Marriage and Migration in Japan: An Explanation By Personal Factors and Ecological Variables

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ABSTRACT

This paper applies a nested logit model to the migration data from a national survey to explain the interprefectural migration behaviors of the Japanese at the time of their marriage by personal factors (attributes of the decision makers) and ecological variables (attributes of the alternatives in the choice set). Before marriage, each person is considered a potential migrant making a two-level decision: to stay or depart at the upper level, and to choose a destination at the lower level.

With respect to the destination choice behaviors, we found (1) that in addition to having a strong tendency to choose the partner's premarital prefecture of residence, the migrants were attracted by high income level and employment growth at destination, (2) that they were more likely to select destinations that were nearby, contiguous or located in the same linguistic region, and (3) that personal factors were less important than ecological variables in influencing the destination choice probabilities.

With respect to departure behaviors, we found (1) that the potential migrants were subject to the retaining effect of high origin employment growth and income level on the one hand and the repelling effect of high population density at origin on the other, (2) that the inclusive variable, representing the attractiveness of the rest of the system, had a positive effect on the departure probabilities, (3) that although surplus siblings indeed had relatively high propensities to make interprefectural migrations, the effect of sibling status on departure probabilities was weaker than those of sex, nativity and education, and (4) that personal factors were much more important than ecological variables in influencing the departure probabilities.

1. Introduction

In the life-course of most people, the propensity to move or migrate is intensified by certain individual events in the life cycle, such as transition to postsecondary education, entry into labor market, marriage, job change or transfer, retirement, death of spouse, and events involving changes in intrafamilial relations such as death or aging of a parent, and changes in the conditions of habitation or deterioration in the dwelling environment due to growth of child/children, death of spouse, etc.(Kawabe, 1991, pp. 3-8). In migration surveys, the respondents usually mentioned one of these events as the reason for migration. However, when we examine the events that actually occasion migrations encountered in the life-course of individuals, we find that they normally are age-specific and constitute the raison d'etre of what is generally known as age-based selectivity of migration. In other words, even those migrations that are occasioned by extremely personal causes are, when perceived as a group phenomenon, strongly controlled, as a minimum, by the demographic factor of age. Similarly, the personal causes themselves are largely controlled by factors common to the communities to which individuals belong. To ascertain the true nature of population migration, it therefore becomes necessary to converge individuals into birth cohorts and grasp the causes of migration common to each cohort by clearly observing the actual course of migration taken by each individual during his/her life cycle and what the specific characters of the community to which the individual belonged had to do in occasioning his/her migration.

It is, therefore, natural that the behavioral theory of migrations and local moves since Rossi (1955) has emphasized the importance of such events. Actually, Rossi (1980) speculated a few decades later that the high stability in mobility level through periods of major economic changes in the United States was probably due to the large number of movements associated with the life-cycle events that tend to happen at a high level of regularity.[1] However, the empirical data showing the migrations associated with life-cycle events are usually lacking. Most of the knowledge on the effects of these events are indirectly inferred from the analysis of age-specific migration data from population censuses (Rogers, 1979; and Liaw and Nagnur, 1985) and sometimes surveys (Shryock and Siegel, 1973, pp. 660-661).

The event of marriage is one of the most important reasons for migrations. In many cases, marriage, an event that is experienced at least once by most individuals during his/her lifetime, involves migration. Under the family-system idea commonly accepted in prewar Japan, it was the general practice for males (the family successor, in particular) to continue living with their parents even after marriage, and for females to move into the groom's home after marriage. Although that notion has undergone changes after the Second World War, there still are many cases where the male prepares the new home for the purpose of marriage and the female moves into it following marriage. Moreover, because the tendency to live with one's parents even after marriage has declined in postwar Japan, there now exists a strong trend for even males who hitherto had lived with their parents after marriage to move away and set up their own homes. As a result, after-marriage male migration has increased sharply when compared to prewar Japan. A study of prewar rural outmigrations of agricultural population in Japan during the 1930s (Nojiri, 1942) showed that although employment and economic reasons were overwhelmingly important for the migrations of males, marriage was the most important reason for the migrations of females, accounting for 40 to 50 percent of their migrations. A national survey on interprefectural migrations in Japan (National Land Agency, 1982) also showed that marriage was the second and third most important reasons for males in the 25-29 and 30-34 age groups, accounting for 18 and 11 percent of their migrations respectively, and that marriage was by far the most important reason for the migrations of females in the 20-24 and 25-29 age groups (32 and 36 percent). According to another survey on the migrations of Miyazaki Prefecture (Miyazaki Prefecture, 1982), marriage was the most important reason for both in- and outmigrations of females in the 20-24, 25-29 and 30-34 age groups, although the most important reason for the in- and outmigrations of males in the same age groups was getting a new job or having a job transfer.

The increased migrations associated with a life-cycle event such as marriage have strong impacts on not only interregional population distribution but also the compositions of regional populations, because they are highly selective with respect to certain personal attributes (Myrdal, 1957). Due to this selectivity, the migrations, particularly during the period of rapid economic growth, tend to result in a large net loss of the better educated and economically more productive individuals in less well-off regions and hence to aggravate interregional income disparities, despite the prediction of the free market theory that migrations will equalize regional incomes (Hicks, 1932). Any attempt to understand the causes and consequences of migrations that fails to include personal factors runs the risk of yielding misleading results.

In choice theory, interregional migration is considered as an outcome of a choice process whereby the choice set includes a number of regions of different attractiveness. The variables affecting the attractiveness of a region such as income level and employment growth are called "ecological" variables and should be used jointly with the personal factors in a comprehensive explanation of migrations.

The purpose of this paper is to explain the interprefectural migrations at marriage in Japan by personal factors and ecological variables, using a nested logit model derived from a random-utility choice theory. The research was made possible by a national survey on the life-course migration history of household heads and spouses, conducted in 1986 by the Institute of Population Problems in the Ministry of Health and Welfare (IPP, 1988). It is the first survey attempted in Japan to get better insights into the migrations associated with major life-cycle events, including graduations from four levels of formal education, getting first job, marriage and some other events. It also contains information on major personal attributes such as the place and time of birth, sibling status and level of education. For simplicity, we call this survey the 1986 IPP Migration Survey.(2)

2. The Migration Data and the Definition of Basic Migration Measures

The 1986 IPP Migration Survey was conducted on October 1 (the same day as the date of the 1985 population census). Questionnaires were distributed to all the household heads (8,323 persons) in the 1975 census divisions that were randomly selected from the 4,966 divisions defined for the whole nation in population census. As high as 94.1 percent (7,829 persons) of these household heads responded, yielding 94.0 percent (7,825) of useable responses. The survey covered all members of the households and provided particularly detailed information on household heads, spouses, and children who returned to their parental homes. In this paper, we focus on only the household heads and spouses.

From the 7,825 useable household records, we are able to identify the pre- and post-marital prefectures of residence for 6,307 household heads and 5,163 spouses. Thus, the actual sample size for this study is 11,470 persons. Among the household heads, a large majority (89 percent or 5,620 persons) are male, and a small minority (11 percent or 687 persons) are female. Among the spouses, the opposite is true: 1 percent or 34 persons are male, and 99 percent or 5,129 persons are female. Ignoring the household status, we see that our sample is fairly well balanced between the sexes: 49.3 percent (or 5,654 persons) being male, and 51.7 percent (or 5,816 persons) being female.

To define the basic migration measures, we consider each person immediately before marriage as a **potential migrant** (PM) who makes a two-level decision. At the upper level, the PM chooses to become a **stayer** (i.e. remaining in the existing prefecture of residence) or an **outmigrant** (i.e. moving to some other prefecture). At the lower level, the outmigrant chooses a specific prefecture as destination. The propensity of the PM in prefecture i and with personal attributes s to outmigrate is represented by the **departure probability**:

$$p[i,s]$$

where the square brackets are used to indicate that the probability depends on i and s. If the PM is known to have migrated, his/her propensity to choose prefecture j as the destination is represented by the **destination choice probability**:

$$p[j|i,s]$$

where the vertical bar is used to indicate that the PM is known to have migrated from prefecture i at marriage.

Although they are not observable, these probabilities can be estimated from empirical data for a group of persons with similar personal attributes. Let K[i,s] be the number of potential migrants with personal attributes s and being a resident of prefecture i immediately before marriage. Also let M[i,s] be the number of persons in K[i,s] who outmigrated at the time of marriage to some other prefectures. Then p[i,s] can be estimated by the **departure rate**:

$$P[i,s] = M[i,s] / K[i,s] \qquad (1)$$

By letting M[i,s,j] be the number of outmigrants in M[i,s] who selected prefecture j as the destination, we can also estimate p[j¦i,s] by the **destination choice proportion**:

$$P[j|i,s] = M[i,s,j] / M[i,s] \qquad (2)$$

Note that the survey did not ask the postmarital residence of the spouse. In finding the values of M[i,s] and M[i,s,j], we assume that the postmarital residences of the spouses were identical to those of the corresponding household heads.

To measure the dispersion in the destination choice pattern, we use the entropy:

$$E[i,s] = - \sum_{j \neq i} \{P[j|i.s]^{*}\log[P[j|i,s]]\} \qquad (3)$$

where the base of the log function is 2. This entropy can assume a value between a minimum of zero (when all migrants chose the same destination) and a maximum of log [46]=5.52 bits (when the migrants were equally distributed among all destinations).

To get some preliminary ideas about how the departure rate and destination choice proportion may vary with the personal attributes and the premarital prefecture of residence, the individuals in the sample are first cross-classified so that various versions of equations (1) and (2) can be applied. The results are summarized in Tables 1 to 4.

3. The Observed Departure Rates

We find that 15.2 percent of the potential migrants actually migrated among the prefectures at marriage (Table 1). For comparison, the 1980 population census data show that the 1979-80 interprefectural departure rates for the 20-24, 25-29 and 30-34 age groups were 6.7, 5.1 and 3.4 percent, respectively (Liaw and Otomo, 1991). It appears, therefore, that the event of marriage strongly enhances the propensities of making not only local moves but also long-distance migrations.

In contrast to the clear male dominance in the interprefectural migrations of the total population (Statistics Bureau, 1989a), we see in Table 1 that at marriage, the female departure rate (22.9 percent) was about three times the male departure rate (7.3 percent). For each sex, the table also suggests the effects of six other personal factors.

Co-prefecture with Partner. It is obvious that if the premarital prefectures of residence of the partners (fiance and fiancee) were different, at least one of them would migrate. The effect of this difference was extremely strong on females: the departure rates were only 4.2 percent for those having the same premarital prefecture of residence and as high as 88.3 percent for those living in different prefectures immediately before marriage. The effect on males was also strong: the corresponding departure rates were 4.2 and 18.8 percent, respectively.

Co-residence with Parents. The individuals who were still living in parental homes immediately before marriage might have stronger attachment to their parents and be less likely to migrate. This speculation seemed to receive some support from the male departure rates (6.5 percent for those residing in parental homes versus 8.1 percent for those not in parental homes), but was somewhat contradicted by the female departure rates (23.7 versus 20.2 percent).

Nativity. Non-natives (those whose prefecture of birth was different from the prefecture of residence immediately before marriage) are expected to be more likely to make interprefectural migrations

Table 1. Observed Departure Rates of Potential Interprefectural Migrants at Marriage: Based on the 1986 National Survey.

Personal Factor	Male	Female	Both sexes
		(percent)	
1. CO-PREFECTURE WITH PARTNER			
Same prefecture	4.2	4.2	4.2
Different prefecture	18.8	88.3	53.6
Foreign land	.	.	.
Unknown	3.9	15.8	10.7
2. CO-RESIDENCE WITH PARENT			
In parental home	6.5	23.7	16.6
Not in parental home	8.1	20.2	12.5
Unknown	11.1	25.0	18.7
3. NATIVITY			
Native	4.7	20.8	13.5
Non-native	13.1	32.7	20.5
Foreign born	5.5	21.0	12.6
Unknown	7.1	20.3	14.5
4. EDUCATION			
Primary	4.2	16.2	10.3
High school	7.8	24.6	17.0
College	7.1	29.8	22.6
University	12.4	42.5	18.0
Student	.	.	.
Unknown	.	.	.
5. SIBLING			
Only child	6.4	19.7	12.8
Eldest son/daughter	6.3	19.9	8.0
Surplus child	8.2	23.3	18.1
Unknown	.	.	10.7
6. PERIOD			
Pre-1937	3.7	20.0	12.5
1937-1945	3.8	18.8	11.9
1946-1960	5.9	18.8	12.6
1961-1973	7.9	27.1	18.0
1974+	8.9	22.9	15.4
Unknown	.	.	.
TOTAL	7.3	22.9	15.2

Note: When the size of the at-risk population is less than 50 persons, the departure rate is considered to be unreliable and is represented by a dot.

than **natives** (those whose prefecture of birth was identical to the premarital prefecture of residence) and **foreign-borns**, partly because non-natives, particularly those who previously left their home prefecture for education purpose, are prone to return. This expectation seemed to be quite consistent with the observed departure rates: those of non-natives (13.1 percent for males and 32.7 percent for females) were much higher than the corresponding figures of natives (4.7 percent for males and 20.8 for females) and foreign-borns (5.5 percent for males and 21.3 percent for females).

Education. Since education tends to increase the information field and perhaps also weaken the locational attachment, the propensity to make interprefectural migration is expected to increase with education. Furthermore, the heavy concentrations of the postsecondary educational institutions in a few metropolitan areas tend to result in first a large net gain of the youngsters entering into colleges and universities in the metropolitan prefectures and then relatively large departure rates for the best educated individuals in the metropolitan prefectures at the times of entry into labor market and marriage. The observed departure rates indeed tended to increase with education. They were the lowest for the primary school graduates (4.2 percent for males and 16.2 percent for females) and the highest for the university graduates (12.4 percent for males and 42.5 percent for females). Note that when the distinction between the sexes is ignored, the departure rate of the university graduates turns out to be **lower** than that of the college graduates. It would be a mistake to interpret this result as indicating that too much education can have a negative effect on migration propensity. The sizes of the at-risk populations shown in Table 2 reveal that this strange phenomenon was due to the fact that most of the university graduates were male, and the fact that at each level of education, males were much less likely to migrate at marriage than females.

Sibling Status. According to the research on prewar migrations in Japan, it was quite common that the eldest sons, as the heir of the family line, mostly did not migrate from the parental homes and, once having migrated, were obliged to return, whereas most of the second and third sons had to leave the parental home and rarely returned (Nojiri, 1942). In postwar Japan, as a consequence of the changes in

Table 2. The Size of the Population at Risk of Making Inter-prefectural Migration at Marriage.

Personal Factor		Male	Female	Both sexes
			(person)	
1.	CO-PREFECTURE WITH PARTNER			
	Same prefecture	3962	3962	7924
	Different prefecture	1201	1201	2402
	Foreign land	1	0	1
	Unknown	490	653	1143
2.	CO-RESIDENCE WITH PARENT			
	In parental home	3015	4296	7311
	Not in parental home	2576	1444	4020
	Unknown	63	76	139
3.	NATIVITY			
	Native	3772	4582	8354
	Non-native	1696	1029	2725
	Foreign born	73	62	135
	Unknown	113	143	256
4.	EDUCATION			
	Primary	2051	2125	4176
	High school	2246	2710	4956
	College	340	742	1082
	University	999	226	1225
	Student	5	4	9
	Unknown	13	9	22
5.	SIBLING			
	Only child	343	315	658
	Eldest son/daughter	2524	342	2866
	Surplus child	2747	5124	7871
	Unknown	40	35	75
6.	PERIOD			
	Pre-1937	135	160	295
	1937-1945	398	462	860
	1946-1960	1547	1650	3197
	1961-1973	1906	2119	4025
	1974+	1644	1411	3055
	Unknown	24	14	38
TOTAL		5654	5816	11470

the traditional family system and in the value system of the rural population, the difference in migration behaviors by sibling status may have lessened to some extent. According to Namiki (1957) and Kawabe (1978), the increased intensity of rural outmigrations of **both** the eldest and other siblings contributed to the increase in overall mobility during the period of rapid economic growth. In explaining the inter- and intraprefectural mobility declines after the oil crisis of 1973, Itoh (1984) suggested that the sharp fertility decline following the brief postwar baby boom resulted in a sharp decline in the proportion of higher-parity siblings and hence contributed to the mobility declines. However, Kawabe (1989) continued to suggest that the importance of sibling effect on migration is weakening in recent years.

To study the sibling effect, we use three categories: (1) only child, (2) eldest son/daughter and (3) surplus sibling. Note that the eldest daughter should actually be called "essential eldest daughter", because we require that in addition to being the eldest among the female siblings, she must not have any brother. It turned out that the departure rates of the first two categories were almost identical (about 6.4 percent for males and 20 percent for females), whereas those of the third category were only moderately higher (8.2 percent for males and 23.3 percent for females).

Period of Marriage. Various socioeconomic changes may affect the temporal pattern of the departure rates at marriage. On the one hand, substantial improvement in education and some increase in the proportions of non-natives and of marital partners with different prefectures of residence before marriage tend to result in an upward trend in the departure rates. On the other hand, a decrease in the proportion of surplus siblings and a transition from the rapid economic growth of the 1960s to the moderate economic growth in the 1970s and 1980s tend to result in a downward trend. Because of such countervailing influences, it is difficult to predict or account for the temporal patterns of aggregate departure rates.

Since the survey did not ask the time of marriage, we estimated the year of marriage from the information on the year of birth, using the assumption that the age of marriage is 27 for males and 24 for females. We then used the estimated year of marriage to define five

Table 3. Origin-specific departure rates: migration at time of marriage.

Origin prefecture		Population at risk	Number of outmigrants	Departure rate	Origin prefecture
		(person)	(person)	(percent)	
1	HOKKAIDO	591	21	3.6	HOKKAIDO
2	AOMORI	208	19	9.1	AOMORI
3	IWATE	152	25	16.4	IWATE
4	MIYAGI	182	26	14.3	MIYAGI
5	AKITA	167	25	15.0	AKITA
6	YAMAGATA	186	13	7.0	YAMAGATA
7	FUKUSHIMA	157	31	19.7	FUKUSHIMA
8	IBARAKI	216	43	19.9	IBARAKI
9	TOCHIGI	198	30	15.2	TOCHIGI
10	GUMMA	204	26	12.7	GUMMA
11	SAITAMA	366	85	23.2	SAITAMA
12	CHIBA	357	49	13.7	CHIBA
13	TOKYO	1268	263	20.7	TOKYO
14	KANAGAWA	559	76	13.6	KANAGAWA
15	NIIGATA	233	32	13.7	NIIGATA
16	TOYAMA	83	15	18.1	TOYAMA
17	ISHIKAWA	97	18	18.6	ISHIKAWA
18	FUKUI	99	17	17.2	FUKUI
19	YAMANASHI	73	14	19.2	YAMANASHI
20	NAGANO	240	30	12.5	NAGANO
21	GIFU	238	35	14.7	GIFU
22	SHIZUOKA	388	34	8.8	SHIZUOKA
23	AICHI	639	47	7.4	AICHI
24	MIE	207	27	13.0	MIE
25	SHIGA	80	23	28.7	SHIGA
26	KYOTO	267	35	13.1	KYOTO
27	OSAKA	768	124	16.1	OSAKA
28	HYOGO	382	82	21.5	HYOGO
29	NARA	49	16	32.7	NARA
30	WAKAYAMA	130	15	11.5	WAKAYAMA
31	TOTTORI	64	14	21.9	TOTTORI
32	SHIMANE	53	15	28.3	SHIMANE
33	OKAYAMA	219	33	15.1	OKAYAMA
34	HIROSHIMA	205	34	16.6	HIROSHIMA
35	YAMAGUCHI	192	21	10.9	YAMAGUCHI
36	TOKUSHIMA	48	12	25.0	TOKUSHIMA
37	KAGAWA	112	24	21.4	KAGAWA
38	EHIME	183	24	13.1	EHIME
39	KOCHI	56	11	19.6	KOCHI
40	FUKUOKA	430	70	16.3	FUKUOKA
41	SAGA	75	25	33.3	SAGA
42	NAGASAKI	144	30	20.8	NAGASAKI
43	KUMAMOTO	248	38	15.3	KUMAMOTO
44	OITA	139	25	18.0	OITA
45	MIYAZAKI	151	11	7.3	MIYAZAKI
46	KAGOSHIMA	251	49	19.5	KAGOSHIMA
47	OKINAWA	116	9	7.8	OKINAWA
	JAPAN	11470	1741	15.2	JAPAN
	Minimum	48	9	3.6	Minimum
	Maximum	1268	263	33.3	Maximum
	Average	244	37	16.6	Average

marriage periods: pre-1937 (prewar period), 1937-1945 (war period), 1946-60 (period of economic recovery), 1961-73 (period of rapid economic growth), and 1974-86 (period of moderate economic growth). It turned out that the male departure rates displayed an upward trend (from 3.7 percent in the prewar period to 8.9 percent in the most recent period), whereas the female departure rates had an irregular pattern. For both sexes, the departure rate increased during the period of rapid economic growth and then declined: about 12 percent in the earlier periods, 18 percent in 1961-73 and 15 percent in 1974-86.

Finally, we turn our attention to the **spatial pattern** of the departure rates. Although they appeared to differ substantially among the premarital prefectures of residence, their pattern is not easy to characterize (Table 3). They ranged between a minimum of 3.6 percent for Hokkaido and a maximum of 33.3 percent for Saga. It seems that most of the prefectures with relatively low rates are located in remote regions and/or have relatively large inhabitable areas. In contrast, most of the prefectures with relatively high rates are located not too far from large metropolitan cores or from regional metropolitan centers.

4. The Observed Destination Choice Proportions

The destination choice pattern shows strong dominations by three destinations: (1) Tokyo for migrants leaving most of the prefectures in eastern Japan; (2) Osaka for migrants leaving most of the prefectures in western Honshu and Shikoku Island; and (3) Fukuoka for migrants leaving most of the prefectures on Kyushu Island (Table 4). Suburban prefectures (particularly Kanagawa) of the two largest metropolitan areas were frequently the second or third most preferred destinations. For a few origin prefectures (e.g. Akita, Shimane and Nagasaki), the most preferred destination was simply a neighboring prefecture.

The entropies in Table 4 show that the dispersions of the destination choice patterns of the outmigrants differed substantially among the origin prefectures in a rather complex way, ranging from a minimum of 1.66 for Gifu and a maximum of 3.95 for Aichi. The complexity is

Table 4. The three most preferred destinations of the household heads and spouses who made interprefectural migrations at marriage.

	Origin	Entropy		1st choice &	share		2nd choice &	share		3rd choice &	share	Sum of 3	Origin
		(bit)			(%)			(%)			(%)	(%)	
1	HOKKAIDO	3.23	13	TOKYO	23.81	23	AICHI	14.29	11	SAITAMA	9.52	47.62	HOKKAIDO
2	AOMORI	3.05	1	HOKKAIDO	21.05	14	KANAGAWA	21.05	13	TOKYO	15.79	57.89	AOMORI
3	IWATE	2.98	13	TOKYO	32.00	14	KANAGAWA	16.00	1	HOKKAIDO	12.00	60.00	IWATE
4	MIYAGI	2.95	14	KANAGAWA	23.08	3	IWATE	15.38	12	CHIBA	15.38	53.85	MIYAGI
5	AKITA	3.49	2	AOMORI	16.00	13	TOKYO	16.00	14	KANAGAWA	12.00	44.00	AKITA
6	YAMAGATA	2.97	13	TOKYO	23.08	14	KANAGAWA	23.08	2	AOMORI	7.69	53.85	YAMAGATA
7	FUKUSHIMA	2.37	13	TOKYO	41.94	14	KANAGAWA	25.81	4	MIYAGI	12.90	80.65	FUKUSHIMA
8	IBARAKI	2.70	13	TOKYO	30.23	12	CHIBA	25.58	14	KANAGAWA	13.95	69.77	IBARAKI
9	TOCHIGI	2.06	13	TOKYO	46.67	10	GUMMA	26.67	11	SAITAMA	13.33	86.67	TOCHIGI
10	GUMMA	2.51	13	TOKYO	30.77	14	KANAGAWA	23.08	11	SAITAMA	15.38	69.23	GUMMA
11	SAITAMA	2.52	13	TOKYO	51.76	14	KANAGAWA	14.12	12	CHIBA	9.41	75.29	SAITAMA
12	CHIBA	2.19	13	TOKYO	57.14	11	SAITAMA	14.29	14	KANAGAWA	10.20	81.63	CHIBA
13	TOKYO	3.34	14	KANAGAWA	27.76	11	SAITAMA	20.91	12	CHIBA	18.63	67.30	TOKYO
14	KANAGAWA	3.11	13	TOKYO	46.05	11	SAITAMA	9.21	12	CHIBA	5.26	60.53	KANAGAWA
15	NIIGATA	3.41	13	TOKYO	28.13	27	OSAKA	12.50	11	SAITAMA	9.38	50.00	NIIGATA
16	TOYAMA	2.69	11	SAITAMA	20.00	12	CHIBA	20.00	17	ISHIKAWA	20.00	60.00	TOYAMA
17	ISHIKAWA	3.28	23	AICHI	22.22	13	TOKYO	11.11	26	KYOTO	11.11	44.44	ISHIKAWA
18	FUKUI	2.63	26	KYOTO	23.53	27	OSAKA	23.53	17	ISHIKAWA	17.65	64.71	FUKUI
19	YAMANASHI	2.38	13	TOKYO	28.57	14	KANAGAWA	28.57	12	CHIBA	14.29	71.43	YAMANASHI
20	NAGANO	2.28	13	TOKYO	46.67	23	AICHI	20.00	14	KANAGAWA	13.33	80.00	NAGANO
21	GIFU	1.66	23	AICHI	68.57	13	TOKYO	8.57	26	KYOTO	8.57	85.71	GIFU
22	SHIZUOKA	3.06	13	TOKYO	38.24	14	KANAGAWA	11.76	23	AICHI	8.82	58.82	SHIZUOKA
23	AICHI	3.95	21	GIFU	17.02	27	OSAKA	8.51	11	SAITAMA	6.38	31.91	AICHI
24	MIE	2.27	23	AICHI	33.33	27	OSAKA	33.33	13	TOKYO	14.81	81.48	MIE
25	SHIGA	2.02	26	KYOTO	56.52	18	FUKUI	13.04	27	OSAKA	13.04	82.61	SHIGA
26	KYOTO	3.23	25	SHIGA	20.00	27	OSAKA	20.00	13	TOKYO	14.29	54.29	KYOTO
27	OSAKA	3.83	28	HYOGO	29.84	29	NARA	14.52	26	KYOTO	6.45	50.81	OSAKA
28	HYOGO	2.59	27	OSAKA	54.88	26	KYOTO	9.76	13	TOKYO	7.32	71.95	HYOGO
29	NARA	1.72	27	OSAKA	56.25	28	HYOGO	25.00	13	TOKYO	6.25	87.50	NARA
30	WAKAYAMA	2.00	27	OSAKA	60.00	11	SAITAMA	6.67	14	KANAGAWA	6.67	73.33	WAKAYAMA
31	TOTTORI	2.12	27	OSAKA	50.00	26	KYOTO	14.29	32	SHIMANE	14.29	78.57	TOTTORI
32	SHIMANE	2.79	31	TOTTORI	26.67	27	OSAKA	20.00	14	KANAGAWA	13.33	60.00	SHIMANE
33	OKAYAMA	3.27	28	HYOGO	21.21	27	OSAKA	18.18	34	HIROSHIMA	18.18	57.58	OKAYAMA
34	HIROSHIMA	3.25	27	OSAKA	35.29	13	TOKYO	8.82	28	HYOGO	8.82	52.94	HIROSHIMA
35	YAMAGUCHI	3.14	40	FUKUOKA	23.81	13	TOKYO	19.05	28	HYOGO	14.29	57.14	YAMAGUCHI
36	TOKUSHIMA	1.96	27	OSAKA	50.00	28	HYOGO	16.67	38	EHIME	16.67	83.33	TOKUSHIMA
37	KAGAWA	2.55	27	OSAKA	41.67	28	HYOGO	25.00	4	MIYAGI	4.17	70.83	KAGAWA
38	EHIME	3.38	27	OSAKA	25.00	26	KYOTO	12.50	28	HYOGO	12.50	50.00	EHIME
39	KOCHI	2.85	28	HYOGO	27.27	13	TOKYO	18.18	1	HOKKAIDO	9.09	54.55	KOCHI
40	FUKUOKA	3.60	44	OITA	20.00	42	NAGASAKI	12.86	43	KUMAMOTO	12.86	45.71	FUKUOKA
41	SAGA	2.00	40	FUKUOKA	64.00	42	NAGASAKI	8.00	12	CHIBA	4.00	76.00	SAGA
42	NAGASAKI	3.41	41	SAGA	23.33	27	OSAKA	16.67	13	TOKYO	10.00	50.00	NAGASAKI
43	KUMAMOTO	3.69	40	FUKUOKA	23.68	13	TOKYO	10.53	27	OSAKA	10.53	44.74	KUMAMOTO
44	OITA	2.76	40	FUKUOKA	48.00	13	TOKYO	8.00	27	OSAKA	8.00	64.00	OITA
45	MIYAZAKI	2.59	27	OSAKA	27.27	40	FUKUOKA	27.27	12	CHIBA	9.09	63.64	MIYAZAKI
46	KAGOSHIMA	3.65	40	FUKUOKA	18.37	1	HOKKAIDO	10.20	13	TOKYO	10.20	38.78	KAGOSHIMA
47	OKINAWA	2.28	14	KANAGAWA	22.22	27	OSAKA	22.22	28	HYOGO	22.22	66.67	OKINAWA

partly due to the smallness of the origin-specific number of migrants. Nevertheless, we can make a couple of general observations. The origin prefectures that have a relatively small population and are located near a populous metropolitan prefecture (e.g. Gifu near Aichi, Nara near Osaka, and Saga near Fukuoka) have relatively small entropies, indicating that their outmigrants tended to concentrate heavily on a single destination. In contrast, the largest metropolitan core prefectures (Tokyo, Osaka and Aichi) tended to have relatively large entropies, indicating that their outmigrants were distributed more widely among several destinations. Because of the smallness of the number of migrants in the sample, we refrain from displaying the destination choice proportions for separate personal attributes. The effects of the personal factors will be directly examined in the following multivariate model.

5. The Statistical Model and the Estimation Method

In order to evaluate the effects of personal factors and ecological variables on the departure and destination choice propensities in a **multivariate** context, we use a two-level **nested logit model** derived from a random-utility theory of individual choice behavior (Kanaroglou, Liaw and Papageorgiou, 1986; and Liaw and Otomo, 1991). At the lower level, the destination choice probability p[j¦i,s] is expressed as a function of a column vector of **observable** personal factors and ecological variables, X[i,s,j], according to:

$$p[j|i,s] = \exp[V[i,s,j]/u] \Big/ \sum_{k \neq i} \{\exp[V[i,s,k]/u]\} \qquad (4)$$

where

$$V[i,s,j] = B'X[i,s,j] \qquad (5)$$

where

B' is a row vector of unknown parameters and u is an unknown parameter to be estimated. At the upper level, the departure probability p[i,s] depends on another row vector of observable factors and variables, Y[i,s], according to:

$$p[i,s] = \exp[c+u^{*}I[i,s]-A'Y[i,s]] \; / \; \{1 + \exp[c+u^{*}I[i,s]-A'Y[i,s]]\} \qquad (6)$$

where

A' is a row vector of unknown parameters and c is another unknown parameter to be estimated; and

$$I[i,s] = \ln[\sum_{k \neq i} \{\exp[V[i,s,k]/u\}] \qquad (7)$$

The variable I[i,s] is called the **inclusive variable** and can be interpreted as a measure of the attractiveness of the rest of the system perceived by the potential migrant with personal attribute s and in prefecture i. To be theoretically meaningful, the coefficient of the inclusive variable in equation (6) must assume a value between zero and one. Equations (4) and (6) are called the destination choice model and the departure model, respectively.

Since the departure **events** as well as the destination choice **events** reported in our sample may not satisfy the assumption of independence underlying the standard form of the likelihood function, we use the **maximum quasi-likelihood** method (Wedderburn, 1974 and McCullagh, 1983) to estimate the unknown parameters and to assess the relative importance of the personal factors and ecological variables. The estimation method is implemented by the **Newton-Raphson** iterative algorithm, which usually does not converge when several explanatory variables are entered into the model simultaneously with arbitrary initial values for the corresponding parameters such as a set of zeros. Therefore, from a large input data matrix containing many potentially useful ecological variables and several sets of dummy variables (one set for each personal factor), we enter into the model only one or two variables at a time. The residuals obtained after each entry are then examined to determine how the model's explanatory power and theoretical relevance can be improved by allowing more variables to enter.

The goodness-of-fit of a given specification of a model is to be measured by

$$\text{Rho-square} = 1 - L[g]/L[0] \qquad (8)$$

where

L[g] is the maximum value of the log of the given specification's quasi-likelihood; and L[0] is the corresponding value of the "null" model.(3) For the destination choice problem, the null model has all parameters set to zero, implying that all destinations are equally attractive to every person. For the departure problem, the null model sets all parameters to zero, except for the constant term c, implying that the departure probability does not depend on any personal factor or ecological variable. The constant term c is to be set by the estimation method so that it will allow the estimated overall departure rate to be much less than 0.5. The Rho-square is somewhat like the coefficient of determination commonly used in regression analysis, in the sense that it can not assume a value outside of the range between zero and one. According to McFadden (1974), the actual upper bound of the Rho-square that is based on likelihood values is much less than 1.0 and a value of 0.2 actually represents a very good fit.(4)

Since the numbers of observations in our input data sets (80,086 for the destination choice model, and 22,940 for the departure model) are large, we may assume that the t-ratio (i.e. the estimated coefficient of an explanatory variable divided by its asymptotic standard error) has approximately the standard normal distribution. We may, therefore, consider a t-ratio with a magnitude of 2.0 as an indication of statistical significance for the corresponding explanatory variable in a given specification of the model. We may also use the magnitude of the t-ratio to rank the relative importance of the explanatory variables: the greater the magnitude, the more important the corresponding variable.

We define the **full model** as the model that has a large explanatory power and contains a large number of explanatory variables in a substantively meaningful way. To assess the extent to which the explanatory powers of some explanatory variables overlap or complement each other, we will selectively delete the explanatory variables in question from the full model in a series of tests. Two variables are said to be **overlapping** if the deletion of one of them results in an increase in the magnitude of the t-ratio associated with the other variable; if the effect of the deletion is the opposite, they are said to be **complementary**. In other words, complementary variables strengthen each other's explanatory powers when both are included in the model, whereas overlapping variables weakens each other's explanatory powers. We also define **indispensable** variable as the variable whose deletion from the full model results in a substantively nonsensical coefficient for some remaining variable. To assess the relative importance of two subsets of explanatory variables, we delete one subset from the full model each time and then compare the resulting decreases in Rho-square: the deleted subset with a greater decrease is said to be more important.

The estimations of the parameters of the two levels of the nested logit model are done sequentially. The parameters of the destination choice model are first estimated. The values of the inclusive variable are then computed and passed up for the estimation of the parameters of the departure model.

6. Selection of the Explanatory Variables

In addition to the seven personal factors defined in section 3, we select (1) several ecological variables measuring the properties of the individual prefectures in the choice sets, and (2) a systemic variable reflecting the changing property of the whole choice set, according to theoretical relevance and data availability. The values of these variables are chosen so that they are relevant to three broad periods of marriage: pre-1961, 1961-1973, and post-1973. For convenience, the expected sign of the effect of each variable is indicated immediately behind its name.

Some explanatory variables are interaction terms that are generated by multiplying (1) the dummy variables representing some personal factors to (2) some ecological variables.[5]

6.1. Ecological Variables in the Destination Choice Model

Following are the seven ecological variables used in the destination choice model:

Partner's Location (+). This is a dummy variable assuming the value of 1 if the destination in question is the premarital prefecture of residence of the partner, and the value of 0 otherwise.

For a couple living in different prefectures immediately before marriage, it is more likely that one of them will migrate to the prefecture of the partner than that both will migrate to a third prefecture. Thus, this variable is expected to have a positive effect.(6)

Furthermore, this variable may have interactions with several personal factors. First, it is very likely to have a positive interaction with a dummy variable representing the female gender, because the marriage arrangement in Japan is strongly oriented towards the male side. Second, it may also have a positive interaction with a dummy variable representing the male with low (primary and secondary) level of education, because the less well-educated males, perhaps out of economic necessity, may be somewhat more willing to move to the female's family. Third, it may have a negative interaction with a dummy variable representing the 1961-73 period of rapid economic growth, because the prolonged economic boom may make the marrying individuals more optimistic about their future so that they become more willing to take the risk of migrating to a place which is not the partner's premarital prefecture of residence. Fourth, to the extent that the westernization of the Japanese society continues to weaken the tradition of residing with the groom's parents, this variable may also have a negative interaction with a dummy variable representing the most recent period (1974-86).

Log of distance (-). The distance between the origin and destination prefectures is measured by the railroad and ferry distance in 1,000 kilometers. The data are from Suzuki (undated). The distance is transformed by natural log, because the marginal intensity of the distance decay effect decreases with an increase in distance.

Distance is an obstacle to not only the establishment of the intimate relationship before marriage but also the arrangement of marriage contract by a go-between. Furthermore, for an engaged pair of partners, the cost of migration tends to increase and the information on opportunities tends to decrease with an increase in distance. Therefore, the distance decay effect is expected to be highly important.

Contiguity (+). This variable assumes the value of 1 if the destination shares a common border on land with the origin prefecture;

otherwise, it assumes the value of 0. However, we make an exception by assigning the value of 1 to the link between Yamaguchi and Fukuoka, because (1) they were already connected by a tunnel before the war and are now also connected by highway bridges, and (2) the western part of Yamaguchi and the northern part of Fukuoka are part of the Kitakyushu Industrial Area.

This variable is expected to have a positive coefficient, because contiguous prefectures are not affected by the negative effect of "intervening opportunities".

Linguistic similarity (+). Following Liaw and Otomo (1991), this variable assumes the value of 1 if the destination and the origin both belong to the same linguistic region in terms of dialects; otherwise, it assumes the value of 0. We adopted the three linguistic regions defined by Tsuzuki (Yamazaki 1989, p. 116): eastern region, western region and Kyushu. The border between the eastern and western regions is located between Niigata, Nagano and Shizuoka on the eastern side and Toyama, Gifu and Aichi on the western side. Hokkaido and Okinawa do not belong to any of these three regions.

We expect that migrants at marriage as well as at other stages of life cycle prefer a destination with a familiar dialect. This variable may also capture the effects of other cultural factors (e.g. eating habit) that are spatially correlated with it.

Income level at destination (+). As a proxy for income opportunities, this is the real per capita income of the destination prefecture of a year divided by the real per capita income of Japan of the same year.(7) Although the spatial pattern of the values of this variable continued to show the basic contrast between the high values in the metropolitan prefectures and the low values in the peripheral rural prefectures, the spatial variation followed a declining trend, particularly from the mid-1960s to the mid-1970s. In 1975, the values range between a maximum of 1.441 (Tokyo) and a minimum of 0.739 (Kagoshima).

Since married couples must survive on "bread" as well as love, it is likely that migrations at marriage are to some extent affected by the interprefectural variation in income and employment opportunities. We expect the income level at destination to have a positive effect on the destination choice probability.

Employment growth at destination (+). This variable is defined as an annualized percentage growth rate of the total employment in the destination prefecture between census years.(8) Although they used to be relatively high during the 1950s, the employment growth rates of the core prefectures of the three largest metropolitan areas declined substantially, particularly during the early 1970s. For example, the employment growth rate of Tokyo prefecture declined from 7.04 percent per year in 1950-55 to -0.18 in 1970-75. By the early 1980s, the prefectures with relatively high employment growth were mostly suburban and exurban prefectures of the largest metropolitan areas. In terms of standard deviation, the spatial variation in employment growth was much smaller in the 1970s and 1980s than in the previous two decades. In 1970-75, the employment growth rates ranged between a maximum of 2.61 (Chiba and Saitama) and a minimum of -0.98 percent per year (Wakayama).

As a proxy for employment opportunities at destination, this variable is expected to have a positive effect on the destination choice probability, although the attractiveness of the suburban prefectures of the largest metropolitan areas can also be substantially enhanced by the employment opportunities in the metropolitan core prefectures (Liaw and Otomo, 1991).

However, non-native migrants are expected to be less sensitive to the attraction of destination income and employment opportunities, because many of them were probably previous inmigrants from prefectures of relatively low income and slow employment growth and may choose to return at the time of marriage. Therefore, income level and employment growth at destination are expected to have a negative interaction with a dummy variable representing the non-native status.

Log of destination population (+). This variable is the natural log of the percentage share of the national population by the destination prefecture.(9) As an indication of the "too dense/too thin" (kamitsu/kaso) problem (Kawabe, 1989), the spatial variability in this variable followed an upward trend at a decreasing speed. In 1975, the prefectural population shares ranged between a maximum of 10.23 percent (Tokyo) and a minimum of 0.53 percent (Tottori).

To the extent that this variable can be considered as a proxy for the amount of urban amenities such as large department stores, sports stadiums and theaters as well as a large diversity of specialized services, the effect of this variable is expected to be positive.

Area of destination (+). This is the 1975 **inhabitable** area of the destination prefecture in 1,000 square kilometers.(10) Its values ranged between a maximum of 21.250 (Hokkaido) and a minimum of 0.816 (Nara).

Holding everything else constant, it is expected that the prefecture with a larger inhabitable area will attract a greater share of migrants.

6.2. Ecological and Systemic Variables in the Departure Model

For the departure model, we select the following five ecological and systemic variables. The values of these variables are matched with the three periods of marriage as was done for those of the ecological variables in the destination choice model.

Income level at origin (-). This is the real per capita income of the origin prefecture relative to the corresponding national value.

As a proxy of the income opportunities at origin, this variable is expected to have a negative effect on departure probability.

Employment growth at origin (-). This is the annualized percentage employment growth rate of the origin prefecture minus the corresponding value of the nation in the same period.

As a proxy of the relative employment opportunities at origin, this variable is also expected to have a negative effect on departure probability.

Population density at origin (+). This variable is defined for each origin prefecture by dividing its population size by its inhabitable area, with the unit being 1,000 persons per square kilometer.(11) Again, as an indication of the "too dense/too thin" problem, the spatial coefficient of variation of this variable followed an upward trend at a decreasing speed. In 1975, the values of this variable ranged between a maximum of 8.391 (Tokyo) and a minimum of 0.251 (Hokkaido).

As a measure of congestion, this variable is expected to have a positive effect on departure probability.

Inhabitable area of origin (-). This is the inhabitable area of the origin prefecture in 1,000 square kilometers.

As the inhabitable area of a hypothetical prefecture is made larger, a greater proportion of relocations of its residents becomes intraprefectural movers or migrants, resulting in a lower proportion of the residents who outmigrate to other prefectures. Thus, we expect this variable to have a negative effect on departure probability.

National employment growth (+). This is the annualized percentage employment growth rate of Japan.

This systemic variable is used to capture the negative effect on the departure propensities of the substantial slowdown in economic growth after the 1973 oil crisis.

7. Empirical Findings from the Destination Choice Model

After successively entering the ecological variables into the destination choice model, various interaction terms between an ecological variable and some dummy variables representing the personal factors were introduced. Most of these interaction terms turned out to have a t-ratio of small magnitude and were thus deleted. In the end, we obtained the so-called full model which, by allowing some statistically insignificant but substantively plausible variables to remain, provides a fairly broad framework for the evaluations of the relative importance of various subsets of explanatory variables (Table 5).

7.1. The Full Model

With a Rho-square of 0.6838, the full model has explained the observed destination choice pattern very well. All explanatory variables turned out to have the coefficients of the expected signs. Except for income level, all ecological variables are also statistically significant. Since 64 percent of all migrants selected the pre-marital prefecture of their partner, it is not surprising that the ecological variable with a t-ratio of the largest magnitude (7.1) is the partner's location immediately before marriage.

There are two statistically significant interaction terms in the

TABLE 5

The Estimation Results of the Destination Choice Model of Interprefectural Migrations in Japan

Explanatory variable	Full model	Test 1 -Employment growth & interaction	Test 2 -Income level & interaction	Test 3 -Log(Population)	Test 4 -Economic & Population variables
	Coefficient (T)	Coefficient (T)	Coefficient (T)	Coefficient (T)	Coefficient (T)
I. ECOLOGICAL VARIABLES:					
Partner's location	3.0265 (7.1)	2.9552 (6.5)	3.0147 (7.1)	3.1386 (7.1)	3.2097 (8.0)
Log(Distance)	-0.6333 (-6.1)	-0.6934 (-6.3)	-0.6338 (-6.1)	-0.6863 (-6.6)	-1.1166 (-13.0)
Contiguity	0.4823 (2.7)	0.4351 (2.3)	0.4666 (2.6)	0.4803 (2.7)	0.1027 (0.7)
Linguistic similarity	0.5999 (3.4)	0.5342 (2.9)	0.5993 (3.5)	0.5354 (3.0)	-0.0333 (-0.2)
Income level	0.7843 (1.4)	2.0702 (4.0)	------------	2.8121 (6.5)	------------
Employment growth	0.2496 (4.6)	------------	0.2933 (6.7)	0.2543 (4.5)	------------
Log(Population)	0.7361 (5.3)	0.7337 (4.9)	0.8525 (9.4)	------------	------------
Inhabitable area	0.0530 (2.8)	0.0569 (2.8)	0.0435 (2.6)	0.1042 (6.5)	0.0841 (5.0)
II. INTERACTIONS:					
Partner's location * Female	3.2001 (8.6)	3.2091 (7.9)	3.1995 (8.6)	3.1726 (8.3)	3.2194 (9.0)
Partner's location * Male with low education	0.7942 (1.7)	0.7597 (1.6)	0.7789 (1.7)	0.7702 (1.7)	0.6147 (1.4)
Partner's location * Period: 1961-73	-0.8835 (-2.6)	-0.8005 (-2.2)	-0.8587 (-2.6)	-0.9290 (-2.6)	-0.6274 (-2.0)
Partner's location * Period: 1974-86	-0.4346 (-1.2)	-0.3277 (-0.8)	-0.4050 (-1.1)	-0.4895 (-1.3)	-0.3054 (-0.9)
Income level * Non-native	-0.6056 (-0.9)	-1.4402 (-2.8)	------------	-0.5799 (-0.9)	------------
Employment growth * Non-native	-0.1426 (-1.7)	------------	-0.1999 (-3.2)	-0.1368 (-1.6)	------------
Log of quasi-likelihood	-2107.77	-2128.03	-2109.57	-2131.84	-2338.23
Contribution beyond null model:Rho-square	0.6838	0.6807	0.6835	0.6802	0.6492
Contribution below full model: Decrease in Rho-square	-----	0.0030	0.0003	0.0036	0.0346

Note: Total number of migrants = 1,741 persons.

full model: a positive interaction between partner's location and a dummy variable representing the female gender, and a negative interaction between partner's location and a dummy variable representing the period of rapid economic growth (1961-73). The former has a t-ratio of the largest magnitude (8.6) among all explanatory variables in the full model and indicates that females are much more prone to select the partner's premarital prefecture of residence than are males. The latter has a t-ratio (-2.6) of relatively small magnitude and suggests that the rapid economic growth in 1961-73 probably somewhat weakened the attraction of the partner's premarital prefecture of residence.

The lack of statistical significance among several explanatory variables in the full model is probably due to the problem of collinearity. An examination of the table of correlation coefficients between the explanatory variables (Appendix Table 1) reveals that there are several groups of highly or moderately correlated variables. First, the three proximity variables form a group: r[log of distance, contiguity]=-0.60, r[log of distance, linguistic similarity]=-0.71, and r[contiguity, linguistic similarity]=0.39. Second, the two economic variables and population size also form a group: r[income level, employment growth]=0.58, r[income level, log of population]=0.61, and r[employment growth, log of population]=0.54. Note that inhabitable area, though totally unrelated to the two economic variables, has a moderately high correlation with log of population (0.38). Third, the interactions of non-native status with income level and employment growth have a high correlation of 0.64.

Because of the collinearity problem, the importance of an explanatory variable can not be judged simply according to the magnitude of the associated t-ratio in the full model. For example, from the fact that the income variable has a small t-ratio of 1.4, we can not immediately infer that the destination choice behaviors at marriage were not subject to the pull of the high income of a potential destination, because the explanatory power of income level may overlap substantially with those of employment growth and log of population at destination. Only when its t-ratio remains small in magnitude after the deletions of the correlated variables can we safely claim the variable in question to be totally unimportant. Strictly speaking, this claim still needs the assumption that all important variables have been included in the full model.

For the purposes of (1) knowing better the overlapping and complementary relationships among the explanatory variables and (2) assessing the relative importance of different subsets of the explanatory variables, we will now selectively delete some of the explanatory variables from the full model and observe the consequences in a series of tests.

7.2. Achieving Better Insights into the Destination Choice Behaviors by the Method of Elimination

We learn from Test 1 in Table 5 that the deletions of employment growth and its interaction with non-native status cause an increase in the explanatory powers of both income level and its interaction with non-native status: the corresponding t-ratios are changed from 1.4 and -0.9 to 4.0 and -2.8. Test 2 shows that the deletions of income level and its interaction with non-native status also cause an increase in the explanatory powers of both employment growth and its interaction with the non-native status: the corresponding t-ratios are changed from 4.6 and -1.7 to 6.7 and -3.2. The results of these two tests suggest that the destination choice behaviors were subject to the pull of high income and high employment growth at potential destination, and that these pull effects were very weak for the non-native migrants. These findings are highly consistent with those on the destination choice behaviors of young adult interprovincial migrants in Canada, which was based on the microdata from the 1981 census (Liaw, 1990). The low sensitivity of the non-native migrants to the pulls of destinations with better economic opportunities suggests the importance of return migration at the time of marriage as well as in other occasions.

Test 3 shows that the deletion of the log of population causes a large increase in the explanatory powers of income level and inhabitable area, although the explanatory power of employment growth remains almost unchanged. It is interesting to note that the deleted variable actually has a higher correlation with employment growth than with inhabitable area. Therefore, we see that the extent of overlap in explanatory powers can not be easily inferred from the correlation between the explanatory variables.

The reductions in Rho-square resulting from the deletions in Tests 1 to 3 (0.0030, 0.0003 and 0.0036) suggest that income level is less important than employment growth and population, with the latter two variables being similarly important. However, these reductions appear to be so small that we can not help doubting the usefulness of any of the deleted variables. Test 4 shows that the simultaneous deletion of all three variables in question causes a decrease in Rho-square (0.0346) that is much larger than the sum of the decreases in the first three tests. Therefore, it is difficult to deny that the destination choice behaviors of the migrants at marriage were to some extent affected by the destination economic opportunities and by the amenities associated with a large population at a potential destination.

How about the relative importance of three proximity variables? Tests 5 through 7 in Table 5 suggest that the explanatory power of the log of distance overlaps substantially with those of contiguity and linguistic similarity, and that contiguity and linguistic similarity are complementary variables in the sense that their coefficients and t-ratios are magnified when both are included in the model. The reductions in Rho-square resulting from the deletions of each variable in turn suggest that among the three proximity variables, distance is most important and contiguity is least important.

What happens if all three proximity variables are simultaneously deleted from the full model? Test 8 shows that this causes the Rho-square to decrease by a fairly large magnitude of 0.0526, compared with the decreases of 0.0009, 0.0015 and 0.0047 as a result of deleting contiguity, linguistic similarity and distance individually. Thus, the joint explanatory power of the three proximity variables is fairly strong. Actually the reduction in Rho-square would have been even larger if part of the joint explanatory power of these variables were not 'stolen' by partner's location. Notice the large increase in its coefficient and t-ratio.

The overwhelming importance of partner's location and its interactions with personal factors is shown in Test 9, where we see that the deletions of these variables from the full model causes the Rho-square to decrease sharply from 0.6838 to 0.3287. The substantial

TABLE 5

The Estimation Results of the Destination Choice Model of Interprefectural Migrations in Japan (continued)

Explanatory variable	Full model	Test 5 -Contiguity	Test 6 -Linguistic similarity	Test 7 -Log(Distance)	Test 8 -All proximity variables
	Coefficient (T)	Coefficient (T)	Coefficient (T)	Coefficient (T)	Coefficient (T)
I. ECOLOGICAL VARIABLES:					
Partner's location	3.0265 (7.1)	3.0480 (7.5)	3.0165 (7.3)	3.1561 (6.5)	3.9159 (11.0)
Log(Distance)	-0.6333 (-6.1)	-0.8361 (-12.2)	-0.8664 (-11.3)	------------	------------
Contiguity	0.4823 (2.7)	------------	0.3425 (2.0)	1.2698 (8.9)	------------
Linguistic similarity	0.5999 (3.4)	0.4838 (3.0)	------------	1.2852 (8.3)	------------
Income level	0.7843 (1.4)	0.6944 (1.3)	0.7592 (1.4)	0.7672 (1.2)	0.1962 (0.4)
Employment growth	0.2496 (4.6)	0.2447 (4.8)	0.2418 (4.6)	0.2729 (4.5)	0.2838 (6.3)
Log(Population)	0.7361 (5.3)	0.7334 (5.5)	0.7017 (5.2)	0.8457 (5.2)	0.9136 (7.4)
Inhabitable area	0.0530 (2.8)	0.0595 (3.3)	0.0530 (2.9)	0.0263 (1.3)	-0.0337 (-2.0)
II. INTERACTIONS:					
Partner's location * Female	3.2001 (8.6)	3.2005 (9.0)	3.2102 (8.8)	3.1394 (7.4)	2.6817 (8.6)
Partner's location * Male with low education	0.7942 (1.7)	0.7797 (1.8)	0.7872 (1.8)	0.7894 (1.5)	0.7304 (2.0)
Partner's location * Period: 1961-73	-0.8835 (-2.6)	-0.9004 (-2.8)	-0.8678 (-2.6)	-0.9321 (-2.4)	-1.0180 (-3.5)
Partner's location * Period: 1974-86	-0.4346 (-1.2)	-0.4258 (-1.2)	-0.4094 (-1.1)	-0.5208 (-1.2)	-0.5744 (-1.8)
Income level * Non-native	-0.6056 (-0.9)	-0.5279 (-0.9)	-0.6852 (-1.1)	-0.5009 (-0.7)	-0.3816 (-0.7)
Employment growth * Non-native	-0.1426 (-1.7)	-0.1502 (-1.9)	-0.1037 (-2.4)	-0.0981 (-1.0)	0.0077 (0.1)
Log of quasi-likelihood	-2107.77	-2114.06	-2117.88	-2139.06	-2458.34
Contribution beyond null model:Rho-square	0.6838	0.6828	0.6823	0.6791	0.6312
Contribution below full model: Decrease in Rho-square	-----	0.0009	0.0015	0.0047	0.0526

Note: Total number of migrants = 1,741 persons.

TABLE 5

The Estimation Results of the Destination Choice Model of Interprefectural Migrations in Japan (continued)

Explanatory variable	Full model	Test 9 -Partner's location & Interactions	Test 10 -Sex & Education	Test 11 -Nativity	Test 12 -Periods
	Coefficient (T)	Coefficient (T)	Coefficient (T)	Coefficient (T)	Coefficient (T)
I. ECOLOGICAL VARIABLES:					
Partner's location	3.0265 (7.1)	------------	5.4989 (24.5)	3.00152 (6.5)	2.4672 (7.4)
Log(Distance)	-0.6333 (-6.1)	-0.7014 (-13.1)	-0.6032 (-6.7)	-0.5912 (-5.3)	-0.6347 (-6.1)
Contiguity	0.4823 (2.7)	0.5528 (6.2)	0.4814 (3.1)	0.4753 (2.5)	0.4915 (2.8)
Linguistic similarity	0.5999 (3.4)	0.6997 (7.8)	0.5931 (4.0)	0.6494 (3.5)	0.5926 (3.4)
Income level	0.7843 (1.4)	1.1776 (4.4)	0.7847 (1.6)	0.6592 (1.2)	0.7224 (1.3)
Employment growth	0.2496 (4.6)	0.1841 (7.7)	0.2459 (5.4)	0.1975 (4.4)	0.2477 (4.5)
Log(Population)	0.7361 (5.3)	0.9696 (12.8)	0.7188 (5.9)	0.7261 (4.8)	0.7382 (5.3)
Inhabitable area	0.0530 (2.8)	0.0532 (5.4)	0.0523 (3.2)	0.0521 (2.6)	0.0521 (2.7)
II. INTERACTIONS:					
Partner's location * Female	3.2001 (8.6)	------------	------------	3.2102 (7.9)	3.2228 (8.7)
Partner's location * Male with low education	0.7942 (1.7)	------------	------------	0.8400 (1.7)	0.8870 (2.0)
Partner's location * Period: 1961-73	-0.8835 (-2.6)	------------	-0.7788 (-2.9)	-0.8699 (-2.4)	------------
Partner's location * Period: 1974-86	-0.4346 (-1.2)	------------	-0.5400 (-1.8)	-0.4239 (-1.1)	------------
Income level * Non-native	-0.6056 (-0.9)	-1.0866 (-3.4)	-0.5744 (-1.0)	------------	-0.5718 (-0.9)
Employment growth * Non-native	-0.1426 (-1.7)	-0.1021 (-2.4)	-0.1238 (-1.7)	------------	-0.1413 (-1.7)
Log of quasi-likelihood	-2107.77	-4474.76	-2191.65	-2116.78	-2114.09
Contribution beyond null model:Rho-square	0.6838	0.3287	0.6712	0.6824	0.6828
Contribution below full model: Decrease in Rho-square	-----	0.3551	0.0126	0.0014	0.0009

Note: Total number of migrants = 1,741 persons.

increases in the magnitudes of the t-ratios associated with the remaining explanatory variables suggest that the previous destination choice behaviors of the partners of many individuals were also subject to the similar influences of the remaining variables. This finding also suggests that a model without including partner's location runs the risk of overstating the influences of other explanatory variables.

Next, we consider the relative importance of the personal factors that are involved in interaction terms. The reductions in Rho-square in Tests 10 to 13 suggest that sex (0.0126, mostly due to the female/male distinction) is much more important than nativity (0.0022), period (0.0009) and male with low education (0.0004), even though much of the explanatory power of sex was taken back by the ecological variable of partner's location. When all interactions with personal factors are deleted from the full model in Test 14, the reduction in Rho-square is only 0.0145, suggesting that the personal factors were less important than ecological variables in accounting for the destination choice behaviors.

Finally, we obtain the so-called "best model" by retaining only statistically significant explanatory variables (last column of Table 5). All the variables in the best model have substantively sensible signs. Its explanatory power is almost as great as that of the full model.

7.3. The Spatial Pattern of Inclusive Values

An interesting result from the application of the destination choice model is the values of the inclusive variable. For an outmigrant from a given origin prefecture, her/his inclusive value can be interpreted as her/his perceived attractiveness of the rest of the system. To present them in a readable form, we average the inclusive values from the best destination choice model for the more important factors and display them in Table 6. In every origin prefecture, the females with a partner not residing in the same prefecture have the largest inclusive value, whereas the males and females with a partner residing in the same prefecture have the smallest inclusive values. In other words, the rest of the system is most (least) attractive to females with a partner living in the rest of the system (males and

TABLE 5

The Estimation Results of the Destination Choice Model of Interprefectural Migrations in Japan (continued)

Explanatory variable	Full model	Test 13 -Male with low education	Test 14 -All personal factors	"Best model"
	Coefficient (T)	Coefficient (T)	Coefficient (T)	Coefficient (T)
I. ECOLOGICAL VARIABLES:				
Partner's location	3.0265 (7.1)	3.5056 (10.7)	5.0011 (43.9)	3.2291 (13.1)
Log(Distance)	-0.6333 (-6.1)	-0.6344 (-6.1)	-0.5762 (-6.1)	-0.6395 (-6.2)
Contiguity	0.4823 (2.7)	0.4816 (2.7)	0.4764 (2.9)	0.4637 (2.6)
Linguistic similarity	0.5999 (3.4)	0.5986 (3.4)	0.6218 (4.0)	0.5930 (3.4)
Income level	0.7843 (1.4)	0.7789 (1.4)	0.5895 (1.3)	-------------
Employment growth	0.2496 (4.6)	0.2501 (4.7)	0.2000 (5.2)	0.2889 (6.6)
Log(Population)	0.7361 (5.3)	0.7351 (5.3)	0.7168 (5.7)	0.8518 (9.3)
Inhabitable area	0.0530 (2.8)	0.0539 (2.9)	0.0501 (3.0)	0.0448 (2.7)
II. INTERACTIONS:				
Partner's location * Female	3.2001 (8.6)	2.7644 (9.9)	-------------	2.7805 (9.9)
Partner's location * Male with low education	0.7942 (1.7)	-------------	-------------	-------------
Partner's location * Period: 1961-73	-0.8835 (-2.6)	-0.9391 (-2.8)	-------------	-0.6636 (-2.5)
Partner's location * Period: 1974-86	-0.4346 (-1.2)	-0.4920 (-1.3)	-------------	-------------
Income level * Non-native	-0.6056 (-0.9)	-0.5891 (-0.9)	-------------	-------------
Employment growth * Non-native	-0.1426 (-1.7)	-0.1487 (-1.8)	-------------	-0.2031 (-3.3)
Log of quasi-likelihood	-2107.771	-2110.32	-2204.68	-2113.437
Contribution beyond null model:Rho-square	0.6838	0.6834	0.6692	0.6829
Contribution below full model: Decrease in Rho-square	-----	0.0004	0.0145	0.0009

Note: Total number of migrants = 1,741 persons.

TABLE 6
Average Inclusive Values Obtained from the Best Destination Choice Model of Interprefectural Migration at Marriage in Japan.

	Origin prefecture	Inclusive value					Rank					Origin prefecture
		Male		Female		Average	Male		Female		Average	
		Same P.	Dif. P.	Same P.	Dif. P.		Same P.	Dif. P.	Same P.	Dif. P.		
1	HOKKAI	4.48	5.10	4.61	7.44	5.40	46	47	47	46	47	HOKKAI
2	AOMORI	5.45	7.06	5.44	8.56	6.63	40	20	42	36	34	AOMORI
3	IWATE	5.46	6.53	5.60	8.77	6.59	39	33	38	29	37	IWATE
4	MIYAGI	5.68	6.90	6.21	9.01	6.95	33	24	19	23	21	MIYAGI
5	AKITA	5.98	6.64	5.98	8.52	6.78	21	31	26	37	29	AKITA
6	YAMAGA	5.95	5.87	6.22	8.99	6.76	22	45	18	24	32	YAMAG
7	FUKUSHI	6.23	7.99	6.32	9.29	7.46	12	4	17	18	15	FUKUSH
8	IBARAKI	6.21	7.20	6.45	9.98	7.46	14	19	13	10	16	IBARAKI
9	TOCHIGI	6.70	7.31	6.47	10.09	7.64	3	18	12	8	9	TOCHIGI
10	GUMMA	6.22	8.02	6.54	10.10	7.72	13	3	10	7	5	GUMMA
11	SAITAMA	6.62	9.00	6.80	10.67	8.28	4	1	3	1	1	SAITAM
12	CHIBA	6.71	7.86	7.12	10.65	8.08	2	5	1	2	2	CHIBA
13	TOKYO	6.55	7.68	6.65	9.85	7.68	5	10	6	11	6	TOKYO
14	KANAGA	6.29	7.76	6.61	10.02	7.67	10	7	7	9	7	KANAG
15	NIIGATA	5.64	7.37	5.92	8.72	6.91	36	17	28	30	22	NIIGATA
16	TOYAMA	5.66	6.68	6.03	9.17	6.89	35	28	24	21	25	TOYAM
17	ISHIKAW	5.68	6.39	5.68	8.69	6.61	34	37	35	32	36	ISHIKAW
18	FUKUI	5.69	6.95	5.75	8.71	6.77	32	23	34	31	31	FUKUI
19	YAMANA	6.09	6.75	6.90	10.27	7.50	18	25	2	4	12	YAMAN
20	NAGANO	6.48	7.50	6.45	9.48	7.48	6	15	14	16	13	NAGAN
21	GIFU	6.35	7.82	6.54	10.26	7.74	7	6	9	5	3	GIFU
22	SHIZUOK	5.81	7.51	6.39	9.66	7.34	29	14	16	14	18	SHIZUO
23	AICHI	5.90	6.73	6.11	8.77	6.88	24	27	23	28	27	AICHI
24	MIE	6.32	8.14	6.15	9.80	7.60	9	2	21	12	11	MIE
25	SHIGA	6.73	7.55	6.60	9.61	7.62	1	12	8	15	10	SHIGA
26	KYOTO	6.29	7.70	6.72	9.18	7.47	11	9	5	20	14	KYOTO
27	OSAKA	6.05	6.96	6.21	8.91	7.03	20	22	20	27	20	OSAKA
28	HYOGO	6.34	7.49	6.49	10.30	7.65	8	16	11	3	8	HYOGO
29	NARA	6.17	7.73	6.80	10.21	7.73	16	8	4	6	4	NARA
30	WAKAYA	5.93	7.67	6.44	9.67	7.43	23	11	15	13	17	WAKAY
31	TOTTORI	6.06	6.73	6.14	8.66	6.90	19	26	22	33	23	TOTTOR
32	SHIMANE	6.11	6.20	5.88	8.92	6.78	17	40	30	25	30	SHIMAN
33	OKAYAM	5.90	6.33	6.00	8.91	6.79	25	38	25	26	28	OKAYA
34	HIROSHI	5.80	6.50	5.87	8.59	6.69	30	35	31	34	33	HIROSHI
35	YAMAGU	5.70	6.55	5.64	8.40	6.57	31	32	37	39	38	YAMAG
36	TOKUSHI	5.89	6.65	5.89	9.10	6.88	26	29	29	22	26	TOKUSH
37	KAGAWA	5.89	6.65	5.82	9.19	6.89	27	30	33	19	24	KAGAW
38	EHIME	6.18	6.33	5.57	8.38	6.61	15	39	39	40	35	EHIME
39	KOCHI	5.38	6.39	5.93	8.44	6.54	43	36	27	38	40	KOCHI
40	FUKUOK	5.37	6.18	5.49	8.12	6.29	44	41	41	42	43	FUKUOK
41	SAGA	5.55	7.52	5.86	9.34	7.07	38	13	32	17	19	SAGA
42	NAGASA	5.39	5.78	5.40	8.06	6.16	42	46	43	44	45	NAGASA
43	KUMAMO	5.55	5.94	5.65	8.10	6.31	37	43	36	43	42	KUMAM
44	OITA	5.40	7.06	5.23	8.56	6.56	41	21	45	35	39	OITA
45	MIYAZAK	5.82	6.51	5.54	8.22	6.52	28	34	40	41	41	MIYAZA
46	KAGOSHI	5.18	6.10	5.30	8.05	6.16	45	42	44	45	44	KAGOSH
47	OKINAW	4.43	5.87	4.85	7.04	5.55	47	44	46	47	46	OKINAW
Minimum		4.43	5.10	4.61	7.04	5.40						Minimum
Maximum		6.73	9.00	7.12	10.67	8.28						Maximum
Average		5.90	6.96	6.05	9.09	7.00						Average

females with a partner living in the same origin prefecture).

We also learn from Table 6 and Figure 1 that the inclusive values have a systematic spatial pattern. Relatively large values are found in the prefectures near the largest metropolitan cores (e.g. Saitama, Chiba, Gifu, Nara and Hyogo), whereas relatively small values are found in peripheral prefectures (e.g. Hokkaido, Okinawa and most of the prefectures on Kyushu Island).

The inclusive variable defined in our model can also be interpreted as the **accessibility** to the opportunities in the rest of the system. In this interpretation, it is better than the **potential variable** widely used in macrogeography (Warntz, 1965) in two respects. First, the potential variable is defined as a function of distance and only one location-specific variable such as population size or income level, whereas the inclusive variable incorporates the influences of several location-specific variables simultaneously. Second, the parameters in the potential function are predetermined in an ad hoc manner, whereas those in the inclusive function are determined in an objective way by the observed choice outcomes (i.e. the observed destination choice behaviors). Finally, it is worth noting that our destination choice model does not consider intraprefectural migration and hence does not deal with the internal attraction within a prefecture. This is why the inclusive value of Tokyo is less than that of Saitama, although the potential value of Tokyo, computed in terms of total population or total income, may turn out to be the highest among all prefectures.

8. Empirical Findings from the Departure Model

Before the application of the departure model, the values of the inclusive variable for the stayers, which are all missing, have to be imputed from those of the migrants of the same premarital prefecture of residence, co-prefecture status, sex, nativity and period. In the cases where such matching migrants do not exist, the average inclusive value of a group of migrants with similar attributes is used.

The application of the departure model was started with only the constant term which assumes the value of 1 if the potential migrant

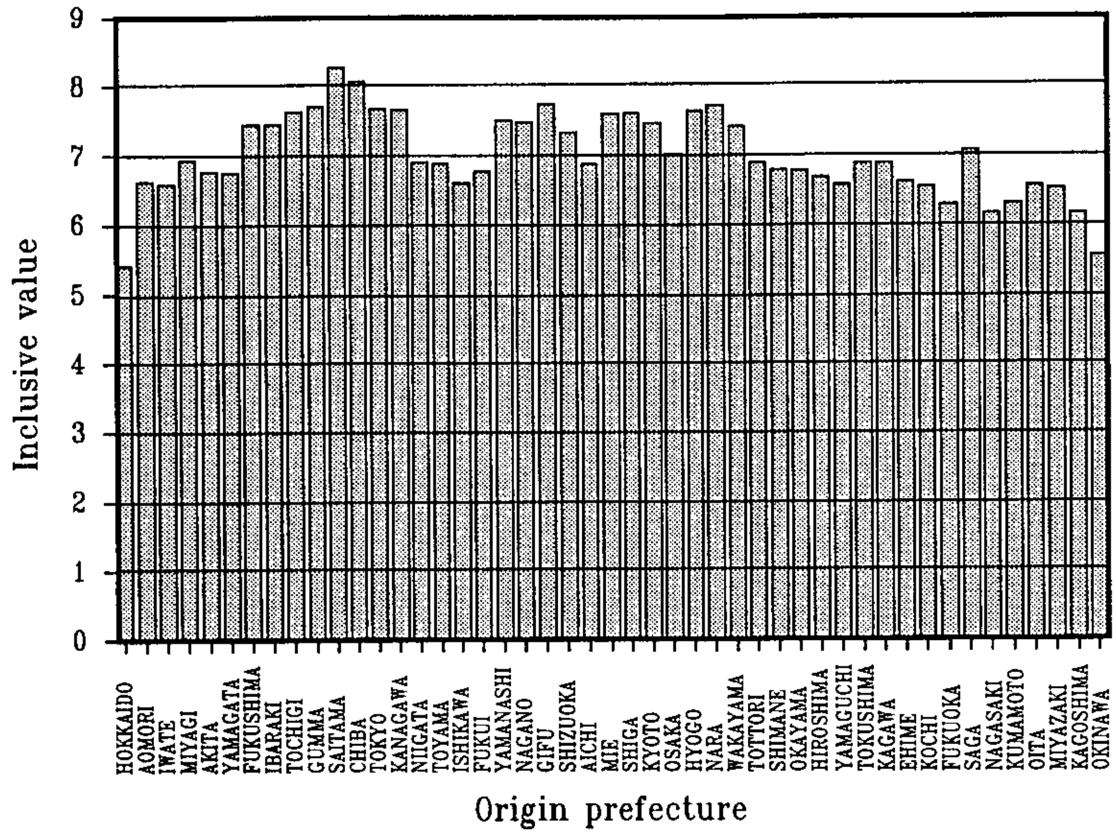

FIGURE 1.
The Average Inclusive Values of the 47 prefectures: Based on the Destination Choices of Interprefectural Migrants at Marriage. The Prefectures are Arranged basically from Northeast to Southwest.

actually became a migrant, and the value of 0 otherwise. With a t-ratio of -66.1, the negative coefficient (-1.7207) of this term simply means that a randomly selected individual is much less likely to become an interprefectural migrant than a stayer. By necessity, the departure probability predicted by the null model is equal to the observed overall departure rate (15.2 percent).

The preliminary impressions on the relative importance of the personal factors we formed earlier from the information in Table 1 were then used to guide the introductions of the dummy variables representing the personal factors into the model. The introductions of the ecological and systemic variables were guided by the simple correlation coefficients between each of them and the residuals of successive specifications of the model. After more than 20 trials, we obtained the so-called full model. In establishing the full model, we have not found any interaction between a personal factor and an ecological variable that is worth retaining. Instead, we found a highly significant negative interaction between two personal factors: a dummy variable representing the female gender and a dummy variable representing the status of residing in the prefecture of the marital partner immediately before marriage. Actually, this negative interaction was strongly suggested by the fact that the departure rate of this type of female was only 4.2 percent, compared with 22.9 percent for all females.

8.1. The Full Model

The goodness of fit of the full model is represented by a high Rho-square of 0.4430 (Table 7). The coefficients of all explanatory variables turn out to have substantively sensible signs and, except for income level and inclusive variable, are statistically significant. From the signigicant coefficients in the full model, we may make the following inferences. First, the propensities to depart were reduced by good employment opportunities and large inhabitable areas at origin and enhanced by congestion at origin. Second, the departure propensities were to some extent enhanced by the growth of the national economy. Third, the departure propensities tended to be high if the individuals were (1) not living in the partner's prefecture, (2)

TABLE 7

The Estimation Results of the Departure Model of Interprefectural Migrations at Marriage in Japan

Explanatory variable	Full model	Test 1 -Employment growth	Test 2 -Income level	Test 3 -Population density	Test 4 -Sex * Partner's pre-marital location
	Coefficient (T)	Coefficient (T)	Coefficient (T)	Coefficient (T)	Coefficient (T)
I. MIGRANT/STAYER CONTRAST:					
Migrant status	0.2005 (0.3)	1.7312 (3.7)	-0.4373 (-0.9)	-0.9369 (-1.9)	-4.8989 (-8.4)
II. ECOLOGICAL (ORIGIN) VARIABLES:					
Income level	-0.8242 (-1.7)	-2.2931 (-6.8)	------------	0.5888 (2.7)	-0.9920 (-1.8)
Employment growth	-0.1691 (-4.5)	------------	-0.2135 (-7.8)	-0.2346 (-7.3)	-0.2063 (-5.0)
Population density	0.1295 (3.3)	0.2235 (6.8)	0.0687 (4.0)	------------	0.1069 (2.4)
Inhabitable area	-0.0533 (-3.6)	-0.0516 (-3.6)	-0.0551 (-3.8)	-0.0603 (-4.1)	-0.0229 (-1.4)
III. SYSTEMIC VARIABLE:					
National employment growth	0.1815 (2.5)	0.1638 (2.3)	0.1758 (2.4)	0.1545 (2.2)	0.1425 (1.8)
Inclusive variable	0.0209 (0.4)	-0.0069 (-0.1)	0.0164 (0.3)	0.0270 (0.5)	0.4026 (8.3)
IV. PERSONAL FACTORS:					
Pre-marital residence:					
Different prefecture	1.4543 (11.6)	1.4607 (11.6)	1.4600 (11.6)	1.4483 (11.5)	2.5222 (17.6)
Sex:					
Male	-3.6282 (-22.3)	-3.6804 (-22.5)	-3.6399 (-22.3)	-3.6131 (-22.2)	-1.5956 (-13.8)
Nativity:					
Non-native	0.5813 (6.3)	0.5182 (5.7)	0.5809 (6.3)	0.6136 (6.7)	0.6005 (5.8)
Education level:					
Highschool graduate	0.3739 (4.1)	0.35427 (3.9)	0.3763 (4.1)	0.3835 (4.2)	0.3749 (3.7)
College graduate	0.3846 (2.8)	0.3646 (4.5)	0.3833 (2.7)	0.3931 (2.8)	0.4609 (3.1)
University graduate	0.5942 (4.6)	0.5778 (4.5)	0.5974 (4.7)	0.6152 (4.8)	0.5196 (3.5)
Sibling status:					
Surplus sibling	0.2351 (2.6)	0.2340 (2.6)	0.2384 (2.7)	0.2442 (2.7)	0.2475 (2.3)
V. INTERACTION:					
Female * Same prefecture	-3.2796 (-18.0)	-3.3309 (-18.5)	-3.2916 (-18.1)	-3.2657 (-18.0)	------------
Log of quasi-likelihood	-2720.34	-2730.82	-2721.81	-2725.69	-2889.2
Contribution beyond null model: Rho-square	0.4430	0.4409	0.4427	0.4419	0.4084
Contribution below full model: Decrease in Rho-square	-----	0.0021	0.0003	0.0011	0.0346

Note: Size of at-risk population = 11,470 persons.

female, (3) non-native, (4) better educated, and (5) surplus sibling. However, the departure propensity of a female was substantially reduced if she had a partner living in the same prefecture. As suggested by the large difference in the magnitudes of the t-ratios, these inferences differ substantially in strength.

The importance of income level and inclusive variable should not be ruled out simply because the associated t-ratios are rather small in magnitude (-1.7 and 0.4). We see in Appendix Table 2 that these two variables are highly correlated with some other variables in the full model: r[income level, employment growth]=0.70, r[income level, population density]=0.88, r[inclusive variable, different location] =0.71 and r[inclusive variable, female * same location]=-0.42. We can not unequivocally declare the uselessness of them, if the deletions of the correlated variables result in substantial improvements in the associated t-ratios.

8.2. Achieving Better Insights into the Departure Behaviors by the Method of Elimination

Do the explanatory powers of the income and employment variables overlap substantially in the departure model? Tests 1 shows that the elimination of employment growth causes the coefficient of income level and the associated t-ratio to become much more negative (from -0.82 and -1.7 to -2.29 and -6.8), allowing us to infer strongly that the propensity to outmigrate was indeed reduced by high income in the origin prefecture. Similarly, Test 2 shows that the deletion of income level causes the coefficient of employment growth and the associated t-ratio to become more negative (from -0.17 and -4.5 to -0.21 and -7.8). Thus, we found that they overlap substantially.

In general, prefectures with better economic opportunities also tend to be relatively congested, although congestion (population density) has a push effect and the economic variables have a retaining effect on the potential migrants. Would the deletion of population density from the full model lead to a misleading result about the retaining effects of income level and employment growth? Test 3 in Table 7 shows that this deletion strengthens the retaining effect of employment growth but results in a nonsensical coefficient for income level. In other words, population density overlaps with employment growth but is an indispensable variable for income level.

How important is the inclusive variable, when some overlapping variables are excluded from the full model? Tests 4 to 6 in Table 7 show that the deletions of two personal factors (premarital prefecture of residence and sex) and an interaction between the two result in substantial increases in the t-ratio associated with the inclusive variable, making it one of the most important explanatory variables. Due to its serious overlaps with the deleted explanatory variables, the coefficient of the inclusive variable even occasionally assumes a value that exceeds the theoretical maximum of 1.0 (see Test 5).

We now turn our attention to personal factors. First, we see from Test 6 that the deletion of sex results in not only a substantial reduction in the model's goodness of fit (0.0679) but also misleading coefficients for the dummy variables representing the effects of the education factor. The estimated coefficients in Test 6 suggest that university graduates were less migratory than college and high school graduates. To avoid getting such misleading information about the effects of education, sex must be included in the departure model. In other words, sex is an indispensable factor for revealing the effects of education. Note that the deletion of sex also results in a misleadingly large coefficient for sibling status. The underlying cause for both misleading results is severe imbalance in the sex composition of the at-risk population: strong male dominance in the university-educated population, and strong female dominance in the population of surplus siblings.

Second, nativity is another indispensable factor. Test 7 in Table 7 shows that its deletion resulted in not only some decrease in Rho-square (0.0040) but also a negative, though insignificant, coefficient (-0.06) for the inclusive variable. A negative coefficient implies that the more attractive the rest of the system, the lower the propensity to leave the origin. This is, of course, contrary to the assumption of rationality which was the theoretical basis of the nested logit model.

Third, we see in Test 8 that the deletion of the education factor causes some visible decrease in Rho-square (0.0027) and loss of significance for national employment growth. As a complementary factor,

TABLE 7

The Estimation Results of the Departure Model of Interprefectural Migrations at Marriage in Japan (continued)

Explanatory variable	Full model	Test 5 Partner's pre-marital location	Test 6 -Sex	Test 7 -Nativity	Test 8 -Education
	Coefficient (T)	Coefficient (T)	Coefficient (T)	Coefficient (T)	location Coefficient (T)
I. MIGRANT/STAYER CONTRAST:					
Migrant status	0.2005 (0.3)	-9.4396 (-18.5)	-7.5598 (-15.0)	0.8000 (1.4)	0.6716 (1.2)
II. ECOLOGICAL (ORIGIN) VARIABLES:					
Income level	-0.8242 (-1.7)	-1.1798 (-2.4)	-1.0243 (-2.1)	-0.8068 (-1.7)	-0.8582 (-1.8)
Employment growth	-0.1691 (-4.5)	-0.2642 (-7.0)	-0.2456 (-6.7)	-0.1353 (-3.7)	-0.1620 (-4.4)
Population density	0.1295 (3.3)	0.0780 (1.9)	0.0850 (2.1)	0.1549 (4.0)	0.1393 (3.6)
Inhabitable area	-0.0533 (-3.6)	0.0251 (1.6)	-0.0056 (-0.4)	-0.0588 (-4.0)	-0.0546 (-3.7)
III. SYSTEMIC VARIABLE:					
National employment growth	0.1815 (2.5)	0.1148 (1.6)	0.1474 (2.1)	0.1700 (2.3)	0.0671 (1.0)
Inclusive variable	0.0209 (0.4)	1.1515 (36.1)	0.6897 (17.2)	-0.0612 (-1.3)	0.0181 (0.4)
IV. PERSONAL FACTORS:					
Pre-marital residence:					
Different prefecture	1.4543 (11.6)	------------	1.7300 (15.9)	1.6823 (13.8)	1.5057 (12.0)
Sex:					
Male	-3.6282 (-22.3)	-0.8912 (-10.1)	------------	-3.6218 (-21.9)	-3.6012 (-22.4)
Nativity:					
Non-native	0.5813 (6.3)	1.1523 (13.2)	0.5152 (5.7)	------------	0.5991 (6.5)
Education level:					
Highschool graduate	0.3739 (4.1)	0.4464 (5.0)	0.4103 (4.6)	0.3747 (4.1)	------------
College graduate	0.3846 (2.8)	0.5844 (4.4)	0.6709 (5.1)	0.3942 (2.8)	------------
University graduate	0.5942 (4.6)	0.7669 (5.8)	0.2781 (2.2)	0.6343 (4.9)	------------
Sibling status:					
Surplus sibling	0.2351 (2.6)	0.2712 (2.9)	0.7691 (8.9)	0.2600 (2.9)	0.2222 (2.5)
V. INTERACTION:					
Female * Same prefecture	-3.2796 (-18.0)	------------	------------	-3.3157 (-18.0)	-3.2757 (-18.0)
Log of quasi-likelihood	-2720.34	-3128.2	-3051.8	-2739.8	-2733.4
Contribution beyond null model: Rho-square	0.4430	0.3595	0.3751	0.4390	0.4403
Contribution below full model: Decrease in Rho-square	-----	0.0835	0.0679	0.0040	0.0027

Note: Size of at-risk population = 11,470 persons.

education is essential for the revelation of the mobility depressing effect of the economic slowdown since the oil crisis of 1973.

Fourth, we see in Test 9 that the deletion of the sibling factor causes only a very slight decrease in Rho-square (0.0007) and has almost no effect on the t-ratios or the remaining variables. It is interesting to note that the sibling factor turned out to be much less important than sex, education and nativity, although the importance of its influence on migration level has been emphasized in the literature (Itoh, 1984).

How about the effects of marriage period and co-residence with parent? In the context of the variables included in the full model, we could not detect any period effects by introducing in turn the dummy variables representing the 1961-73 and 1974-86 periods. When the national employment growth is dropped, only the 1974-86 dummy variable assumed a slightly significant coefficient (-0.25), with t=-2.3. Thus, the only period effect we could find is the decline in the departure propensity in the period of slow economic growth. With respect to co-residence with parent, its dummy variable had near-zero correlations with the residuals of various specifications of the departure model and never appeared to be important enough for its inclusion into the model.

Next, we compare the relative importance of the ecological and systemic variables on the one hand and the personal factors on the other. The inclusive variable, being jointly determined by ecological variables and personal factors in the destination choice model, can be included into both groups in the comparison. Test 10 shows that the deletion of the first group results in a moderate decrease in Rho-square by 0.0099, while allowing the t-ratios of all personal factors to retain their proper sign and high level of significance. Test 11 shows that the deletion of the second group not only results in a huge decrease in Rho-square by 0.4274 but also causes the t-ratios of two of the remaining variables to become nearly zero. Therefore, personal factors are much more important than ecological and systemic variables in accounting for the variations in departure behaviors at marriage. In applying the nested logit model to the microdata on elderly and young adult migrations among the provinces in Canada in 1976-81, Liaw and Ledent (1988) and Liaw (1990) also found that personal factors are

TABLE 7

The Estimation Results of the Departure Model of Interprefectural Migrations at Marriage in Japan (continued)

Explanatory variable	Full model	Test 9 -Sibling status	Test 10 -All ecological & systemic variables	Test 11 -All personal factors & Inclusive var.	"Best Model"
	Coefficient (T)	Coefficient (T)	Coefficient (T)	Coefficient (T)	location Coefficient (T)
I. MIGRANT/STAYER CONTRAST:					
Migrant status	0.2005 (0.3)	0.4305 (0.7)	-0.0052 (-0.0)	-0.6319 (-2.3)	-5.0448 (-8.8)
II. ECOLOGICAL (ORIGIN) VARIABLES:					
Income level	-0.8242 (-1.7)	-0.8525 (-1.8)	------------	-1.1932 (-3.7)	-1.0451 (-1.9)
Employment growth	-0.1691 (-4.5)	-0.1689 (-4.6)	------------	-0.0179 (-0.7)	-0.2059 (-5.0)
Population density	0.1295 (3.3)	0.1328 (3.4)	------------	0.1525 (5.6)	0.1169 (2.6)
Inhabitable area	-0.0533 (-3.6)	-0.0523 (-3.6)	------------	-0.0762 (-6.7)	------------
III. SYSTEMIC VARIABLE:					
National employment growth	0.1815 (2.5)	0.1819 (2.5)	------------	-0.0069 (-0.1)	0.1450 (1.8)
Inclusive variable	0.0209 (0.4)	0.0198 (0.4)	------------	------------	0.4199 (8.9)
IV. PERSONAL FACTORS:					
Pre-marital residence:					
Different prefecture	1.4543 (11.6)	1.4580 (11.6)	1.4374 (13.3)	------------	2.4869 (17.7)
Sex:					
Male	-3.6282 (-22.3)	-3.7157 (-23.4)	-3.6713 (-28.6)	------------	-1.5815 (-13.8)
Nativity:					
Non-native	0.5813 (6.3)	0.5917 (6.5)	0.5212 (6.3)	------------	0.6113 (6.0)
Education level:					
Highschool graduate	0.3739 (4.1)	0.3777 (4.2)	0.3392 (3.9)	------------	0.3770 (3.8)
College graduate	0.3846 (2.8)	0.3815 (2.7)	0.3253 (2.4)	------------	0.4643 (3.1)
University graduate	0.5942 (4.6)	0.5769 (4.5)	0.5803 (4.8)	------------	0.5234 (3.5)
Sibling status:					
Surplus sibling	0.2351 (2.6)	------------	0.2474 (2.8)	------------	0.2435 (2.3)
V. INTERACTION:					
Female * Same prefecture	-3.2796 (-18.0)	-3.2807 (-18.1)	-3.3174 (-21.6)	------------	------------
Log of quasi-likelihood	-2720.34	-2723.7	-2768.61	-4807.7	-2900.6
Contribution beyond null model: Rho-square	0.4430	0.4423	0.4331	0.0156	0.4061
Contribution below full model: Decrease in Rho-square	-----	0.0007	0.0099	0.4274	0.0369

Note: Size of at-risk population = 11,470 persons.

of paramount importance in explaining the departure behaviors. Thus, we now have substantial evidence for the necessity of the information on personal attributes in an attempt to explain the observed departure patterns, no matter whether the migrations in question happen to the total population, a specific age group, or people experiencing a specific life-cycle event.

Finally, for the sake of completeness, we present the so-called "best" departure model in the last column of Table 7. It is best in the sense (1) that the inclusive variable is highly significant and consistent with the basic rationale of the nested logit model, (2) that the other explanatory variables all have the expected signs and are statistically significant or nearly so, and (3) that its explanatory power remains fairly strong.

9. Summary

We hope that we have demonstrated the potential advantages of applying a well-designed statistical model to a high-quality microdata for achieving a better and simpler understanding of the highly selective migration behaviors. We have found that migration behaviors at the time of marriage in Japan can be well explained by a combination of personal factors and ecological variables in a sensible way.

With respect to the destination choice behaviors, our main finding are as follows. First, the destination choice probabilities were positively affected by destination income level and destination employment growth. However, similar to an earlier finding in Canada (Liaw, 1990), non-native migrants in Japan were found to be less sensitive to the attractions of destination economic opportunities than native and foreign-born migrants. This difference in sensitivity was probably related to the phenomenon of return migrations. Second, the explanatory powers of the economic variables overlapped to a large extent with each other and with that of destination population size. Thus, the explanatory power of each of them in a multivariate context appeared to be relatively unimpressive. As an attraction to interprefectural migrants, employment growth appeared to be more important than income level. Third, the destination choice probabilities were significantly related to three proximity variables: distance, contiguity and linguistic similarity. Among the three, distance was most important. However, due to intercorrelations, the explanatory power of any of them could be mostly captured by the remaining two. Fourth, there was a strong tendency for the migrants to select the premarital prefecture of residence of their partner. This tendency was particularly strong among female migrants and was somewhat weakened during the 1961-73 period of rapid economic growth. Fifth, the inclusive values, representing the attractiveness of the rest of the system from the viewpoints of origin prefectures, had a sensible spatial pattern: relatively high in prefectures around the largest metropolitan cores, and relatively low in peripheral prefectures.

With respective to the departure behaviors, our major findings are as follows. First, the departure probabilities were affected by the retaining powers of employment growth and, to a lesser extent, income level at origin. However, the explanatory power of each of the two variables was unimpressive, partly because they overlapped with each other. Second, the departure probabilities were subject to the push effect of origin population density. The omission of this variable from the departure model caused origin income level to assume a nonsensical coefficient. Third, the inclusive variable overlapped substantially with a couple of personal factors, and it became one of the most important explanatory variables when these overlapping factors were deleted from the model. Fourth, the departure propensities were enhanced somewhat by national employment growth. The slowdown in economic growth in 1974-86 had a negative effect on these propensities. Fifth, although surplus siblings indeed had relatively high propensities to make interprefectural migrations, the effect of sibling status on departure propensities was weaker than those of sex, nativity and education. We found very strong evidence that the departure probabilities were enhanced by being female, non-native, and well-educated. Of course, the individuals with their partner living in the same prefecture tended to be much less migratory; this was especially true for females. Finally, we found that personal factors are much more important than ecological and systemic variables in explaining the departure behaviors. The omission of these factors makes the explanation of observed departure rates extremely difficult or even futile.

Footnotes

(1) An alternative explanation of the stability in mobility is that it may have resulted from several countervailing socioeconomic changes such as the growth of two-earner families and greater commitment of women to careers and career advancement on the one hand, and an increase in the level of education and a decline in self-employment on the other (Long, 1988, pp. 34-37).

(2) The IPP has conducted a national migration survey every five years since 1976. The questionnaires vary substantially from one survey to another. For more details, see IPP (1988).

(3) The quasi-likelihood function, though having unique first-order partial derivatives, is not unique. For the nested logit model, it can be written in such a form that its maximum value is equal to the maximum value of the standard likelihood function.

(4) In addition to the Rho-square, one may use a weighted R-square or a dissimilarity index to indicate a model's goodness of fit, as shown in Liaw and Otomo (1991). We chose the Rho-square in this paper, because it turned out to be more sensitive to changes in the combination of explanatory variables.

(5) There are two ways to introduce the influences of personal factors into the destination choice model. First, we may allow the dummy variables representing personal factors to interact with ecological variables. The resulting interaction terms allow us to ask questions of the following type: Are non-native migrants less sensitive to the pull of **employment opportunities**? Second, we may allow these dummy variables to interact with a dummy variable representing a specific set of destinations. These interaction terms allow us to ask questions of a different type: Are non-native migrants less subject to the attraction of **metropolitan areas**? Since we feel that the questions of the first type are theoretically more meaningful, we introduce the in-

teraction terms according to the first way.

(6) As many as 2,402 persons (20.9 percent) of the at-risk population of 11,470 persons were not living in the same prefecture as that of their partner immediately before marriage. Among these 2,402 persons, 1,287 (53.6 percent) became interprefectural migrants, representing as many as 73.9 percent of the total of 1,741 interprefectural migrants. Among these 1,287 migrants, a large majority of 1,115 migrants (86.6 percent) went to the premarital prefecture of their partner, leaving only 172 migrants (13.4 percent) who headed for a third prefecture. The 1,115 migrants represented 64.0 percent of all interprefectural migrants.

(7) For the individuals who married before 1961, the value of this variable is estimated by dividing (1) the 1955 per capita prefectural income of the destination by (2) the 1955 per capita income of Japan and (3) the 1963 spatial consumer price index (SCPI) of the destination. The value is further scaled by 100 so that the value of 1.0 indicates a real income level equal to that of Japan. Note that the SCPI indicates the cost of living in each prefecture relative to that of Japan in a given year (rather than the increase in the cost of living from the previous year). We use the 1963 SCPI because the values before 1963 are not available. For the individuals who married in 1961-1973, the values of all three input variables are based on those observed in 1965. For those who married in 1974-1986, the 1975 data are used. The data sources on prefectural and national per capita income are: Economic Planning Agency (1976), pp. 40-45 for 1955 and 1965; and Statistics Bureau (1983), p. 29 for 1975. Although the official definition of this variable was changed several times, we believe that the spatial pattern of the values of this variable was not much affected by these changes. The data on the spatial consumer price index are taken from Statistics Bureau (1988b). For each year the index of Japan was set at 100. The prefecture values were based on those of their capital cities. In 1975, Tokyo had the highest index (105.1),

whereas Tottori had the lowest index (95.5). The missing values of SCPI of Okinawa were replaced by the observed values of 1977 (99.9).

(8) The employment growth rates are computed from the employment sizes reported in the quinquennial population censuses. For each prefecture, we first compute the instantaneous annual growth rate for each five-year period between consecutive censuses and then averaged these figures for the three broad periods: the 1950-60 average for the pre-1961 marriage period; the 1960-70 average for the 1961-73 marriage period; and the 1970-85 average for the 1974-86 marriage period. The missing values of Okinawa's employment growth rate for the first two periods are estimated by the corresponding national values that were based on the data from the remaining 46 prefectures. The source of data are: various pages of Statistics Bureau (1960, 1970, and 1980) for 1950 to 1970; and Statistic Bureau (1989b), p. 353 for 1975 to 1985.

(9) To compute the values of population shares, the 1955, 1965 and 1975 observed population sizes are used for the three broad marriage periods. The missing values of Okinawa for 1955 and 1965 are estimated by backward projection using the average growth rate of the prefecture between 1975 and 1985. These estimated values are then added to the corresponding population sizes of the other 46 prefectures to find the corresponding sizes of the national population. The data source is: Statistics Bureau (1990), pp. 26-27.

(10) Since this variable has remained relatively unchanged, we use the 1975 observed data for all periods (Statistics Bureau, 1989, p. 240).

(11) For the three broad marriage periods, we let the numerator be the population sizes of 1955, 1965 and 1975, respectively. The denominator is the inhabitable area of 1975.

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APPENDIX TABLE 1

Simple Correlation Coefficients of the Explanatory Variables in the Destination Choice Model of Interprefectural Migrations at Marriage in Japan

Explanatory variable	Partner's location	Log of distance	Contiguity	Linguistic similarity	Income level	Employ. growth	Log of population	Inhabitable area	Partner's location * Female	Partner's loc.*Male with low education	Partner's location *1961-73	Partner's location *1974-86	Income *Non-native	Emp. growth *Non-native
Partner's location	1.00	-0.17	0.16	0.11	0.17	0.14	0.16	-0.00	0.91	0.31	0.65	0.52	0.01	0.05
Log(Distance)	-0.17	1.00	-0.60	-0.71	-0.27	-0.21	-0.10	0.17	-0.14	-0.07	-0.11	-0.09	-0.12	-0.19
Contiguity	0.16	-0.60	1.00	0.39	0.08	0.10	0.06	-0.04	0.13	0.07	0.09	0.09	0.02	0.09
Linguistic similarity	0.11	-0.71	0.39	1.00	0.06	0.05	-0.01	-0.08	0.09	0.04	0.07	0.06	0.03	0.04
Income level	0.17	-0.27	0.08	0.06	1.00	0.58	0.61	-0.05	0.16	0.04	0.11	0.08	0.11	0.25
Employment growth	0.14	-0.21	0.10	0.05	0.58	1.00	0.54	0.02	0.13	0.03	0.11	-0.00	0.03	0.44
Log of population	0.16	-0.10	0.06	-0.01	0.61	0.54	1.00	0.38	0.14	0.04	0.11	0.08	0.05	0.24
Inhabitable area	-0.00	0.17	-0.04	-0.08	-0.05	0.02	0.38	1.00	-0.00	0.00	-0.00	-0.00	-0.00	0.01
Partner's loc. * Female	0.91	-0.14	0.13	0.09	0.16	0.13	0.14	-0.00	1.00	-0.00	0.61	0.44	-0.01	0.03
Partner's location *Male with low education	0.31	-0.07	0.07	0.04	0.04	0.03	0.04	0.00	-0.00	1.00	0.16	0.20	0.02	0.02
Partner's location * Period:1961-73	0.65	-0.11	0.09	0.07	0.11	0.11	0.11	-0.00	0.61	0.16	1.00	-0.01	0.00	0.04
Partner's location * Period: 1974-86	0.52	-0.09	0.09	0.06	0.08	-0.00	0.08	-0.00	0.44	0.20	-0.01	1.00	0.01	0.00
Income level * Non-native	0.01	-0.12	0.02	0.03	0.11	0.03	0.05	-0.00	-0.01	0.02	0.00	0.01	1.00	0.64
Employment growth * Non-native	0.05	-0.19	0.09	0.04	0.25	0.44	0.24	0.01	0.03	0.02	0.04	0.00	0.64	1.00

APPENDIX TABLE 2

Simple Correlation Coefficients of the Explanatory Variables in the Departure Model of Interprefectiral Migrations at Marriage in Japan

Explanatory variable	Income level	Employm growth	Population density	Inhabitable area	National employment growth	Inclusive variable	Different prefecture	Male	Non-native	High school	College	University	Surplus sibling	Female* Different prefecture
Income level	1.00	0.70	0.88	-0.20	-0.08	0.11	0.24	0.05	0.33	0.02	0.06	0.13	-0.03	-0.05
Employment growth	0.70	1.00	0.45	-0.11	0.03	0.11	0.21	0.05	0.27	0.02	0.03	0.07	-0.02	-0.05
Population density	0.88	0.45	1.00	-0.28	-0.14	0.12	0.24	0.05	0.34	0.03	0.07	0.15	-0.01	-0.06
Inhabitable area	-0.20	-0.11	-0.28	1.00	0.02	-0.09	-0.34	-0.01	-0.10	-0.01	-0.02	-0.05	0.02	0.04
National employment growth	-0.08	0.03	-0.14	0.02	1.00	-0.03	0.01	-0.05	-0.08	-0.13	-0.16	-0.17	0.01	0.06
Inclusive variable	0.11	0.11	0.12	-0.09	-0.03	1.00	0.71	0.01	0.20	0.01	0.04	0.13	0.01	-0.42
Different prefecture	0.24	0.21	0.24	-0.34	0.01	0.71	1.00	-0.20	0.04	0.03	0.06	0.04	0.08	-0.26
Male	0.05	0.05	0.05	-0.01	-0.05	0.01	-0.20	1.00	0.14	-0.07	-0.12	0.22	-0.43	-0.81
Non-native	0.33	0.27	0.34	-0.10	-0.08	0.20	0.04	0.14	1.00	-0.01	0.02	0.14	-0.01	-0.15
High school	0.02	0.02	0.03	-0.01	-0.13	0.01	0.03	-0.07	-0.01	1.00	-0.28	-0.30	0.06	0.04
College	0.06	0.03	0.07	-0.02	-0.16	0.04	0.06	-0.12	0.02	-0.28	1.00	-0.11	0.05	0.06
University	0.13	0.07	0.15	-0.05	-0.17	0.13	0.04	0.22	0.14	-0.30	-0.11	1.00	-0.13	-0.21
Surplus sibling	-0.03	-0.02	-0.01	0.02	0.01	0.01	0.08	-0.43	-0.01	0.06	0.05	-0.13	1.00	0.34
Female* Different prefecture	-0.05	-0.05	-0.06	0.04	0.06	-0.42	-0.26	-0.81	-0.15	0.04	0.06	-0.21	0.34	1.00