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Relocation Demand and Housing Preference of the Households of the Tokyo Metropolitan Region: A Metropolitan Residential Relocation Survey*

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1. Introduction

In a metropolitan region, whose outerboundary is defined, there are potentially three types of households which have demand for new houses in a specified period. The first are the households which in-migrate to the region. We call them as in-migrating households. The second are those which are newly formed in the region in the period, that is, newly formed households. These two types of households are called new households. The third are those which have been residing in the region since the time preceding the period and have a willingness to relocate in the period. We designate them as relocating households. In the Tokyo metropolitan region, where the residential area for more than 7 million households with low quality houses is widely dispersed around job centers of heavy concentration, the housing demand associated with relocation has become significant, reflecting the current trend of the decrease in the in-migration of population to the region, which is discussed by Vining and Kontuly(1978) and others. In formulating housing policies of the Tokyo region, it is thus quite important to examine how the policies affect the relocation activities of the metropolitan households and, eventually, what kind of housing condition of the region is brought about under different sets of housing policies.

Oguri(1978) developed a Metropolitan Residential Relocation Model (MRRM) with the purpose of this policy examination. This paper describes the hypothesis, methods, and results of the Metropolitan Residential Relocation Survey (MRRS) which was undertaken preceding the model development to provide essential data and parameters for the model. The use of

survey results for the model construction and execution is discussed elsewhere by Oguri(1979).

2. Hypothesis on Housing Preference and Relocation Activity

The relocation activity of an individual household may be defined as a problem of choice between the house in which the household is currently settled and houses of potential acquisition. The choice is dependent on the level of satisfaction attainable from different kinds of houses. The level of satisfaction of residing in a house may be stated in terms of utility with housing service consumption. Thus, the theoretical bases of individual relocation activity are constructed in the general format of residential choice of microeconomic theory.(1)

Residential choice is stipulated as a utility maximization behavior:

$$\text{Maximize} \quad u = f(x(a_1, \ldots a_i, \ldots a_n), z) \tag{1}$$

$$\text{subject to} \quad y = p(x) + p_z \cdot z \tag{2}$$

where

$x(a_1, \ldots a_i, \ldots a_n)$ = amount of housing services derived from housing attributes $a_i (i=1-n)$,

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(1) A theory of local mobility was developed by Goodman(1976) by a utility consideration in a similar manner, based on the studies by Rossi(1955), Wolpert(1966), Brown and Longbrake(1970), and others. A utility model and survey of this paper can be regarded as being derived from it.

z = amount of composite goods other than housing services,

u = level of utility,

$p(x)$ = price of the housing services of amount x,

p_z = price of a unit of the composite good, and,

y = household income.

We may specify the utility function of eq.(1) in a Cobb-Douglas form:[1]

$$u = A \cdot x^{\alpha} \cdot z^{1-\alpha} \tag{3}$$

where

A = a parameter of proportionality, and

α = a parameter which indicates the importance of housing service consumption in the utility (utility parameter).

With this specification and an assumption that $dp(x)/dx = p(x)/x$, the equilibrium condition of a household is:

$$\alpha = p(x)/y \tag{4}$$

$$1 - \alpha = p_z \cdot z/y \tag{5}$$

Eq.(4) indicates that at the equilibrium, the importance attached to the housing service consumption, or the utility parameter, is equal to the (housing expenditure / income) ratio. Thus, a household relocates itself when it changes the subjective significance attached to housing (the utility parameter) and, accordingly, changes the equilibrium

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(1) The specification of the utility function in a Cobb-Douglas form draws upon Solow(1973).

(housing expenditure/income) ratio, or when readjustment of housing expenditure is necessary according to an income change, or when it finds a house of different attributes in which it can consume a larger amount of housing services at the same price.

The relocation activity described in this framework of logic is absolutely deterministic. That is, a household either stays in its current house or it relocates. When it relocates, it selects a house. This is apparently true for any household because it will so act in the real world, but this should be regarded as the consequence of trial and error. The deterministic character of the relocation activity derived from economic theory comes from a very strong assumption that the form of the utility function, or, more specifically, the utility parameter, is known to every household. However, it may be more realistic to adopt the assumption that a household does not hold a unique utility parameter but holds a set of parameters, whose minimum is α_1 and maximum is α_n. This assumption realistically explains the residential search process with trial and error in the following manner.

A household selects a set of housing services $(x_1, \ldots x_i, \ldots x_n)$, all of which are the equilibria corresponding to $(\alpha_1, \ldots \alpha_i, \ldots \alpha_n)$, as the subjects of its search. The household imagines the situation of consuming $(x_1, \ldots x_i, \ldots x_n)$ and attaches the expected utility levels $(u_1, \ldots u_i, \ldots u_n)$. A residential choice for a household is therefore finding the x_j^* and α_j^* which are associated with the highest utility level u_j^*.

The analytical framework of this hypothesis explains the relocation activity as a step-wise process. That is, if a household either experiences

significant changes in its attributes or is dissatisfied with its current house, the household is likely to change its utility parameter or to have an expectation of increasing the utility level by residing in a different house and, consequently, becomes willing to relocate, i.e., it becomes a relocating household. After trial and error, if the household comes to a conclusion that it is its current house that provides the highest level of utility, it decides not to relocate. In contrast, if the household finds that a new house will provide the highest level of utility, it actually decides to relocate, and thus becomes a relocated household.

The hypothesis also suggests that, under the assumption that a household conducting a residential-search holds a set of utility parameters, there is a corresponding set of housing services from which a choice can be made. Since the level of housing services is determined by its attributes, this can be restated as the proposition that a moving household has houses of different attributes as the subjects of its residential search.

If the consumption of other composite goods is disregarded, a moving household may prefer a house which offers more housing services to another house with less services. A moving household is thus likely to have an implicit hierarchy of preference for houses of different attributes which are selected as subjects of residential search.

The questionnaire of the MRRS is designed based on these conjectures derived from the hypothesis.

3. Designing the Questionnaire

Specifying the period of observation as the past five years, from 1972 to 1977, the MRRS is designed to question households on: (1) housing and household attributes at the beginning of the observation period (1972); (2) changes in household attributes during the period; (3) birth of new households during the period and the attributes of the new households at the end of the period (1977); (4) willingness to relocate during the period; (5) preference for houses and activities for housing-search; and (6) attributes of the house acquired during the period.

The MRRS's most characteristic question is housing preference of the moving households. The preceding hypothesis provides a theoretical base to adopt an assumption that a moving household potentially has houses of different attributes as the subjects of its residential search and has implicit preference order for these houses. Based on this assumption, we stipulate twenty-seven (27) housing groups by combining various housing attributes and ask a moving household to indicate housing groups it selected as the subject of housing search and rank order them according to its preference. To stipulate housing groups, we first define fourteen (14) housing types which combine four housing attributes: tenure types, structure, private and public distinction in supply, and floor area:

1. Owned: Single detached houses with floor area of 100 m^2 or more;
2. Owned: Same with f.a. of less than 100 m^2;
3. Owned: Publicly constructed apartments;
4. Owned: Privately constructed apartments with f.a. of 50 m^2 or more;

Table. 1 Twenty-seven (27) Housing Groups

Housing types / Commuting distance	Owned							Rented						Multiple use structures
	Single detached		Publicly constructed apartments	Privately constructed apartments		Single detached		Company-issued	Publicly constructed apartments		Privately constructed apartments		Lodging houses and dormitories	
	f.a.* $100m^2$ or more	l.t.** $100m^2$		$50m^2$ or more	l.t. $50m^2$	$75m^2$ or more	l.t. $75m^2$		$25m^2$ or more	l.t. $25m^2$	$15m^2$ or more	$15m^2$ or more		
Short commuting distance	60 min. or less	60 min. or less	60 min. or less	45 min. or less	45 min. or less	60 min. or less	60 min. or less	60 min. or less	60 min. or less	60 min. or less	30 min. or less	30 min. or less	30 min. or less	27
	1	3	5	7	9	11	13	15	17	19	21	23	25	
Long commuting distance	m.t.*** 60 min.	m.t. 60 min.	m.t. 60 min.	m.t. 45 min.	m.t. 45 min.	m.t. 60 min.	m.t. 60 min.	m.t. 60 min.	m.t. 60 min.	m.t. 60 min.	m.t. 30 min.	m.t. 30 min.	m.t. 30 min.	
	2	4	6	8	10	12	14	16	18	20	22	24	26	

Note: 1-27 indicate housing group numbers.

*f.a. = floor area

**l.t. = less than

***m.t. = more than

5. Owned: Same with f.a. of less than 50 m^2;
6. Rented: Single detached houses with f.a. of 75 m^2 or more;
7. Rented: Same with f.a. of less than 75 m^2;
8. Rented: Company-issued houses;
9. Rented: Publicly constructed apartments with f.a. of 25 m^2 or more;
10. Rented: Same with f.a. of less than 25 m^2;
11. Rented: Privately constructed apartments with f.a. of 15 m^2 or more;
12. Rented: Same with f.a. of less than 15 m^2;
13. Rented: Lodging houses and dormitories; and,
14. Multiple use structures.

Housing groups are then defined by dichotomizing these housing types by commuting distance, which is another important housing attribute (Table 1). Thus the preference for housing group can be quite directly interpreted as preference for housing attributes.

4. Sample Attributes

The survey was undertaken by sampling employees working at major job centers. This was done because, first, the residences of households to which the sample belongs are expected to be distributed among different types of houses all over the region and, second, the residential preference and activities of the metropolitan residents are characterized by the strong competition for houses around areas with great job opportunities.

A total of 2,655 employees from 157 firms were sampled from nineteen (19) districts which are composed of twenty-three (23) Tokyo special wards and twelve (12) surrounding cities of 60,000 employees or more in 1970 (Japan Ministry of Statistics, Office of the Prime Minister, 1971-1975). The size of the sample in each district is roughly proportional to the number of employees. The sample was taken from firms of different employment levels, considering the scale distribution of firms in each district.

The survey was conducted in August and September of 1977. The number of responses totalled 1,599, with a questionnaire return ratio of 60.2%. Table 2 shows the occupational distribution of the sample's household heads and compares it with that of total employed persons in the Tokyo metropolitan area. 69.8% of the sample's household heads are professionals, engineers, technicians, managers, administrators, and clerical workers. The percentage of employed persons in such occupations in the Tokyo metropolitan area was 26.6% in 1970 (Japan Bureau of Statistics, Office of the Prime Minister, 1971-1975). The sample's occupational distribution of the MRRS is apparently skewed to such occupations.

We selected 184 wards, cities, towns, and villages of Ibaraki, Saitama, Chiba, Tokyo, and Kanagawa prefectures, most of which are within a 60 km radius from Tokyo station, and designate them as the components of the Tokyo region.(1) The Tokyo region is defined as being 7,310.28 km^2

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(1) Selection of the municipalities of the Tokyo region was made referring to the definitions given in the 1970 Population Census of Japan (Japan Bureau of Statistics, Office of the Prime Minister, 1971-1975), the definitions of Regional Economic Clusters given by Glickman (1979), and the description of the Tokyo area given by Kumata et al. (Japan Housing Corporation, Department of Residential Lot Planning et al. 1976).

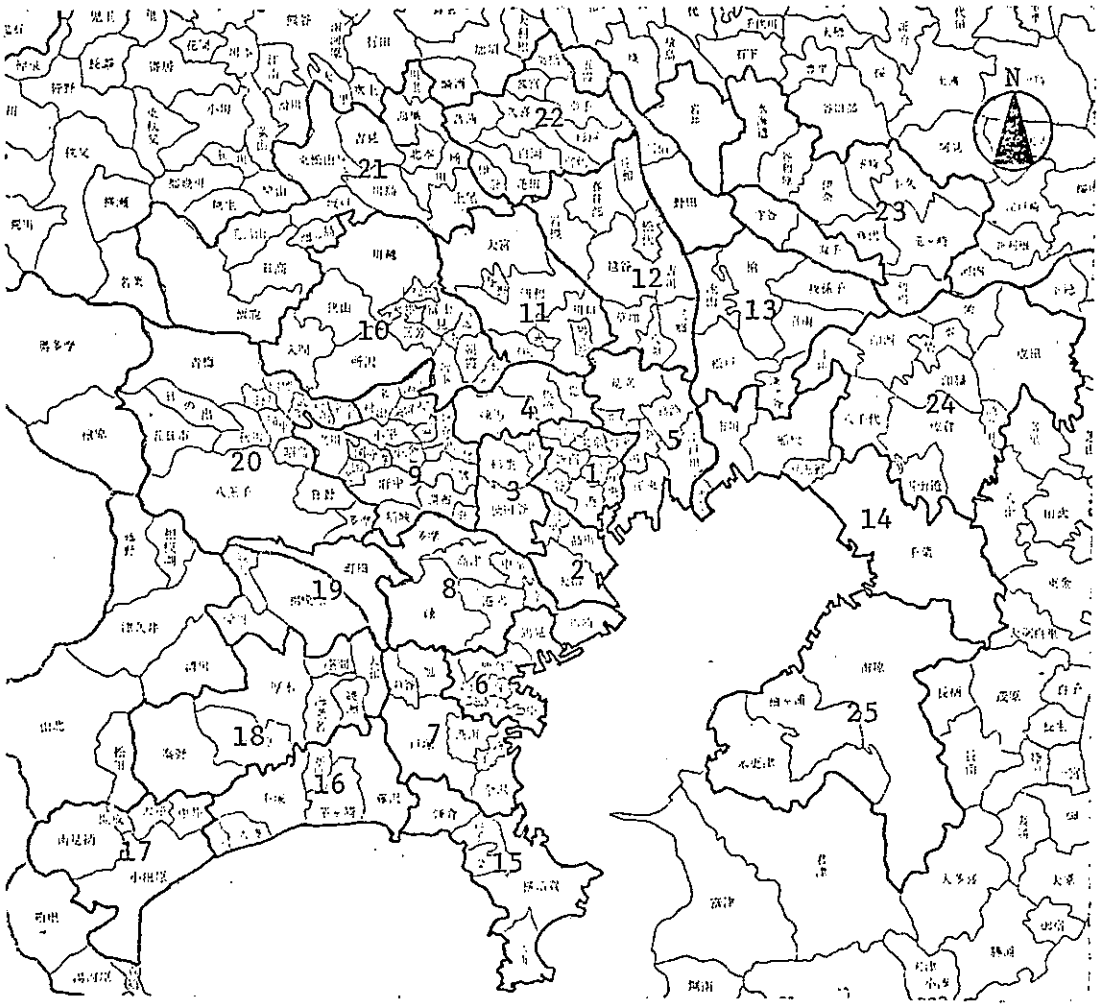
Table. 2 Occupational Distribution of Sample's Household Heads (1977) and of Employed Persons in the Tokyo Metropolitan Area*(1970)

Occupation	MRRS		1970 Population Census of Japan	
	Number of respondents	%	Employed persons	%
Farmers and fishermen	7	0.4	615,280	5.4
Business proprietors	39	2.4	662,805	5.8
Executives of companies and corporations	112	7.0	339,820	3.0
Skilled, semi-skilled, and unskilled workers	166	10.4	4,054,125	35.4
Professionals, engineers, technicians, managers, administrators, and clerical workers	1,116	69.8	3,053,205	26.6
Sales and service workers	93	5.8	2,028,950	17.7
Others**	4	0.3	713,200	6.2
Unknown	62	3.9	-	-
Total	1,599	100.0	11,467,385	100.0

Source: MRRS, Japan Bureau of Statistics, Office of the Prime Minister (1971-1975), 1970 Population Census of Japan.

* The Tokyo metropolitan area is defined in 1970 Population Census of Japan by its own criteria, i.e. the area is composed of those municipalities whose commuters to central cities are more than 1.5% of their total residential population. This defined area is different from the Tokyo metropolitan region of this study.

** Includes teachers, religious workers, free lance professionals, security service workers and workers employed in their homes.



1. Chiyoda
2. Shinagawa
3. Setagaya
4. Kita
5. Koto
6. Naka
7. Konan
8. Kawasaki
9. Mitaka
10. Kawagoe
11. Urawa
12. Koshigaya
13. Matsudo
14. Chiba
15. Kamakura
16. Fujisawa
17. Odawara
18. Hatano
19. Sagamihara
20. Hachioji
21. Ageo
22. Noda
23. Ryugasaki
24. Narita
25. Kisarazu

Fig. 1 Zonal Composition of the Tokyo Metropolitan Region

in area and having a population of 25,190,205, with 7,663,158 households living in houses in 1975 (Bureau of Statistics, Office of the Prime Minister, 1976-1978). The region was then divided into twenty-five (25) zones, considering both the direction and distance from the center of the region as well as the transportation networks (see Fig.1). Zone 1 is named Ring 1, while Zones 2-5 are Ring 2, Zones 6-14 Ring 3, and Zones 15-25 Ring 4.

Table 3 shows the zonal distribution of the residences of the sample, and compares it with the distribution of total households in the Tokyo metropolitan region in 1975. It is observed that the proportion of the sample whose residences are in suburban zones, or in Ring 3 and 4, is slightly higher than the proportion of households living in these zones. The spatial distribution of residences seems, however, reasonably close to reality.

Table 4 categorizes sample households by relocation type. Out of 1,599 respondents, 1,172 households (73.3%) have been residing in the region prior to 1972, while 281 (17.6%) are new households.

5. Analysis of the Survey Results (1): Motivations for Relocation

We now define the Relocating Households Ratio(RGHR) as the ratio of the number of relocating households to the number of households which have been residing in the region since the period prior to 1972. The MRRS shows that the average RGHR is (589/1,172) x 100.0 = 50.3%. The preceding theoretical consideration suggests that those households which either experience changes in household attributes or are dissatisfied with their

Table. 3 Residence Distribution of Sample Households (1977) and of Households in the Tokyo Metropolitan Region (1975)

Ring	Zone		MRRS		1975 Population Census of Japan	
			Number of respondents	%	Number of household	%
Ring 1	Total		73	4.6	609,787	8.0
	Zone 1	Chiyoda	73	4.6	609,787	8.0
Ring 2	Total		321	20.1	2,308,047	30.1
	Zone 2	Shinagawa	50	3.1	466,671	6.0
	3	Setagaya	115	7.2	635,608	8.2
	4	Kita	99	6.2	493,768	6.4
	5	Koto	57	3.6	712,000	9.3
Ring 3	Total		740	46.3	3,209,035	41.9
	Zone 6	Naka	74	4.6	324,890	4.2
	7	Konan	69	4.3	304,216	4.0
	8	Kawasaki	120	7.5	457,118	6.0
	9	Mitaka	88	5.5	543,037	7.1
	10	Kawagoe	37	2.3	298,301	4.0
	11	Urawa	113	7.1	372,531	4.9
	12	Koshigaya	25	1.6	210,589	2.7
	13	Matsudo	36	2.3	241,479	3.2
	14	Chiba	178	11.1	456,874	6.0
Ring 4	Total		366	22.9	1,536,290	20.0
	Zone 15	Kamakura	60	3.8	191,730	2.5
	16	Fujisawa	70	4.4	194,511	2.5
	17	Odawara	1	0.1	62,303	0.8
	18	Hatano	18	1.1	170,483	2.2
	19	Sagamihara	81	5.1	190,884	2.5
	20	Hachioji	61	3.8	265,196	3.5
	21	Ageo	35	2.2	147,481	1.9
	22	Noda	6	0.4	102,440	1.3
	23	Ryugasaki	2	0.1	41,143	0.5
	24	Narita	19	1.2	89,210	1.2
	25	Kisarazu	13	0.8	80,908	1.1
Outer area			89	5.6	-	-
Unknown			10	0.6	-	-
Total			1,599	100.0	7,663,158	100.0

Source: MRRS. Japan Bureau of Statistics, Office of the Prime Minister (1976-1978), 1975 Population Census of Japan.

Table. 4 Sample Household by Relocation Type

Household Categories		No. of households	%
(1) = (2) + (7) +(10) + (11)	Total	1,599	100.0
(2) = (3) + (4)	Households which have been residing in the region prior to 1972	1,172	73.3
(3)	Households which didn't have intention to relocate	583	36.5
(4) = (5) + (6)	Households which had willingness to relocate (relocating households)	589	36.8
(5)	Households which relocated (relocated households)	413	29.8
(6)	Households which had willingness to relocate, but actually did not	176	11.0
(7) = (8) + (9)	New households	281	17.6
(8)	Households which were newly formed (newly formed households)	142	8.9
(9)	Households which migrated into the region (in-migrating households)	139	8.7
(10)	Households which could have been formed, but were not	68	4.3
(11)	Unknown	78	4.9

current housing situation tend to move. This implies that groups of households with these characteristics are likely to have a high RGHR.

From the RGHR's which were computed for households of different characteristics (Table 5), the following observations were made:

(1) Households with younger household heads and fewer family members are more likely to move. These households are transitional in their attributes, generally settled in poor dwellings, and are associated with lower relocation costs. No regular relationship is observed between the RGHR and income level.

(2) The owner/renter distinction makes a big difference in the RGHR. Most importantly, households living in owner-occupied single detached houses appear to have a relatively low willingness to relocate, reflecting their current level of high satisfaction. There in no correlation between commuting distance and the RGHR.

(3) Stratification of households by a constructed variable, floor area in 1972 divided by the number of family members in 1977, makes a significant difference in the RGHR among household groups. This implies that the expectation that spaciousness of the present dwelling will decline with growth in family size causes relocation.

The factors which explain relocation are apparently mutually dependent. To investigate the relative contribution of these factors to relocation,

Table. 5 Relocating Households Ratio (RGHR) by Households of Different Characteristics

Household characteristics		Sample households a	Relocating households b	Relocating household ratio b/a (%)
Total		1,172	589	50.3
Age of household head (1977)	< 29	120	100	83.3
	30 - 39	363	258	71.1
	40 - 49	317	129	40.7
	50 ≤	345	86	24.9
Family size (no. of persons, 1977)	1	71	51	71.8
	2	112	75	67.0
	3 - 4	744	376	50.5
	5 ≤	222	72	32.4
Annual household income (in ¥1,000, 1977)	< 2,000	37	20	54.1
	2,000 - 3,000	173	104	60.1
	3,000 - 4,000	302	183	60.6
	4,000 - 6,000	183	95	51.9
	6.000 ≤	282	112	39.7
Housing category (1972)	Owner-occupied	596	137	23.0
	Single detached	553	113	20.4
	Public apartments	23	11	47.8
	Private apartments	20	13	65.0
	Rented	539	425	78.8
	Single detached	80	62	77.5
	Company-issued	94	76	80.9
	Public apartments	115	74	64.3
	Private apartments	142	119	83.8
	Lodging houses*	108	94	87.0
Commuting distance (in minutes, 1972)	< 5	91	46	50.5
	5 - 15	92	53	57.6
	15 - 30	127	58	45.7
	30 - 60	388	217	55.9
	60 - 90	307	140	45.6
	90 ≤	130	64	49.2
Floor space(1972) divided by family size (1977) (in m^2/person)	< 5	125	115	92.0
	5 - 10	296	191	64.5
	10 - 15	221	109	49.3
	15 - 20	186	77	41.4
	20 - 25	119	29	24.4
	25 ≤	114	22	15.3

we employed Hayashi's Quantitative Method II (HQM II), a version of discriminant analysis whose explanatory variables are qualitative (see Appendix). The result is shown in Table 6. An item with a large range, the absolute difference between maximum and minimum scores associated with categories of the item, makes a large contribution to the discrimination of relocating vs. staying-households. It is observed that the difference in housing explains the distinction most significantly. The results of the discriminant analysis are compatible with the previous observation. It is, however, additionally found that when other factors are kept equal, the higher the income, the more likely a household is to relocate.(1)

We may conclude that the major motivations for relocation in the Tokyo region are: the low satisfaction level of living in rental houses; a strong preference for owner-occupied single detached houses; and demand for floor space to accomodate growth in family size.

6. Analysis of the Survey Results (2): Structure of Housing Preference

A total of 788 responded to the questions concerning housing preference. Of these, 547 (69.4%) answered that they selected two or more housing groups as subjects of their residential-search.

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(1) Households with a high income level are, however, likely to have older household heads and larger families, as well as to live in owner-occupied houses. When these attributes of high income families are mixed, their higher willingness to relocate connot be observed. Thus, no regular relationship between income level and the RDHR was observed in the simple tabulation analysis of Table 5.

Table. 6 Discriminant Analysis of Relocating- vs. Staying-Household by Hayashi's Quantitative Method II

Item	Category	Score	Range
1) Housing (1972)	Owned:		
	Single detached	-11.363	23.736
	Apartments	1.955	
	Rented:		
	Single detached*	10.981	
	Public apartments	5.300	
	Private apartments**	12.323	
2) Floor space (1972) divided by family size (1977) (in m^2/person)	< 5	7.377	14.815
	- 10	1.403	
	10 - 15	-0.135	
	15 - 20	-0.084	
	20 - 25	-2.894	
	25 ≤	-7.438	
3) Annual household income (in ¥1,000, 1977)	< 3,000	-6.180	10.501
	3,000 - 4,000	-0.916	
	4,000 - 6,000	1.537	
	6,000 ≤	4.321	
4) Age of household head (1977)	< 29	4.770	10.359
	30 - 39	4.351	
	40 - 49	-2.138	
	50 ≤	-5.589	
5) Commuting distance (in minutes, 1972)	< 15	-1.030	6.922
	15 - 30	-2.917	
	30 - 60	0.667	
	60 - 90	-0.998	
	90 ≤	4.005	

Note: The total number of sample is 850, and the correlation ratio is 0.632. Concerning Hayashi's Quantitative Method II, See Appendix

* Includes company-issued houses.

** Includes lodging houses and dormitories.

This may give a rationale to conjecture that the ranges of the utility parameters of the moving households are wide. Since there are only five respondents who indicated multiple use structures (housing group 27) as their subjects of search, the multiple use structures are disregarded and two respondents who selected only multiple use structures are neglected in the following analysis.

a. Housing Groups Chosen First

It is found that 508 respondents (64.5%) selected housing groups 1, 2, 3, and 4, i.e., owner-occupied single detached houses, as the most preferable. The intensity of the preference for single detached owned houses is, however, different among households having different characteristics. Households with young household heads give the highest priority to public and private rental apartments and to owner-occupied apartments (Fig. 2). Similar tendencies are found in households with few family members. Relocating households whose former houses are owner-occupied show a strong preference for owner-occupied houses, while relocating households whose former houses are rented and new households show preference for rental houses, too.

b. Transition of Housing Group Selection

How are the housing groups rank ordered according to the preference of the respondents? Suppose that a household rank ordered the housing groups as (1 → 2 → 3 → 5 → 7 → end), which is read as housing group 1 is prefered to 2, 2 is prefered to 3, ..., and housing group 7 is chosen last. Let us regard the pairs of housing groups in the preference order,

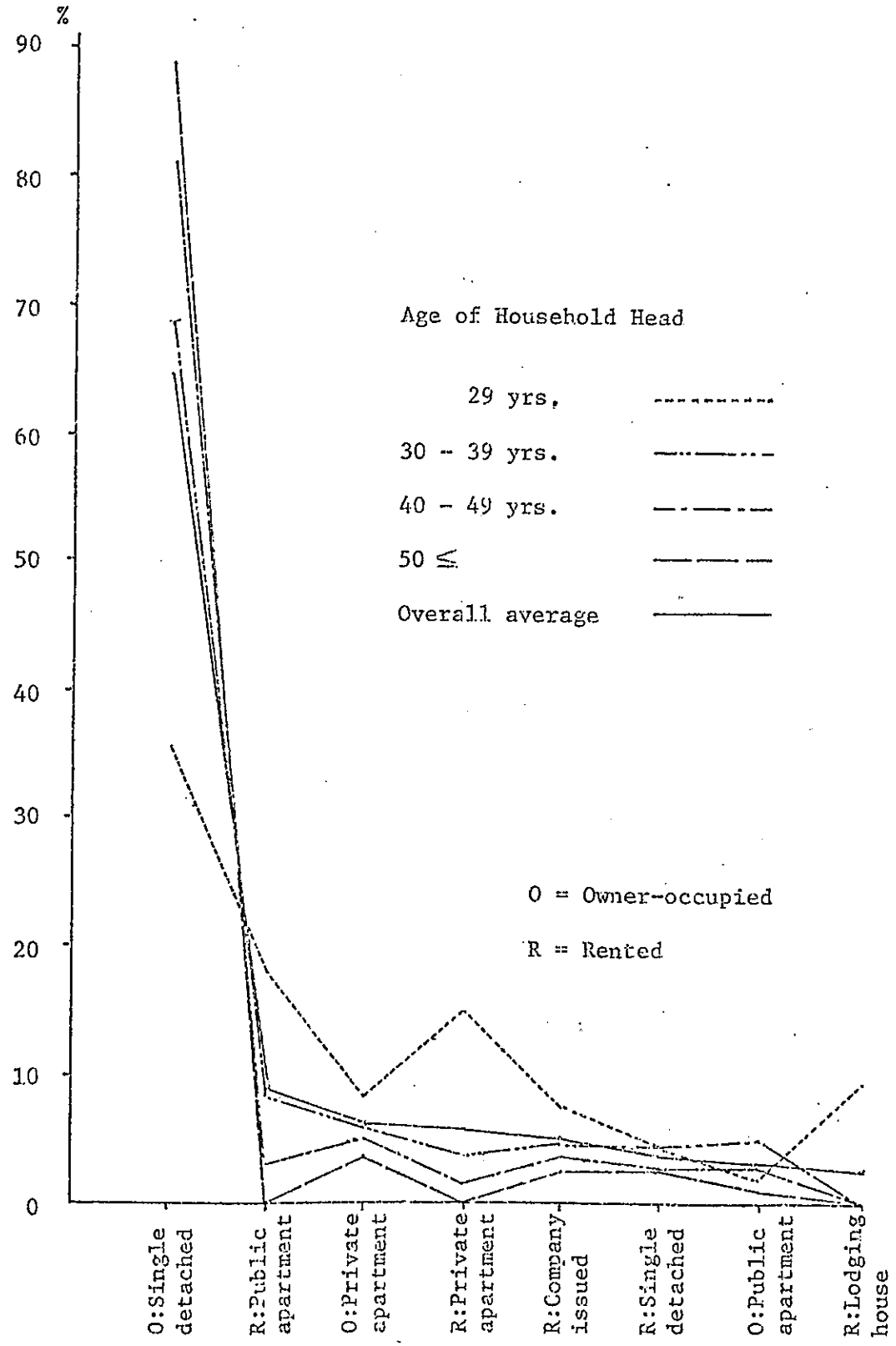

Fig. 2 Distribution of Housing Categories of First Selection by Age of Household Head

which are (1 → 2), (2 → 3), (3 → 5), (5 → 7), and (7 → end), as the samples which indicate the transition of housing group choice. Table 7 is the transition matrix which aggregates all of these samples of all the respondents.

An element of the i-th row the and j-th column, ${}_{i}f_{j}$, indicates the frequency of selecting housing group j next to housing group i as a subject of search. The elements of the 27th column are the frequencies of the termination of the search for a housing group. The percentage attached to ${}_{i}f_{j}$, ${}_{i}p_{j}$, is the probability (in percentage) of transition from i to j, where $\sum_{j=1}^{27} {}_{i}p_{j} = 100.0$. The following can be observed from the matrix:

(1) The transitions from owned to rented houses appear in several cases (see ${}_{9}f_{11}$, ${}_{10}f_{11}$, ${}_{5}f_{17}$, and ${}_{6}f_{17}$), while the transitions from rented to owned rarely appear. These reflect the preference for owner-occupied houses.

(2) Within the owner-occupied housing groups, single detached dwellings are preferred to apartments (see ${}_{3}f_{5}$, ${}_{4}f_{5}$, ${}_{3}f_{7}$, ${}_{4}f_{7}$). Similar preferences are observed within the rental housing groups (see ${}_{12}f_{17}$, ${}_{13}f_{17}$, and ${}_{13}f_{21}$).

(3) As a matter of fact, a larger floor area and a shorter commuting distance are preferred over a smaller floor area and a longer commuting distance, when other factors are held constant. Within owner-occupied housing groups, next to large houses with short commuting distances, more households appear to

Table. 7 Relative Preferences in Housing Groups Desired

Upper row – Number of samples
Lower row – Probability of transition from one housing group to the consecutive one in percentage

Housing group of k-th selection					Housing group of (k+1)-th selection	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	End	Total
Owned	Single detached	f.a.100m² or more	0–60 min.	1		119	103	5	21	2	22	2	2		5				1		1				1	1		1			40	326
						36.5	31.6	1.5	6.4	0.6	6.7	0.6	0.6		1.5				0.3		0.3				0.3	0.3		0.3			12.3	100.0
			60 min.–	2	6		84	53	13	2	8	4	1		2		1		2		1					1			1		36	215
					2.8		39.1	24.7	6.0	0.9	3.7	1.9	0.5		0.9		0.5		0.9		0.5					0.5			0.5		16.7	100.0
		1.t.100m²	0–60 min.	3	12	48		87	62		35	2	6		2		2		4	1	3	1	2		1						94	362
					3.3	13.3		24.0	17.1		9.7	0.6	1.7		0.6		0.6		1.1	0.3	0.8	0.3	0.6		0.3						30.0	100.0
			60 min.–	4	2	3	4		56	13	20	11	3	1	6	1	2		2		1	2			1						72	200
					1.0	1.5	2.0		28.0	6.5	10.0	5.5	1.5	0.5	3.0	0.5	1.0		1.0		0.5				0.5						36.0	100.0
	Publicly constructed apartments		0–60 min.	5	3	3	2	3		64	64	10	8		5		3		6		14										26	211
					1.4	1.4	0.9	1.4		30.3	30.3	4.7	3.8		2.4		1.4		2.8		6.6										12.3	100.0
			60 min.–	6	1	1	2	1			27	13	7		4	2	1		3	1	6	2						1			27	98
					1.0	1.0	2.0	1.0			27.3	13.1	7.1		4.0	2.0	1.0		3.0	1.0	6.1	2.0						1.0			27.3	100.0
	Privately constructed apartments	f.a. 50m² or more	0–45 min.	7	8	4	6	3	6	3		53	40		6		3		7		11			1	1	1	2					57	211
					3.8	1.9	2.8	1.4	2.8	1.4		25.1	19.0		2.8		1.4		3.3		5.2			0.5	0.5	0.9						27.0	100.0
			45 min.–	8		3	5	3	10	4	1		25	11	5	1			2		4	1	1			1						34	111
						2.7	4.5	2.7	9.0	3.6	0.9		22.5	9.9	4.5	0.9			1.8		3.6	0.9	0.9			0.9						30.6	100.0
		1.t. 75m²	0–45 min.	9	1	1	3	5	10	1		4		31	7		2	1	4		6		2		1		1		1		27	108
					0.9	0.9	2.8	4.6	9.3	0.9		3.7		28.7	6.5		1.9	0.9	3.7		5.6		1.9		0.9		0.9		0.9		25.0	100.0
			45 min.–	10				1	6	2		1	1		14	1	1		1		3	1				1			1		16	50
								2.0	12.0	4.0		2.0	2.0		28.0	2.0	2.0		2.0		6.0	2.0				2.0			2.0		32.0	100.0
Rented	Single detached	f.a. 75m² or more	0–60 min.	11		1		1			3					18	31		4		4				1	2				1	7	73
						1.4		1.4			4.1					24.7	42.5		5.5		5.5				1.4	2.7				1.4	9.6	100.0
			60 min.–	12										1			6	6			4										15	32
														3.1			18.7	18.7			12.5										46.9	100.0
		1.t. 75m²	0–60 min.	13		2			1			1				7		11	4		11	2	2	1	10	2	2	1			27	84
						2.4			1.2			1.2				8.3		13.1	4.8		13.1	2.4	2.4	1.2	11.9	2.4	2.4	1.2			32.1	100.0
			60 min.–	14			1		3							1			2		2	3			2	1					12	27
							3.7		11.1							3.7			7.4		7.4	11.1			7.4	3.7					44.4	100.0
	Company issued		0–60 min.	15	2					1	2		1		4		1	1		15	12	1	1		4	1			1		46	93
					2.2					1.1	2.2		1.1		4.3		1.1	1.1		16.1	12.9	1.1	1.1		4.3	1.1			1.1		49.5	100.0
			60 min.–	16						1			1	1			1		1		4	1				1					10	21
										4.8			4.8	4.8			4.8		4.8		19.0	4.8				4.8					47.6	100.0
	Publicly constructed apartments	f.a. 25m² or more	0–60 min.	17	1	1	1				1		1		2		7	1	5			19	20	1	17	10		2	1			43	133
					0.8	0.8	0.8				0.8		0.8		1.5		5.3	0.8	3.8			14.3	15.0	0.8	12.8	7.5		1.5	0.8			32.3	100.0
			60 min.–	18							1		1				1	1					2	5	1	9						23	44
											2.3		2.3				2.3	2.3					4.5	11.4	2.3	20.5						52.3	100.0
		1.t. 25m²	0–60 min.	19					2						4		1	1	2		1	5		3	10	1	8	1	3			11	53
									3.8						7.5		1.9	1.9	3.8		1.9	9.4		5.7	18.9	1.9	15.1	1.9	5.7			20.8	100.0
			60 min.–	20											2										3	1						6	12
															16.7										25.0	8.3						50.0	100.0
	Privately constructed apartments	f.a. 15m² or more	0–30 min.	21						1	1	1						1	2	1						12	13		3	1		32	68
										1.5	1.5	1.5						1.5	2.9	1.5						17.6	19.1		4.4	1.5		47.1	100.0
			30 min.–	22					1					3							1		1				5	6	1			51	69
									1.4					4.3							1.4		1.4				7.2	8.7	1.4			73.9	100.0
		1.t. 15m²	0–30 min.	23															1				1		1	4		16	1			25	49
																			2.0				2.0		2.0	8.2		32.7	2.0			51.0	100.0
			30 min.–	24				1									1		1				1			2			3	2		23	34
								2.9									2.9		2.9				2.9			5.9			8.8	5.9		67.6	100.0
	Lodging houses and dormitories		0–30 min.	25											1				1						1		4	2			10	16	35
															2.9				2.9						2.9		11.4	5.7		28.6	45.7	100.0
			30 min.–	26								1							1					1	1	1						10	16
												6.2							6.2					6.2	6.2	6.2	6.2					62.5	100.0
Total					36	186	211	163	191	94	186	102	97	48	69	31	64	23	56	18	89	38	33	12	56	53	34	30	16	14	786	2739
					1.3	6.8	7.7	6.0	7.0	3.4	6.8	3.7	3.5	1.8	2.5	1.1	2.3	0.8	2.0	0.7	3.2	1.4	1.2	0.4	2.0	1.9	1.2	1.1	0.6	0.5	28.7	100.0

search for houses with the same floor space but with a longer commuting distance rather than houses with smaller floor areas and a short commuting distance (see ${}_1f_2$ vs. ${}_1f_3$ and ${}_7f_8$ vs. ${}_7f_9$). Within single detached rental houses, opposite preference structures are observed (see ${}_{11}f_{12}$ vs. ${}_{11}f_{13}$). Within rental apartments, almost the same number of households select houses with either a longer commuting distance or a smaller floor space, after large dwelling units with a short commuting distance (see ${}_{17}f_{18}$ vs. ${}_{17}f_{19}$ and ${}_{21}f_{22}$ vs. ${}_{21}f_{23}$).

Observation (3) is concerned with the trade-off between floor space and distance in residential location, and there seems to be no dominant tendency as regards to this. Although a discriminant analysis was carried out employing HQM II, no factor seemed to be able to make a consistent distinction between households having contrasting housing preference structures.

c. Housing Groups Chosen Last

Another important item of information contained in the transition matrix (Table 7) is the probabilities, in the 27th column, of terminating the residential-search. For example, out of 786 moving households, 94 (30.0%) terminated their residential-search with housing group 3 (see ${}_3f_{27}$). What, then, is the difference in the housing preference of households with different characteristics, with respect to the termination of their residential-search?

Fig. 3 shows the distributions of the housing categories of last

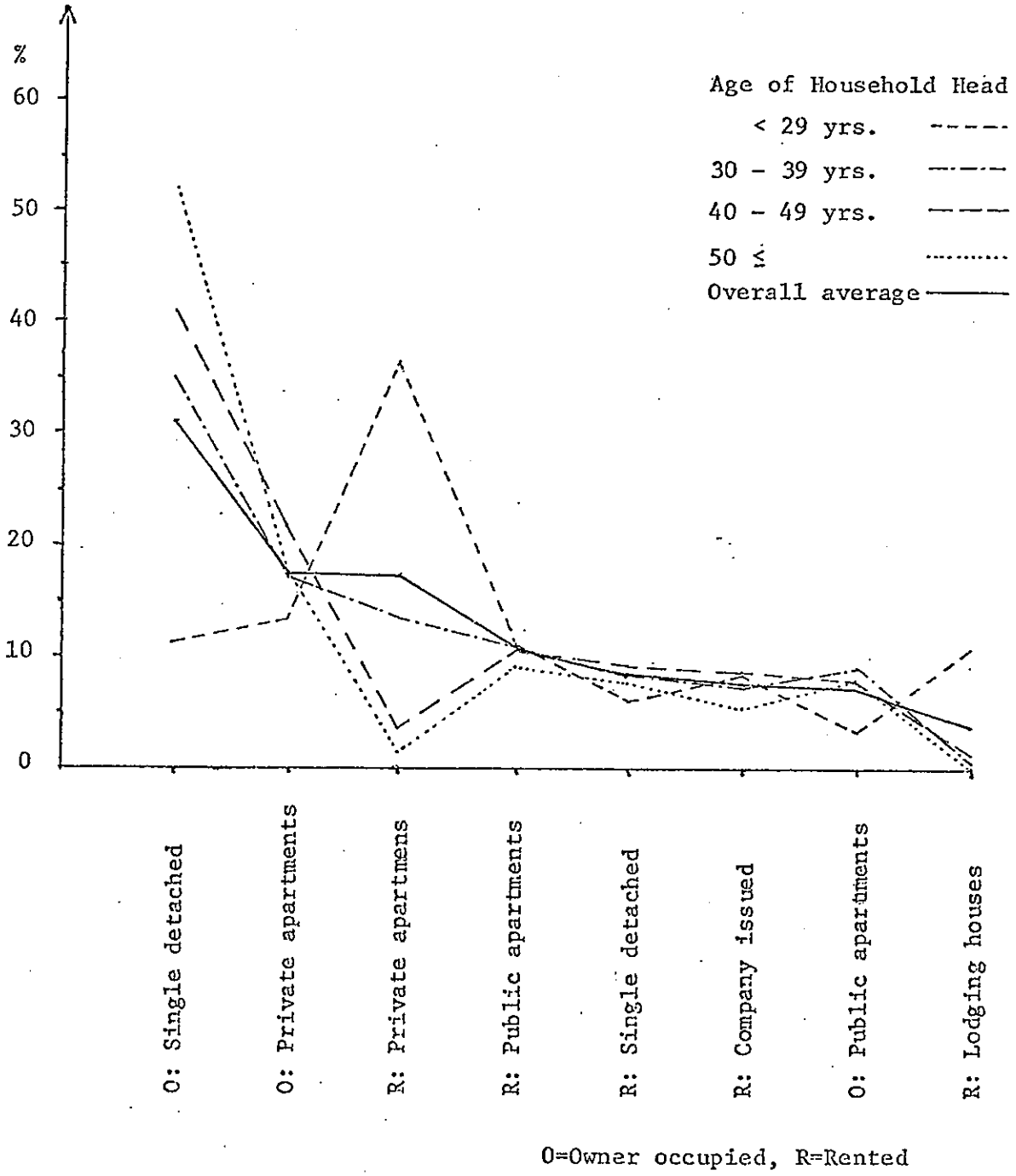

Fig. 3 Distribution of Housing Categories of Last Selection by Age of Head of Household

selection by age of household head. It is observed that the largest portion of the respondents terminate their search with single detached owner-occupied houses, and that this tendency is stronger for households with older household head. Households with heads under age thirty (30) apparently have, however, different preferences in this respect. The largest portion of them terminate their search with a private rental apartment. Similar divergence concerning the houses chosen last can be observed when we stratify moving households by family size, by previous housing, and by the distinction between relocating and new households.

7. Analysis of the Survey Results (3): Potential Demand and Actual Acquisition of Houses.

Out of 589 relocating households, 413 (70.1%) actually relocated. We call the ratio of relocated households to relocating households the Relocated Household Ratio (RDHR). The followings are observations which can be made from the RDHR's computed for households of different characteristics (Table 8):

(1) Households with young heads and small families have a high RDHR. These households are likely to change their household characteristics and to attach higher utility levels to the houses which are subjects of search than to the houses in which they are currently settled.

(2) RDHR's diverge distinctively between households of owner-occupied houses and of rental houses. Owned-house residents

Table 8. Relocated Household Ratio (RDHR) by Households with Different Characteristics

Household characteristics		Relocating households a	Relocated households b	Relocated household ratio b/a(%)
Total		589	413	70.1
Age of household head (1977)	< 29	100	90	90.0
	30 - 39	258	196	76.0
	40 - 49	129	70	54.3
	50 ≤	86	43	50.0
Family size (No. of persons in 1977)	1	51	40	78.4
	2	75	63	84.0
	3 - 4	376	260	69.1
	5 ≤	72	37	56.4
Housing category (1972)	Owner-occupied	137	69	50.4
	Single detached	113	57	50.4
	Public apartment	11	6	54.5
	Private apartment	13	6	46.2
	Rented	425	327	76.9
	Single detached	62	43	69.4
	Company-issued	76	53	69.7
	Public apartment	74	41	55.4
	Private apartment	119	109	91.6
	Lodging houses	94	81	86.2
Commuting distance (in minutes, 1972)	< 5	46	30	65.2
	5 - 15	53	39	73.6
	15 - 30	58	42	72.4
	30 - 60	217	163	75.1
	60 - 90	140	87	62.1
	90 ≤	64	44	68.8
Number of rooms (1972)	1	164	150	91.5
	2	211	149	70.6
	3	132	64	48.5
	4	28	17	60.7
	5	11	4	36.4
	6 ≤	15	8	53.3
Floor space (1972) divided by the number of family members (1977) (in m^2/person)	< 5	115	102	88.7
	5 - 10	191	135	70.7
	10 - 15	109	68	62.4
	15 - 20	77	46	59.7
	20 - 25	22	14	48.3
	25 ≤			

Table. 9 Houses of Potential Demand and Actual Acquisition

(Unit = 1,000 households, %)

Most prefered housing type				Acquired housing type 1	2	3	4	5	6	7	8	9	10	11	12	13	Not re-located	Total
Owned	Single detached	f.a.* $100m^2 \leq$	1	36 12.9	73 26.2	12 4.3	12 4.3	0 0.0	2 0.7	3 1.1	20 7.2	8 2.9	3 1.1	23 8.2	3 1.1	7 2.5	77 27.6	279 100.0
		$<100m^2$	2	1 0.6	75 43.9	3 1.8	9 5.3	1 0.6	1 0.6	3 1.8	2 1.2	2 1.2	1 0.6	7 4.1	1 0.6	0 0.0	65 38.0	171 100.0
	Publicly constructed apartment		3	0 0.0	6 26.1	9 39.1	5 21.7	0 0.0	0 0.0	0 0.0	0 0.0	1 4.3	0 0.0	0 0.0	0 0.0	0 0.0	2 8.7	23 100.0
	Privately constructed apartment	$50m^2 \leq$	4	0 0.0	2 6.7	1 3.3	10 33.3	2 6.7	0 0.0	0 0.0	1 3.3	0 0.0	0 0.0	4 13.3	1 3.3	1 3.3	8 26.7	30 100.0
		$<50m^2$	5	0 0.0	3 27.3	0 0.0	2 18.2	2 18.2	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	3 27.3	0 0.0	1 9.1	0 0.0	11 100.0
Rented	Single detached	$75m^2 \leq$	6	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 40.0	1 20.0	1 20.0	0 0.0	0 0.0	1 20.0	0 0.0	0 0.0	0 0.0	5 100.0
		$<75m^2$	7	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	10 52.6	1 5.3	2 10.5	0 0.0	3 15.8	0 0.0	2 10.5	1 5.3	19 100.0
	Company issued		8	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	30 81.1	1 2.7	0 0.0	3 8.1	0 0.0	0 0.0	3 8.1	37 100.0
	Publicly constructed apartment	$25m^2 \leq$	9	0 0.0	1 2.3	0 0.0	0 0.0	0 0.0	0 0.0	4 9.1	1 2.3	18 40.9	0 0.0	16 36.4	0 0.0	0 0.0	4 9.1	44 100.0
		$<25m^2$	10	0 0.0	0 0.0	0 0.0	0 0.0	1 5.0	0 0.0	0 0.0	1 5.0	1 5.0	1 5.0	8 40.0	4 20.0	3 15.0	1 5.0	20 100.0
	Privately constructed apartment	$15m^2 \leq$	11	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 3.8	0 0.0	22 84.6	1 3.8	2 7.7	0 0.0	26 100.0
		$<15m^2$	12	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	8 44.4	7 38.9	2 11.1	1 5.6	18 100.0
	Lodging house and dormitories		13	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 5.9	16 94.1	0 0.0	17 100.0
Unknown				0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 50.0	0 0.0	0 0.0	1 50.0	2 100.0
Total				37 5.3	160 22.8	25 3.6	38 5.4	6 0.9	5 0.7	21 3.0	57 8.1	34 4.8	5 0.7	99 14.1	18 2.6	34 4.8	163 23.2	702 100.0

* f.a.= floor area

are likely to attach high utility levels to current housing, even when they have a willingness to relocate. Relatively high relocation costs may be the barrier to relocation. In contrast, rental house residents attach low utility levels to their current houses. They can be considered to have low relocation costs. Divergence of RDHR's among households with different expected floor spaces per household member may be explained in the same manner.

Even for relocated households, relocation does not necessarily meet their potential needs. Comparison between housing types of highest priority and those of actual acquisition (Table 9) indicates the following:

(1) Households which demanded either company-issued houses, private rental houses, or lodging houses from the beginning had high probabilities of realizing their needs while other households had low probabilities of fulfilling their needs.

(2) Only 12.9% of the households which attached the highest priority to large owner-occupied single detached houses could realize this ambitious demand. Around one-fourth of them actually acquired rental houses, and another one-fourth did not relocate.

8. Conclusion

The Metropolitan Residential Relocation Survey conducted in the Tokyo metropolitan region detected that: (1) the intensity of the relocation demand is dependent on the household's family cycle stage and on its previous housing; (2) the preference for owner-occupied single detached house is strong, whose intensity varies among households at different family cycle stage and of different housing; and (3) the housing demand realized in the market diverges significantly from the potential demand.

The Metropolitan Residential Relocation Survey which provided these findings has various advantages. First, since the relocation demand and housing preference of the past period were questioned, the data acquired from the MRRS can be regarded to be more reliable than the data which could have been acquired by questioning respondents' desire for the future. Second, analysis of the preference for housing groups, each of which embodied various housing attributes, clarified preference for housing attributes and their interrelations. Third, since our survey on the relocation demand, housing preference, and housing acquisition were stepwisely conducted, we were able to compare the potential and actual demand of relocation and of housing.

We should note that the potential demand of relocation and housing preference are dependent on market circumstance. If, for example, residing in rental houses becomes economically more advantageous, preference for owner-occupied houses may become weaker. We, however, analyzed through the MRRS the potential demand with the market condition as a given circumstance. Development of an analytical method of the market dependency of potential demand may be the most important task which requires further research.

Appendix Hayashi's Quantitative Method II[1]

Hayashi's Quantitative Method II (HQM II) is a version of discriminant analysis, whose explanatory variables are qualitative. Supposewe have a sample of n respondents, each of which has R attributes. We define following linear equation for i(= 1∿n)-th respondent:

$$\alpha_i = \sum_{j=1}^{R} \sum^{K_j}_{k=1} \delta_i(jk) x_{jk} \qquad \text{(B-1)}$$

where

$\delta_j(jk)$ = the dummy variable which takes unity (1) if the j(= 1∿R)-th attributes of the samples is in category k(=1∿k_j) and otherwise zero (0), and

x_{jk} = Score value associated with category k of attribute j.

Suppose the samples are categorized into T groups beforehand. The squared correlation ratio of the samples whose values are defined by eq.(B-1) is:

$$\eta^2 = \delta_b^2/\delta^2 \qquad \text{(B-2)}$$

where

$$\delta^2 = \frac{1}{n} \sum_{i=1}^{n} \alpha_i^2 - \bar{\alpha}^2 \qquad \text{(B-3)}$$

$$\delta_b = \sum_{t=1}^{T} \frac{n_t}{n} (\bar{\alpha}_t - \bar{\alpha})^2 \qquad \text{(B-4)}$$

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(1) The discription given here draws upon Yasuda (1969).

$$\bar{\alpha} = \frac{1}{n} \sum_{i=1}^{n} \alpha_i \qquad \text{(B-5)}$$

$$\bar{\alpha} = \frac{1}{n_t} \sum_{i(t)=1}^{n_t} \alpha_{i(t)} \qquad \text{(B-6)}$$

where δ^2 and δ_b^2 are total and between variances respectively, and n_t is the number of samples in group t ($= 1 \sim T$).

We estimate χ_{jk}'s of eq.(B-1) to maximize the squared correlation ratio η^2 of eq.(B-2). The attributes of respondents are called items in HQM II. An item which has a large range, the absolute difference between maximum and minimum scores associated with categories of the item, makes a large contribution to the discrimination of T groups.

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