and this reflects an element that has brought about a change in the characteristics of new urban area residents.

In Figure 2, a map of the distribution of the scores of PC1 from the years 2000 and 2005 that shows the characteristics of child-rearing households, for the wards and cities discussed in this section, it can be seen that in each case, the characteristics changed from 2000 to 2005 into districts with even higher scores. Previously, the generation of single people tended to choose areas near the urban center that were convenient for commuting, while on the other hand child-rearing families tended to go to the suburbs with lower housing costs and better living environments, despite the considerable distance from the urban center. This was a relatively clear pattern of residential preferences in accord with life cycles, and, during the period known as suburbanization, there was a strong trend for people to move away from the city to the suburbs when they married or had children. However, even for child-rearing households that had previously moved to the suburbs, living in the urban center or near the urban center became an alternative choice, and the number of child-rearing families in the cities increased. Along with that situation, child-rearing households became a new feature of urban residents.

4. Since the composition of scores for the PC1 for the years 2000 and 2005 are not identical, this does not directly show the change, but since it is a PC which can be interpreted in the same way for both years, as something which can estimate the direction of change, the changes can be confirmed in ranking for each year.

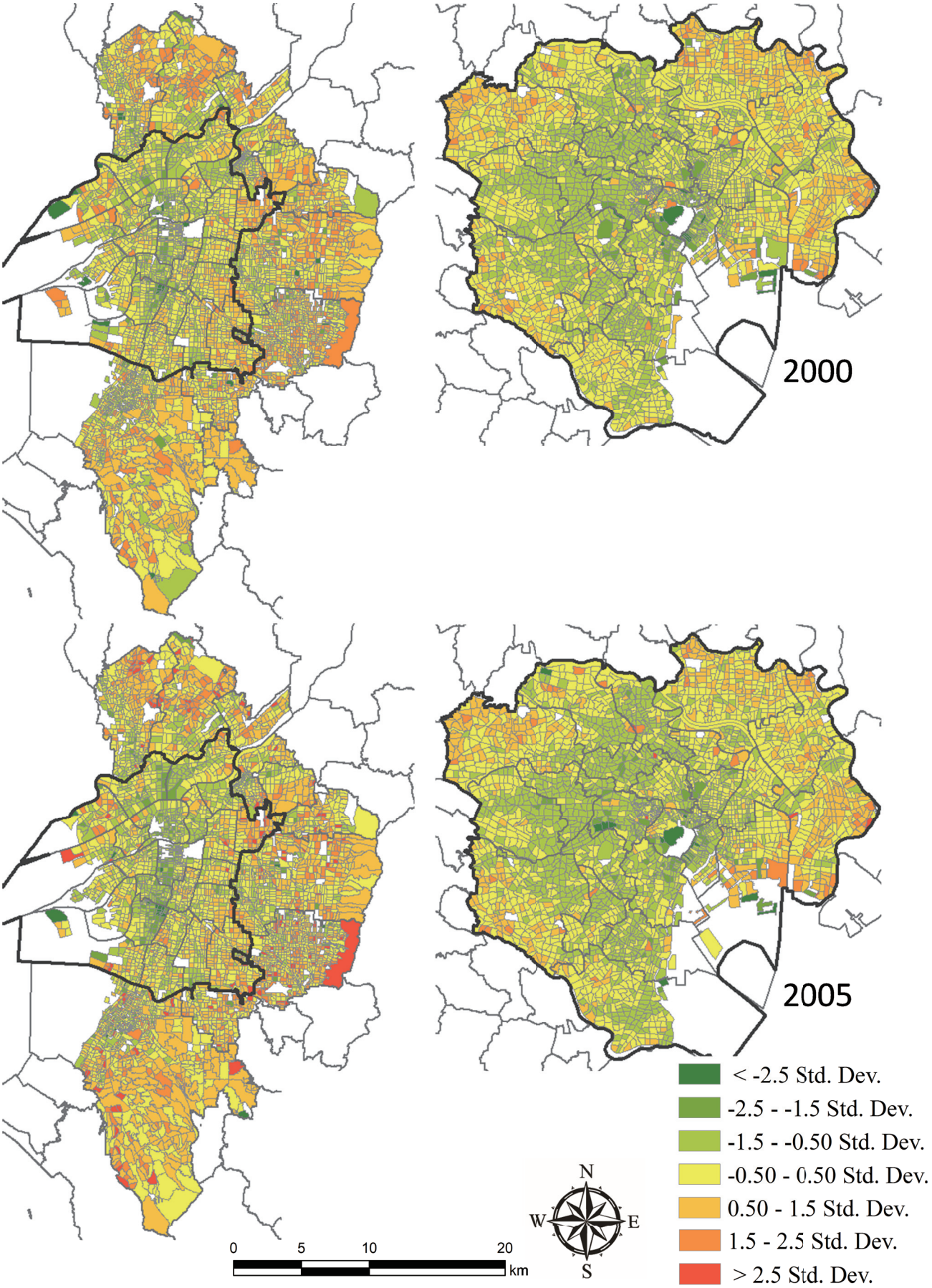

Figure 2. Distribution of principal component 1 (PC1), 2000 and 2005

3. Changes in Principal Components Related to Housing Attributes

Looking also at the characteristics of housing which are strongly related to household characteristics, it can be confirmed that the PC with a strong positive correlation to the proportion of households in public rental housing (Var. 24) that had been collected from 1995 data (as PC7) and from 2000 data (as PC6) could no longer be collected from the 2005 data. Concerning the group of variables related to tenure of dwelling (Var. 23-26), the result of confirming the changes in each administrative unit in both the 5-year period beginning in 1995 and the 5-year period beginning in 2000, as shown in Table 4, is that in the 5-year period beginning in 1995 in all the wards of Tokyo, other than Chuo Ward, Koto Ward, Shibuya Ward, and Edogawa Ward, the proportion of households in public rental housing (Var. 24) increased, and did so in comparatively more wards than did the other proportions (of owned housing, private rental housing, or benefit-supplied housing).

Studies on Tokyo by Yabe (2003) and Miyazawa et al. (2005) that pointed out that there were many cases of public housing that opened up from the mid-1990s onwards, and that, compared to privately developed condominium apartments, the increase in public multi-family housing contributed to the rebound of the population in recent years. In addition, Tokuda et al. (2009) pointed out that Tokyo encouraged people in a wide range of social classes to move into the urban core by providing a large quantity of new housing through the public sector. Taking this scholarship into account, the characteristic of people living in public housing can be seen as one of the indicators that summarizes the characteristics of urban residents in 1995 and 2000. However, in the 5-year period after 2000, the numbers dropped in all the wards except for Shinjuku Ward, Bunkyo Ward, Taito Ward, and Shinagawa Ward, and it can be surmised that, particularly in Tokyo, the rise in the proportion of households living in public housing was a temporary tendency.

By contrast, in Osaka there were cities and wards where the proportion of households living in public housing increased, but they were about half of the total, and for the 5-year period from 2000 on as well, that number was almost the same. When looking at the city as a whole, the differences level out, but if the changes in each district are examined, then after the year 2000, increases can be seen in the urban core wards of Fukushima Ward, Kita Ward, and Chuo Ward. However, compared to the changes in other proportions, it can be surmised that these increases were not enough to have a great influence.

The rise in the provision of housing through the public sector that occurred in the late 1990s had enough of an impact for it to be taken as an indicator that summarized the urban area as a whole, but after that it did not continue to support a PC in the same way; instead, a number of PCs emerged in which the proportion of owned housing (Var. 23) became significant. Looking at the changes in the 5-year period from 2000 in Table 4, the proportion of owned housing increased in the wards of Tokyo except for Chiyoda Ward, Chuo Ward, and Sumida Ward, and in the cities and wards of Osaka except for Fukushima Ward, Nishinari Ward, Kita Ward, and Chuo Ward. The PC with a strong positive correlation to owned single-family dwellings (Var. 20, 23) was collected for each of the three years in combination with the proportion of three-generation households (Var. 15), as PC2 in 1995 and 2000, and as PC5 in 2005. However, in 2005 the component score of this same variable dropped, and a new PC2 that was tied to variables related to aged-people was obtained.

As for the proportion of households in *nagaya* row houses (Var. 21) and the proportion of households in benefit-supplied housing (Var. 25), in as much as they were collected to roughly the same degree for each of the three years, it can be assumed that there were no great changes. From the above, in the housing characteristics of urban residents, the changes seen in both owned housing and public housing can be summed up as follows: Up until the year 2000, public housing with low rents supported residence in the urban centers and surrounding areas and that appeared in the PCs. In contrast with this, due to the end of the economic bubble, the price of housing dropped, and along with the supply of diverse types of newly built housing of varying affordability, it became possible for people to buy their own homes in the areas of urban core and the urban periphery, and so this emerged as a PC of urban residents in 2005.

Table 4. Mean changes in variables related to tenure of dwelling (by administrative unit)

Name	owned housing		public rental housing		private rental housing		benefit-supplied housing	
	1995-2000	2000-2005	1995-2000	2000-2005	1995-2000	2000-2005	1995-2000	2000-2005
Chiyoda	-4.60	-4.16	1.66	-0.29	1.92	8.34	1.67	-2.87
Chuo	0.46	-13.61	-0.00	-0.92	3.57	17.66	-4.40	-1.64
Minato	-1.59	6.71	0.25	-0.23	1.46	-0.67	-0.38	-4.84
Shinjuku	-1.22	0.58	0.20	0.22	1.00	1.24	-0.43	-1.67
Bunkyo	0.65	0.77	0.09	0.06	1.00	2.10	-2.42	-2.31
Taito	-0.06	3.04	0.32	0.38	0.31	-2.29	-1.71	-0.65
Sumida	1.47	-2.36	1.29	-0.66	-2.95	4.14	-0.69	0.22
Koto	2.89	3.60	-0.67	-0.50	-0.64	-0.10	-2.21	-2.71
Shinagawa	2.37	1.79	0.99	0.57	-2.67	-0.14	-1.65	-1.81
Meguro	3.77	4.91	0.15	-0.06	-3.28	-3.60	-1.36	-1.21
Ota	0.69	4.30	0.11	-0.16	-0.97	-1.24	0.62	-3.02
Setagaya	2.25	9.55	0.48	-0.08	-2.67	-7.74	-0.80	-1.44
Shibuya	0.32	3.54	-0.28	-0.41	-0.98	-0.43	1.47	-2.10
Nakano	-0.49	1.19	0.46	-0.50	0.79	-0.11	-1.01	-0.93
Suginami	0.50	2.84	0.07	-0.03	0.59	-1.24	-1.78	-1.19
Toshima	0.84	5.71	0.82	-0.27	-1.63	-4.52	-1.10	-0.69
Kita	1.13	0.84	1.20	-2.17	-1.04	1.58	-2.04	0.32
Arakawa	-0.64	0.42	2.30	-0.01	-0.99	1.38	-1.86	-0.20
Itabashi	2.86	4.61	0.12	-0.32	-1.87	-3.79	-1.57	-0.32
Nerima	1.82	7.99	0.91	-0.30	-1.92	-6.69	-1.26	-0.75
Adachi	3.04	2.20	0.02	-0.65	-3.24	-0.43	-0.61	-0.92
Katsushika	2.28	3.70	0.53	-0.53	-2.13	-1.90	-0.59	-0.89
Edogawa	1.38	1.48	-0.85	-0.91	-0.49	-0.56	-0.66	0.05
Subtotal	1.17	2.95	0.36	-0.35	-1.03	-0.85	-0.98	-1.34
Miyakojima	1.50	1.91	0.34	0.12	-1.28	-1.68	-1.02	-0.43
Fukushima	3.57	-0.92	-0.40	0.82	-1.71	1.31	-1.67	-1.03
Konohana	6.37	5.30	-4.47	0.30	-1.74	-4.27	-0.78	-1.15
Nishi	2.01	5.13	0.16	0.30	1.01	-4.29	-3.40	-1.16
Minato	1.98	0.81	-0.79	0.71	-1.96	0.52	-0.23	-1.51
Taisho	2.25	4.13	0.39	-0.60	-3.81	-1.26	0.38	-1.58
Tennoji	2.18	2.05	-0.54	-0.36	-1.10	-0.80	-0.90	-0.72
Naniwa	-3.67	0.50	0.47	0.75	4.34	-0.75	-1.23	-0.54
Nishiyodogawa	4.53	3.18	-1.33	-0.02	-2.38	-1.49	-1.32	-1.59
Higashiyodogawa	0.98	1.64	-0.41	-0.23	-0.35	-1.03	-0.73	-0.28
Higashinari	2.00	5.52	1.23	-0.33	-3.34	-4.31	-0.46	-0.64
Ikuno	1.08	2.43	0.41	0.12	-1.67	-2.27	-0.49	-0.21
Asahi	2.69	1.79	-0.28	0.14	-2.22	-1.74	-0.75	-0.15
Joto	2.14	4.48	-0.06	0.11	-2.22	-3.51	-0.33	-0.93
Abeno	4.27	3.91	-0.64	0.17	-3.64	-2.69	-0.48	-1.06
Sumiyoshi	3.23	4.05	0.06	0.04	-3.18	-3.51	-0.53	-0.48
Higashisumiyoshi	3.13	2.46	-0.07	0.08	-2.78	-1.81	-0.74	-0.51
Nishinari	0.07	-0.20	1.26	0.09	-1.56	0.90	-0.21	-0.43
Yodogawa	1.22	2.82	-0.52	-0.22	-0.18	-1.60	-1.12	-0.85
Tsurumi	1.61	4.91	-0.38	-0.30	-0.89	-3.93	-0.60	-0.68
Suminoe	3.38	3.39	2.31	0.15	-1.32	-2.72	-1.08	-0.37
Hirano	3.61	2.87	-0.29	0.24	-3.05	-2.70	-0.74	-0.27
Kita	-1.27	-1.18	-0.29	1.13	2.08	3.01	-0.36	-2.50
Chuo	1.53	-11.44	-0.13	0.82	2.44	12.12	-3.02	-1.28
Sakai	3.20	5.15	0.11	-0.07	-2.50	-3.91	-0.62	-1.25
Toyonaka	4.88	2.93	0.04	-0.30	-3.00	-2.15	-1.37	-0.53
Suita	2.60	4.00	0.18	-1.07	-1.82	-1.23	-1.23	-2.16
Moriguchi	2.65	4.42	-0.06	-0.06	-2.38	-4.07	-0.69	-0.29
Yao	2.50	4.72	0.31	-0.12	-2.45	-3.18	-0.27	-1.14
Matsubara	3.52	2.66	0.43	-0.13	-3.11	-2.06	-0.92	-0.47
Daito	2.87	2.06	0.10	0.13	-1.53	-1.55	-0.58	-0.88
Kadoma	2.79	2.14	-0.16	0.89	-2.62	-1.87	-0.55	-0.68
Settsu	0.64	2.97	0.71	-0.01	0.42	-1.99	-1.58	-1.11
Higashiosaka	3.13	4.08	-0.20	-0.20	-2.33	-3.25	-0.52	-0.71
Mihara	-3.87		8.89		-1.07		-13.41	
Subtotal	2.77	3.03	0.05	-0.03	-1.99	-1.99	-5.32	-0.94
Total	2.17	-48.77	0.17	-7.33	-1.62	-37.63	-4.93	-4.71

4. Changes in Principal Components Related to Occupational Attributes

Finally, this section will conclude with a discussion of the changes in PCs related to occupational attributes. In each of the data years, a PC related to occupational attributes was collected as the third PC. However, in 1995 and 2000 this PC was one in which the relation to white-collar[5] workers in general was significant, whereas in 2005 the PC that was obtained was one with blue-collar[6] characteristics. For 2005, a PC was extracted that was particularly associated with upper class white-collar jobs as PC7. As far as an association with grey-collar[7] work is concerned, for each of the years it was stable, being extracted as either PC5 or PC6.

While it is true that in general the residents who contributed to the return of population to the urban area were highly educated white-collar workers, the residents choosing to live in cities were not necessarily limited to people with high incomes. Indeed, the prediction of Miyazawa et al. (2005) that Tokyo, where a wide variety of housing of varying affordability had been supplied in the urban core, was not just making it possible for a particular type of resident to live in the city, is borne out by the 2005 data, which suggests that in occupational characteristics a new class comprised of an aggregation of urban residents emerged.

In comparing the distribution maps for PC3 in both cities, it can be seen that the white-collar PC in 1995 and 2000 clearly shows a residential differentiation in Tokyo that is higher in the west and lower in the east, and residential differentiation in Osaka that is high in the Uemachi upland, Senri, and Senboku, but low in all other districts. The pattern of the blue-collar PC from 2005 is the inverse of white-collar PCs, and the pattern of residential differentiation between white-collar and blue-collar did not change. Additionally, looking at the distribution map for PC7 in 2005, in Tokyo the values are high for Chuo Ward, Chiyoda Ward, Minato Ward, and Shibuya Ward, which are near the urban core, and in the southern part of Setagaya Ward. Osaka shows a more spotty distribution, but basically the scores are high in the urban core and in marginal areas. In this way, the general distribution patterns for white-collar workers differ somewhat, and as an indicator that collected occupational characteristics, the upper class of white-collar workers has more explanatory power.

IV. Changes in Classification of Areas Using Cluster Analysis

1. Changes in Clustering by Occupational Characteristics

For both 1995 and 2000, among the smaller categories, both the general white-collar and blue-collar were respectively grouped as having the common parameter of single-person households in apartment housing. However, in 2005 the occupation classes were categorized in more detail as upper class white-collar, clerical workers and sales workers, and service workers. In particular, the white-collar upper class, at the major category level, was divided into separate clusters, that of single-person households in apartment housing, and the married couple homeowner cluster, and the white-collar upper class was grouped as having a common variable with clerical workers and sales workers in single-person households living in apartment housing. Also, aside from that, the service workers cluster was divided up among groups in

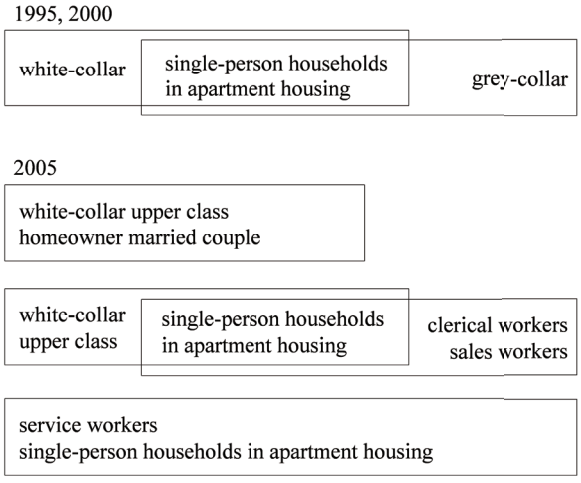

Figure 3. Changes in clustering by occupational characteristics (image)

5. "White-collar" is divided into an upper class (specialist and technical workers, administrative and managerial workers) and a lower class (clerical workers).

6. "Blue-collar" indicates security workers, transport and communication workers, production process and related workers.

7. "Grey-collar" indicates sales workers and service workers.

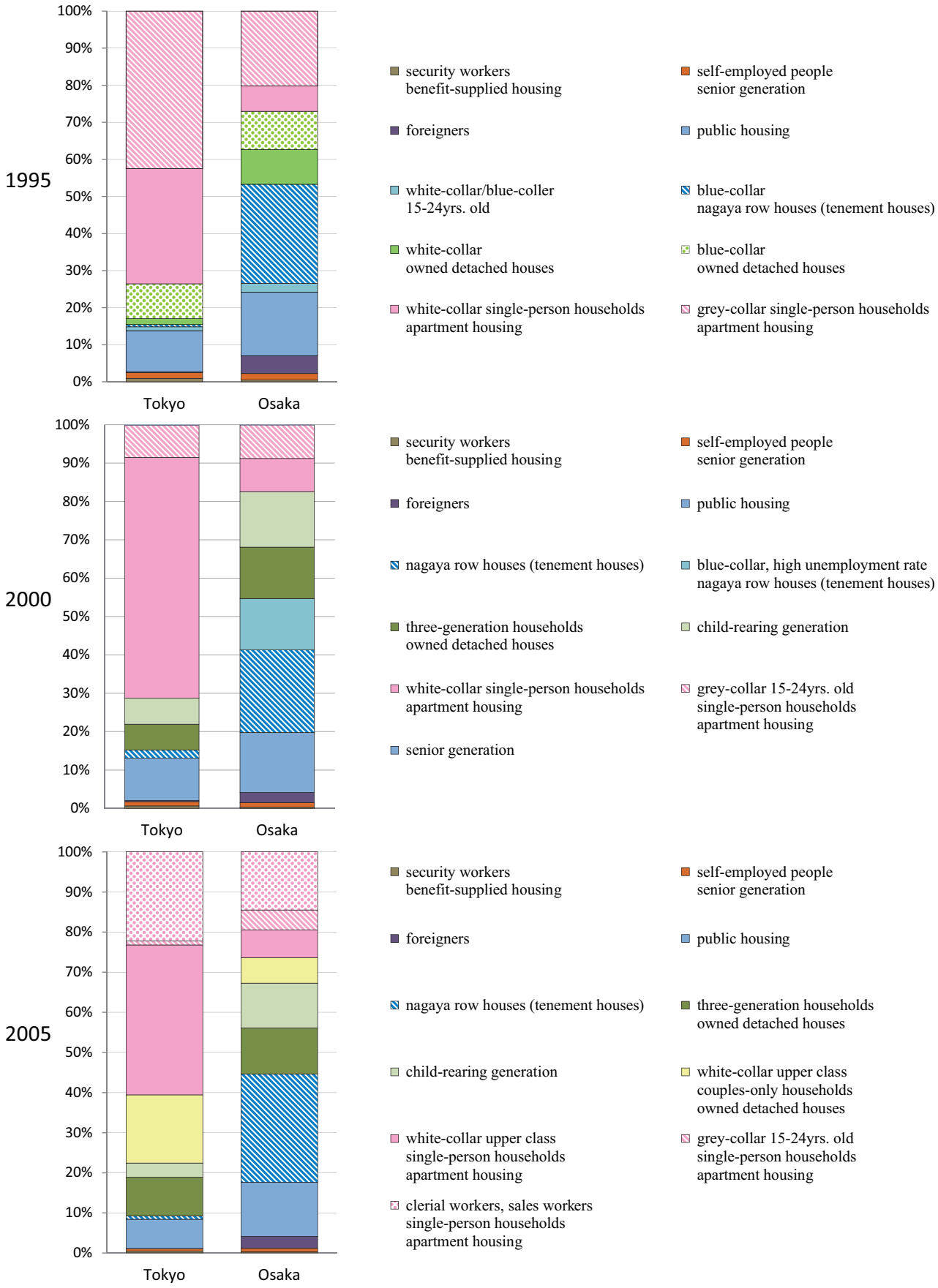

Figure 4. Proportional composition of clusters, 1995-2005

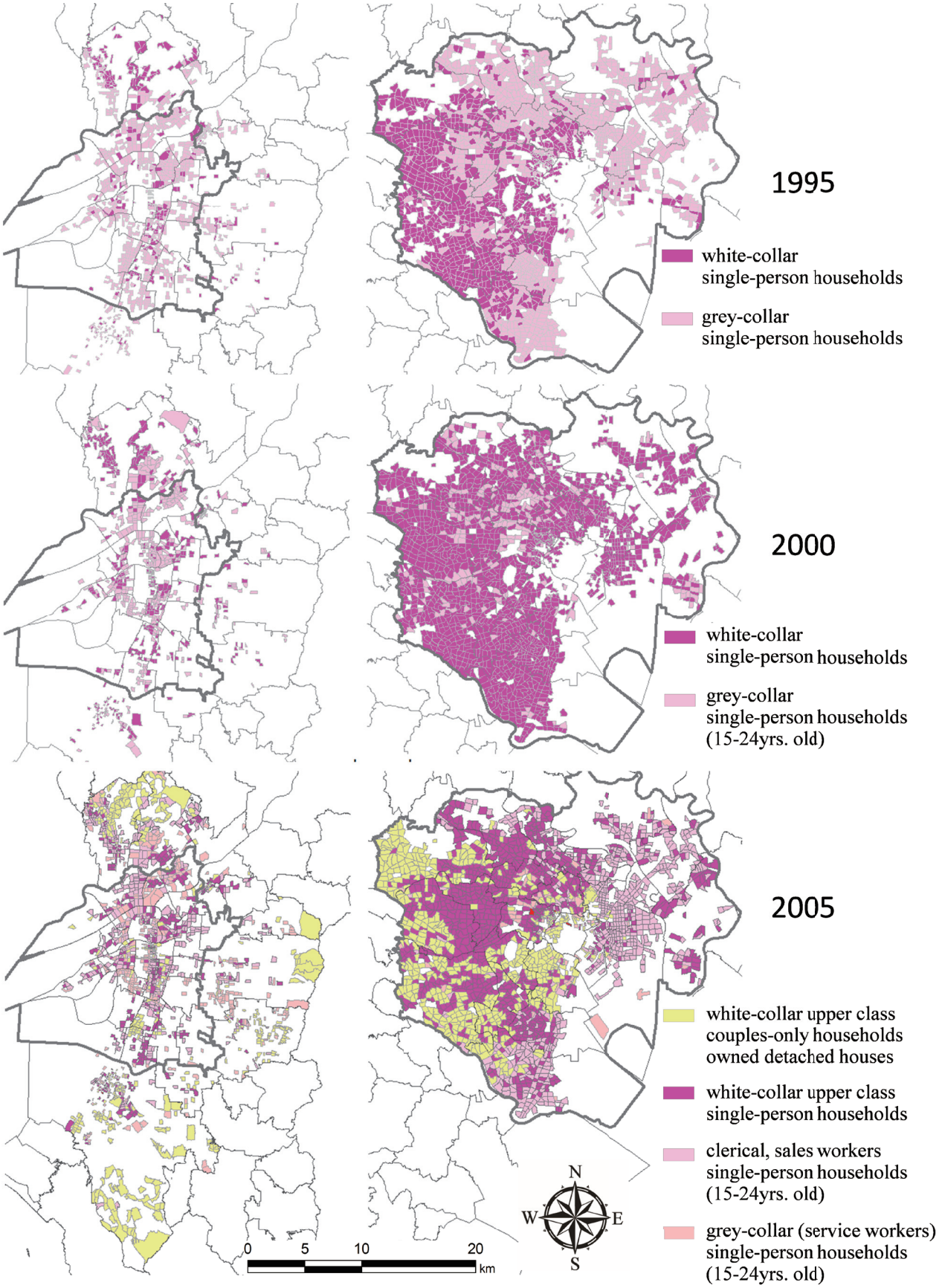

Figure 5. Distribution of clusters related to occupational attributes, 1995-2005

the major category (see Figure 3).

Formerly, there was a pattern of single-person households living in the urban areas and family households living in suburbs. Consequently, it can be surmised that when the characteristics of urban residents were classified as white-collar, grey-collar, or blue-collar without being categorized in more detail because people of each class had comparatively similar qualities in terms of non-class-related characteristics. However, with the return of population that began in the latter half of the 1990s, it seems that the makeup of urban residents diversified and characteristics other than occupational category which could be categorized emerged in 2005. As mentioned in above, along with the diversification of the housing supply, living in the city, which previously had been limited to a particular class, became possible for all kinds of households, and this outcome is also reflected in the results of the clustering classifications.

As Figure 4 shows, in 1995 white-collar workers as a whole cluster in both cities accounted for 1,157 districts with a population of 2,850,371 people (21.0%), and the grey-collar cluster contained 1,919 districts with 4,510,180 people (33.3%), and the two together accounted for more than half of the urban population. In 2000, these numbers were 5,575,347 people (40.7%) for white-collar and 1,168,972 people (8.5%) for grey-collar, the two together covering about half of the population. For 2005, looking at the new more detailed grouping based on categories of housing and household types, the results are that white-collar upper-class homeowner married-couple households accounted for 997 districts with 1,802,269 people (12.8%); white-collar upper-class single-person households in apartment dwellings accounted for 1,290 districts with 3,553,868 people (25.2%); office worker and sales worker single-person households in apartment dwellings accounted for 1,122 districts with 2,698,160 people (19.2%); and service worker single-person households in apartment dwellings accounted for 379 districts with 363,816 people (2.6%). The two clusters of white-collar upper class correspond to 38.0% of the population, approaching the level of population covered by white-collar as a whole in 2000. Looking at the changes in occupational class and level of population coverage, this suggests that in these ten years occupations became more white-collar.

However, if one looks at this tendency separately in Tokyo and Osaka, a clear contrast becomes visible. A relationship with the changes in Tokyo underpinned the reversal of the rates of population coverage of white-collar and grey-collar in 2000. In Tokyo, the respective rates of coverage for each are 37.2% and 5.0% with the result that white-collar greatly exceeds grey-collar. In contrast, in Osaka, at 3.5% and 3.6%, there was no reversal, and even in 2005 this contrast did not change. From this result, it is evident that Tokyo was the driving force in the white-collarization of urban residents, as is clearly illustrated by the distribution of clusters in both cities (see Figure 5).

2. Comparison between Cities by Composition of Neighborhood Classifications

From the changes in the composition of clusters for the two cities, next there will be an examination of how the categorization of residents' characteristics has changed. Figure 4 shows that there are clear differences in the makeup of clusters in Tokyo and Osaka. In Tokyo in 1995, the proportion belonging to the middle class and above group of occupational classes is high, with this group alone always comprising more than half of the total. On the other hand, in Osaka, even though it forms the largest group, it never exceeded a proportion of more than about 30%. Instead, compositional proportions of the cluster grouped together with the child-rearing generation and the cluster formed with the common component of *nagaya* row housing are relatively high.

The results of the PCA confirm that it is not just a particular socio-economic class of people who have returned to urban areas, but that a wide variety of resident characteristics are coming into being, such as families, although their influence is not enough to exclude them from the categorization of groupings that has existed up until now. Rather, it can be considered that by the increasing advance of white-collarization, they tend to be subsumed into the grouping that is tied up with this occupational characteristic. On the other hand, it cannot be confirmed whether the same kind of tendency manifested in Osaka, and it is difficult to assess the direction of change. Comparing these clustering results between Tokyo and Osaka, Tokyo exhibited a group of people with comparatively similar characteristics forming an overwhelming proportion of the urban makeup, whereas Osaka presented the appearance of having residents with a wide range of characteristics.

V. Discussion and Conclusion

This paper used Tokyo and Osaka as the subjects of analysis to examine how the characteristics of urban residents have been changing in conjunction with the return of population to the urban centers since the late 1990s from a comparative perspective using PCA and cluster analysis. The findings are summarized below.

From the PCA, looking at what variables collect the characteristics of the urban residents and how these have changed, the following variables are suggested: 1) Beginning for the first time in 2000, the foreigner index, which for example can be found in combination with other indices with strong white-collar characteristics, appeared in a number of principal components, and the characteristics of foreigners in cities have diversified. This tendency was especially prominent in Tokyo. 2) From 2000 on, child-rearing generations were found to be the first PC, and in 2005 they were additionally linked with buying a home. Compared to Tokyo, there is no such increase visible in child-rearing generations in Osaka. However, if the tendencies are compared separately in areas of the urban core and the urban periphery, then the lopsided tendency of child-rearing generations in Osaka can be seen to have weakened. 3) Reflecting the housing supply by the public sector that was actively carried out in Tokyo in the late 1990s, the housing characteristic of living in public housing was obtained as an indicator collecting characteristics of urban residents. However, in 2005 the owned housing indicator appeared in multiple PCs, which shows that the proportion of people buying their own homes in the urban area increased. 4) The fact that the PC in which blue-collar workers were significant appeared as the third PC, and the fact that a PC was obtained in which the white-collar upper class was especially prominent indicates that through the return of population to the urban core, new occupational characteristics have taken on explanatory power. While there is relatively minimal white-collarization in Osaka in comparison to Tokyo, the return of population suggests that the lopsided tendency of white-collar households and child-rearing households has weakened even in Osaka.

In the cluster analysis, from the perspective of how the classifications have changed from their relative positioning, it has been observed that while on the one hand Tokyo has served as a platform for the continuously increasing tendency towards white-collarization, Osaka shows no particularly predominant classification and its proportional makeup has remained a variegated situation.

According to the Basic Resident Registration Report, in the 23 wards of Tokyo, population recovery became apparent in 1997, and even in Osaka, Japan's second largest city after Tokyo, the flow of people changed to a net influx in 2001. However, the longstanding structural framework of Tokyo's "over-concentration" and Osaka's "stagnation and decline" has not changed, instead, the gap between the two cities has grown more glaring. Urban policies can probably be cited as one of the factors bringing this about. Amidst the promotion of settled residence urban policies by each of the developed nations, Tokyo Prefecture Governor Shintarō Ishihara tabled a "Strategic Plan for Overcoming Crisis" which offered a switch from existing policies aimed at urban dispersal to urban policies aimed at concentration and infill (Tokyo Prefecture: 2000). This plan to rearrange Tokyo marks a shift away from the demand-led measures style of city building. It raises the three important issues of renewal of the urban core, redevelopment of the shoreline districts, and inner city residence; it also switches from the existing suburban dispersal type of urban development to a renewal of the urban core type of development; and it attempts to have the policy system itself lead the way in the return to the city.

In addition to this, the Urban Renewal Project has been initiated, emphasizing the importance of urban renewal as is evident in the statement: "Concerning 'the urban' which is the source of our nation's vitality, we must enhance its attractiveness and international competitiveness, and realize its revitalization," (Urban Renewal Headquarters: 2001). This project also came about under the influence of the Ishihara administration, with Tokyo positioned as the highest priority city for urban renewal. The Ishihara administration is openly proclaiming that if the capital of Tokyo grows as a global city, then it will in turn pull the rest of Japan along with it. These policies have increased the scale and accelerated the speed of development, which has been proceeding rapidly in the urban renewal areas that have been designated for urgent infrastructure improvements (Ueno: 2008). While this is natural, the areas being developed are one-sided, leading to a skewing of the spatial structure. Actually, most of the areas where changes in residential characteristics have been confirmed through the analysis of this paper overlap with areas being developed. Through deregulation,

Tokyo has been relying on the principles of the real estate market, and has experienced rapid advancement of white-collarization. In comparison, Osaka movements for urban renewal have not been sufficient to change the characteristics of the residents over the city as a whole, and the disparities between the two cities have increased.

Population recovery is something occurring precisely in "urban core" areas and not in suburbs (Asakawa:2006). Consequently, analysis focused only on urban areas leads to different analytical results than would be the case if the analysis included suburbs. This study took the urban areas of Tokyo and Osaka as objects of study but did not analyze the two cities separately, instead a single analysis was conducted with one parameter intended to highlight the contrast between Japan's two major cities. As a result, the contrasts can be grasped quantitatively and can be mapped from the perspective of spatial structure.

Through the supplying of housing in city centers after the collapse of the bubble economy, the option of living in the city center was added to the previous set of choices that had been limited to leaving the city and relocating to the suburbs (Yabe: 2003). This has drastically altered the internal areas of the cities. Along with this, the nature of the urban residents is diversifying, and their situation is becoming more complicated. The approach of geodemographics, which analyzes who lives where, makes it possible to quantitatively comprehend these diverse urban residents, and additionally offers a perspective for gaining an understanding of the portrait of the city as a whole. In the 'Vision for Greater Osaka' published by the Osaka Restoration Association, which represented Osaka City Mayor Tōru Hashimoto (former Osaka prefectural governor), a proposal was put forth for restructuring the 24 wards of Osaka City and the 10 adjoining cities (the area analyzed in this paper) into a total of 20 wards. For Osaka, a city where people with a wide variety of resident characteristics are mixed together, this study provides a meaningful perspective for considering how, in the future, the urban areas that exceed city boundaries can be effectively redrawn. Not only does this study put forth a viewpoint that can be used to grasp what is happening in particular areas of the city, at the same time it provides an understanding of how those areas are situated within the city as a whole.

Acknowledgments

This paper was re-written, with the inclusion of additional data, based on a report presented in April, 2007 at the Annual Meeting of the Association of American Geographers. This research was supported by the Grant-in-Aid for Scientific Research (No. 21200024 "Experimental Research on Human Bond Formation and Using ITACO to Create a New Regional Geography," Japanese fiscal years 2009-2011).

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