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Migration Analysis using Life Tables

— Case of Osaka City —

Teruaki Fujii

1. Introduction

* Preview of the Economy and Population of Osaka City

After a sharp decrease in the later part of the 1970s, the population of Osaka City now seems to be decreasing moderately and has become stable in recent

keywords: Population Estimate, Estimation of Migration, Cohort Method, Life Tables, Population Census

* The first draft of this paper was prepared for a meeting held in City of Helsinki Urban Facts on 17th of August 1999. I would like to thank Mrs. Asta Manninen, Dr. Ilkka Susiluoto and their colleagues for their kind invitation and useful comments in the discussion.

I would also like to thank Prof. Kiyoshi Hiroshima (Shimane University), who introduced me to the cohort method and gave me useful comments about this work at meetings of the Society of Economic Statistics and through e-mail .

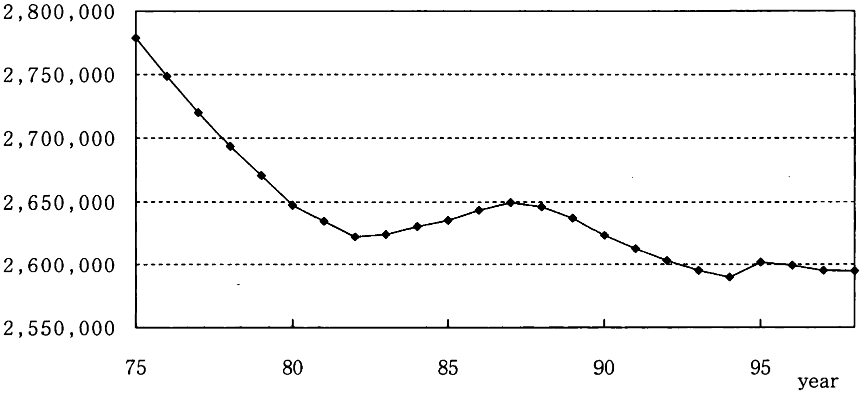
years (see figure 1.1). As previous studies have mentioned, the cause of decrease of population in the later part of the 1970s may be related to industrial recession especially in manufacturing. In fact, retail and wholesale, finance and insurance, real estate, and the service sectors, all expanded their activities in these two decades, taking over the role of business leader from the manufacturing industry (see table 1.1 and figure 1.2). Therefore, the change during past two decades might be just structural change in industries. The fact of stability in population in spite of recession in the 1990s may support this hypothesis. However, problems concerning commuting or residence may be hidden. As other works have already mentioned, Osaka has a huge attractive potential which may have covered serious problems.

* Aims of this study

In this study, I estimated migration rates by age group to reinvestigate the tendency of stability of population in Osaka, with the hope that they would reveal the reasons people select their habitat in Osaka.

* Summary of work

We can estimate migration rates by age group to compare estimated populations by age group, using the cohort method, with actual populations by age group.



Source: Osaka City, Department of Planning and Co-ordination (1999)

Figure 1.1 Estimated Population of Osaka City

Table 1.1 Industry Structure of Osaka City

	Number of workers		Percentage	
Classification	1980	1995	1980	1995
Agriculture	1,890	1,190	0.146 %	0.089 %
Foresty & Hunting	233	129	0.018 %	0.010 %
Fishery and Aquiculture	150	100	0.012 %	0.007 %
Mining	143	160	0.011 %	0.012 %
Construction	117,548	138,726	9.056 %	10.382 %
Manufacturing	371,323	291,865	28.606 %	21.843 %
Electricity,Gas,Water & Steam	6,257	5,711	0.482 %	0.427 %
Transport & Communication	85,043	90,153	6.552 %	6.747 %
Wholesale and Retail Trade	421,729	392,120	32.489 %	29.346 %
Finance and Insurance	35,547	35,166	2.738 %	2.632 %
Real Estate	18,799	28,243	1.448 %	2.114 %
Services	219,924	326,022	16.943 %	24.400 %
Government	17,465	17,848	1.345 %	1.336 %
Unclassifiable	2,003	8,743	0.154 %	0.654 %
Total	1,298,054	1,336,176	100.000 %	100.000 %

Source: Osaka City, Department of Planning and Co-ordination (1999) based on Population Census

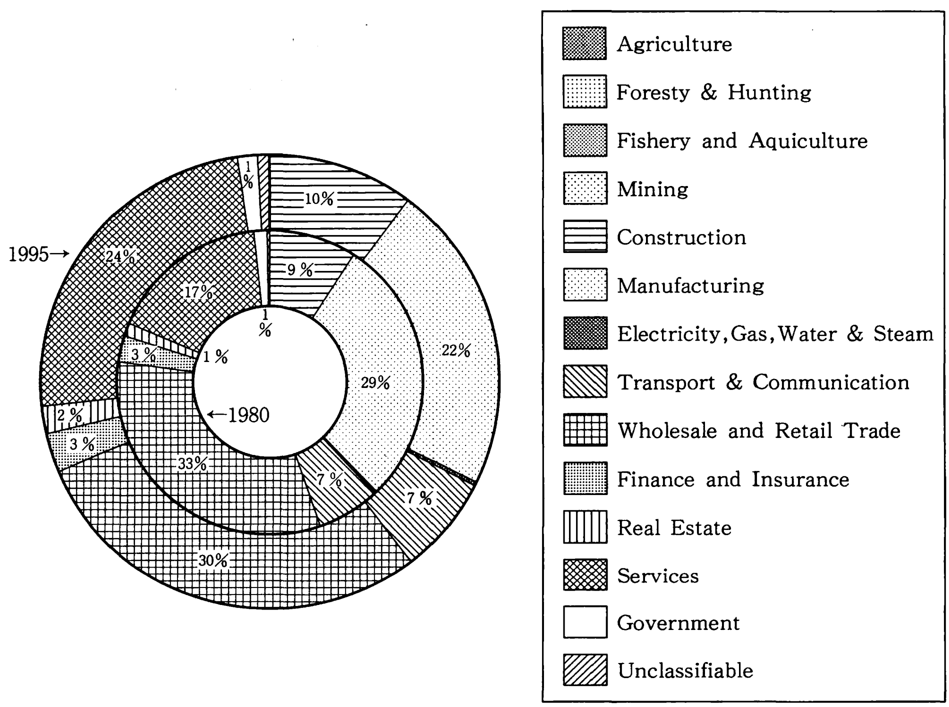


Figure 1.2 Industry Structure of Osaka City

Results showed dynamic migrations by age group and their possible reasons. The main reasons people live in Osaka are its expected role as a center of commuting (especially for young women) and the accessibility to the work place. Out-migrates were concentrated in the generation rearing children. This may be the effect of an expensive cost of living in an urban environment, which is not a very pleasant to live in with young children.

2. Method

2.1 The Cohort Method for estimating Social Population Dynamics

* Population Dynamics Equation

We can obtain current population estimates to calculate according to the following formula.

(1) Estimated population at the stated time = Population of the previous time + Net increasing population.

(2) Net increasing population = Natural change of the previous term + Migration change of the previous term.

(3) Natural change = Live births − Deaths.

(4) Migration change = Entries − Exits.

Births depend on the structure of women's (potential mothers') age, and deaths depend on the age structure of the population. The migration change also has a certain pattern by age. Therefore, we need the age structure of the population to estimate the future population exactly.

We can obtain populations by age based on a population census. We can also procure fertility rates by age group. Although we can see the migration total in the report on the internal migration, we cannot obtain migrations by age or age group.

But, the relation in the formula above shows that we can calculate the migration if we have data relating to a net increasing population and natural change.

(5) Migration change = Net increasing population − Natural change.

This relation can be held in each age group(cohort). Therefore, We can estimate migration by age group using the cohort method.

* Age Group and the Cohort Method for estimating Population

Now I will explain the cohort method procedure, in the case where we assume the closed system, to explain the method applied to the stages of this study more clearly.

1) Make groups which contain men or women born in the same term. We call these groups cohorts. For the generations who were already born, the cohort population can be calculated by the following equation:

(6) Population in the future ($k+i$ age group, $t+i$)
= Population at mark (k age group, t) * survival rate (k age group, cumulative probability in i term).

2) Calculate the median of the female population in estimating term by age 15–49 (productive age).

3) Obtain live births in the term, following:

(7) Live births = Σ (median of female population by age * fertility rate by age).

4) Divide the live births into male or female according to the male or female ratio in births.

5) Obtain the population of the 1st cohort (generation born in the term and survived till mark time). It is written as

(8) Population of 1st cohort = Live births * Survival rate till mark time.

6) Obtain total population to aggregate population of each cohort.

Necessary parameters are

1) The population at mark time by age and sex (actual data),
2) Survival rates by age and sex (supposed or estimated data),
3) Fertility rates by mother's age (supposed or estimated data),
4) Male (or female) ratio in births (supposed or estimated data).

Supposed or estimated data should be assumed or estimated by other data to predict the future population. But, to analyze the past facts, we can use the information based on the data listed above.

2.2 Concrete Problems in Estimation

It is relatively easy to decide the supposed parameters in our case, because our purpose is to analyze the present situation using past data.

* Male or female ratio of live births, and fertility rate by mother's age group

All parameters will be clear only after the women's reproductive life within a cohort is finished. That is, unknown parameters remain while women can have babies.

In this paper, as the subject is the past fact, we use the median of 1990 and 1995 for supposing the fertility rates by mother's age and the male rate of births.

* Survival rates during 5 years by age group and sex

We can obtain the mortalities by age group during 1990–1995 by seeing the life tables for 1995. I will select Table 2.1a and 2.1b to show and explain some data. We can integrate information regarding the number of mortalities with the stationary population. The stationary population is the population by age (or age group) if live births are stationary (100,000 per year) and the mortalities by age are fixed as listed in the table.

If all of the group is alive, the population of the 5–year age group should be 500,000. In Table 2.1a, you can see ${}_5L_{10}$ 496,815. That is, the sum of deaths till

Table 2.1a Life Tables of Osaka City 1995 (Male)

age	population	number of deaths	mean mortality	mortality	number of survivors	number of deaths	stationary population		life expectancy
x	$_nP_x$	$_nD_x$	$_nm_x$	$_nq_x$	l_x	$_nd_x$	$_nL_x$	T_x	e_x
0	–	35	–	0.00266	100,000	266	99,812	7,415,680	74.16
1	11,454	8	0.00070	0.00064	99,734	64	99,702	7,315,869	73.35
2-4	32,936	8	0.00024	0.00090	99,671	90	298,860	7,216,166	72.40
5-9	56,104	18	0.00032	0.00155	99,580	154	497,495	6,917,306	69.46
10-14	59,187	15	0.00025	0.00123	99,426	122	496,815	6,419,812	64.57
15-19	78,105	34	0.00044	0.00188	99,304	187	496,143	5,922,996	59.65
20-24	113,832	67	0.00059	0.00301	99,117	298	494,863	5,426,853	54.75
25-29	104,294	70	0.00067	0.00340	98,819	336	493,302	4,931,991	49.91
30-34	87,137	90	0.00103	0.00543	98,482	534	491,137	4,438,689	45.07
35-39	72,631	109	0.00150	0.00740	97,948	725	487,993	3,947,551	40.30
40-44	83,912	199	0.00237	0.01152	97,223	1,120	483,512	3,459,559	35.58
45-49	106,569	479	0.00450	0.02268	96,103	2,180	475,443	2,976,047	30.97
50-54	97,370	698	0.00717	0.03400	93,923	3,194	462,267	2,500,604	26.62
55-59	88,085	942	0.01070	0.05196	90,729	4,715	442,500	2,038,338	22.47
60-64	79,529	1,382	0.01738	0.08433	86,015	7,254	412,779	1,595,837	18.55
65-69	59,486	1,592	0.02675	0.12668	78,761	9,977	370,388	1,183,059	15.02
70-74	36,617	1,532	0.04182	0.19153	68,784	13,174	312,192	812,671	11.81
75-79	23,098	1,509	0.06535	0.28310	55,609	15,743	240,158	500,479	9.00
80-84	15,071	1,696	0.11250	0.43827	39,866	17,472	155,150	260,321	6.53
85-89	6,227	1,116	0.17929	0.60518	22,394	13,552	75,598	105,171	4.70
90-94	1,635	463	0.28327	0.76514	8,842	6,765	24,658	29,572	3.34
95≦	207	70	0.33850	1.00000	2,077	2,077	4,915	4,915	2.37
Total	1,213,487	12,133							

Table 2.1b Life Tables of Osaka City 1995 (Female)

age	population	number of deaths	mean mortality	mortality	number of survivors	number of deaths	stationary population		life expectancy
x	$_nP_x$	$_nD_x$	$_nm_x$	$_nq_x$	l_x	$_nd_x$	$_nL_x$	T_x	e_x
0	–	51	–	0.00415	100,000	415	99,636	8,122,093	81.22
1	11,004	5	0.00045	0.00042	99,585	42	99,564	8,022,458	80.56
2-4	31,380	9	0.00029	0.00093	99,542	93	298,481	7,922,894	79.59
5-9	53,671	12	0.00022	0.00108	99,450	107	496,952	7,624,413	76.67
10-14	56,710	12	0.00021	0.00104	99,343	103	496,454	7,127,461	71.75
15-19	74,175	18	0.00024	0.00094	99,240	94	496,008	6,631,007	66.82
20-24	112,849	33	0.00029	0.00150	99,146	149	495,356	6,134,999	61.88
25-29	103,594	30	0.00029	0.00154	98,997	152	494,645	5,639,643	56.97
30-34	84,410	43	0.00051	0.00261	98,845	258	493,617	5,144,997	52.05
35-39	68,772	59	0.00086	0.00427	98,587	421	492,011	4,651,381	47.18
40-44	78,507	101	0.00129	0.00640	98,166	628	489,352	4,159,370	42.37
45-49	100,618	194	0.00193	0.00972	97,537	948	485,479	3,670,018	37.63
50-54	96,099	289	0.00301	0.01469	96,590	1,419	479,572	3,184,540	32.97
55-59	90,668	376	0.00415	0.02095	95,171	1,993	471,256	2,704,968	28.42
60-64	84,174	605	0.00719	0.03534	93,177	3,293	458,015	2,233,712	23.97
65-69	68,941	756	0.01097	0.05380	89,885	4,836	438,308	1,775,697	19.76
70-74	54,548	1,018	0.01866	0.08999	85,048	7,654	407,460	1,337,389	15.73
75-79	39,241	1,403	0.03575	0.16540	77,395	12,801	357,181	929,930	12.02
80-84	28,253	1,825	0.06460	0.28321	64,593	18,293	279,066	572,748	8.87
85-89	13,920	1,544	0.11092	0.44247	46,300	20,486	180,004	293,682	6.34
90-94	4,401	874	0.19859	0.63132	25,813	16,296	85,347	113,678	4.40
95≦	730	206	0.28206	1.00000	9,517	9,517	28,331	28,331	2.98
Total	1,256,664	9,463							

between the ages of 10 to 14 should be 3,185. Since $_5L_5$ is 497,495, the deaths should be 2,505. The difference of 680 is the sum of deaths while people belonging to the 5–9 cohort grow up to the 10–14 cohort (expected number of deaths in these 5 years).

Conditional probabilities that anyone in the group i may survive until he grows up and transfers to the group $i+n$, i. e. cumulative survival probabilities by age group, are written as

$$(9) \quad \frac{{}_nL_{i+n}}{{}_nL_i} \quad .$$

Mortalities in newborn babies and infants are detailed as estimates in the actual procedure. To estimate the migration comparing the two years 1990 and 1995, the mortality of the 0–4 age group in the later part is recalculated.

In the case of the oldest age group, which does not have an upper limit, cumulative survival probability is written as

$$(10) \quad \frac{\sum_i^{\infty} {}_nL_{i+n}}{\sum_i^{\infty} {}_nL_i} \quad .$$

I chose the median of values at 1990 and 1995 in the 5 year survival rate as the supposed parameter. The reasons for this are

1) the number of deaths in youth is very small even in a large city like Osaka; therefore, the mortality rate may change depending on random fluctuations;

2) mortality rates may be changed as the reflection of structural changes caused by medical improvements, changes in labour or life environment, and other factors.

3. Results and Discussions

3.1 Estimated values of parameters

Table 3.1 shows fertility rates by mothers' age group and male ratio in births. The total fertility rate is 5 times the sum of fertility rates by mothers' age group because each group has a 5 year age width. The total fertility rate decreased 0.1

Table 3.1 Estimated fertility rate (1990, 1995)

age group	1990	1995	median
15∼19	0.005972	0.006000	0.005986
20∼24	0.043842	0.040219	0.042031
25∼29	0.116297	0.099749	0.108023
30∼34	0.086369	0.082138	0.084253
35∼39	0.023214	0.025869	0.024542
40∼44	0.003436	0.003520	0.003478
45∼49	0.000062	0.000118	0.000090
Σ	0.279193	0.257613	0.268403
fertility rate	1.395965	1.288066	1.342016
male ratio	0.516138	0.516717	0.516428

point in these 5 years. We see a sharp decreas in fertility rates for the 20s and younger half of 30s, and a moderated increase in other generations. The generation aged 20 to 34, whose fertility rate has decreased, overlaps with the so-called minor baby boomers. This may weaken the effect of the natural increase in population. The fertility rate in the future will depend on this generation for the considerable part.

Table 3.2 shows the estimated number of births by sex in this 5 year term. Fertility rates are based on the results shown in Table 3.1.

Table 3.2 Estimated number of birth by mothers' age group (1990, 1995)

age group	population '90	population '95	population median	fertility median	births in a year	births for 5 years
15∼19	97,172	75,652	86,412	0.005986	517	2,586
20∼24	114,253	117,075	115,664	0.042031	4,861	24,307
25∼29	101,090	109,471	105,280	0.108023	11,373	56,864
30∼34	80,341	90,727	85,534	0.084253	7,207	36,033
35∼39	84,520	73,809	79,165	0.024542	1,943	9,714
40∼44	107,885	81,566	94,725	0.003478	329	1,647
45∼49	101,004	105,630	103,317	0.000090	9	46
Σ	686,266	653,930	670,098	0.268403	26,240	131,198
male					13,551	67,754
female					12,689	63,444

Table 3.3a and 3.3b show estimated 5 year survival rates by age group. First, I recalculated 5 year survival rates by age group at 1990 and 1995 using the stationary population to make consistency in both the survival rate in the 0-4 cohort and in other cohorts. Consequently, we must aggregate the stationary populations. In these cases, we can find some errors caused by the calculation

Table 3.3a Survial Rate (Male:1990, 1995)

age at 1990 x	stationary population $_nL_x$	age at 1990 x	5 year survival rate $_5L_{i+5}/_5L_i$	age at 1995 x	stationary population $_nL_x$	age at 1995 x	5 year survival rate $_5L_{i+5}/_5L_i$	median of 5 year survival rate
neonatal	500,000	neonatal	0.992970	neonatal	500,000	neonatal	0.996748	0.994859
0–4	496,485	0–4	0.998499	0–4	498,374	0–4	0.998236	0.998368
5–9	495,740	5–9	0.999092	5–9	497,495	5–9	0.998634	0.998863
10–14	495,290	10–14	0.998758	10–14	496,815	10–14	0.998646	0.998702
15–19	494,675	15–19	0.994776	15–19	496,143	15–19	0.997420	0.996098
20–24	492,091	20–24	0.995850	20–24	494,863	20–24	0.996846	0.996348
25–29	490,049	25–29	0.997261	25–29	493,302	25–29	0.995611	0.996436
30–34	488,707	30–34	0.992316	30–34	491,137	30–34	0.993597	0.992957
35–39	484,952	35–39	0.991143	35–39	487,993	35–39	0.990817	0.990980
40–44	480,657	40–44	0.983248	40–44	483,512	40–44	0.983312	0.983280
45–49	472,605	45–49	0.971613	45–49	475,443	45–49	0.972287	0.971950
50–54	459,189	50–54	0.953483	50–54	462,267	50–54	0.957240	0.955362
55–59	437,829	55–59	0.931457	55–59	442,500	55–59	0.932833	0.932145
60–64	407,819	60–64	0.899355	60–64	412,779	60–64	0.897304	0.898329
65–69	366,774	65–69	0.877617	65–69	370,388	65–69	0.842878	0.860247
70–74	321,887	70–74	0.753041	70–74	312,192	70–74	0.769263	0.761152
75–79	242,394	75–79	0.645354	75–79	240,158	75–79	0.646035	0.645694
80–84	156,430	80–84	0.486409	80–84	155,150	80–84	0.487257	0.486833
85–89	76,089	85≦	0.282436	85–89	75,598	85≦	0.281186	0.281811
90≦	29,949			90–94	24,658			
				95≦	4,915			

Table 3.3b Survival Rate (Female:1990, 1995)

age at 1990 X	stationary population $_nL_x$	age at 1990 x	5 year survival rate $_5L_{i+5}/_5L_i$	age at 1995 x	stationary population $_nL_x$	age at 1995 x	5 year survival rate $_5L_{i+5}/_5L_i$	median of 5 year survival rate
neonatal	500,000	neonatal	0.994312	neonatal	500,000	neonatal	0.995361	0.994836
0–4	497,156	0–4	0.999043	0–4	497,680	0–4	0.998536	0.998789
5–9	496,680	5–9	0.999245	5–9	496,952	5–9	0.998999	0.999122
10–14	496,305	10–14	0.999597	10–14	496,454	10–14	0.999102	0.999350
15–19	496,105	15–19	0.998952	15–19	496,008	15–19	0.998685	0.998819
20–24	495,585	20–24	0.998699	20–24	495,356	20–24	0.998565	0.998632
25–29	494,940	25–29	0.998303	25–29	494,645	25–29	0.997920	0.998111
30–34	494,100	30–34	0.994515	30–34	493,617	30–34	0.996747	0.995631
35–39	491,390	35–39	0.996019	35–39	492,011	35–39	0.994595	0.995307
40–44	489,434	40–44	0.991866	40–44	489,352	40–44	0.992085	0.991976
45–49	485,453	45–49	0.986897	45–49	485,479	45–49	0.987833	0.987365
50–54	479,092	50–54	0.980565	50–54	479,572	50–54	0.982659	0.981612
55–59	469,781	55–59	0.974088	55–59	471,256	55–59	0.971904	0.972996
60–64	457,608	60–64	0.956336	60–64	458,015	60–64	0.956972	0.956654
65–69	437,627	65–69	0.924943	65–69	438,308	65–69	0.929620	0.927282
70–74	404,780	70–74	0.867721	70–74	407,460	70–74	0.876605	0.872163
75–79	351,236	75–79	0.766243	75–79	357,181	75–79	0.781301	0.773772
80–84	269,132	80–84	0.613026	80–84	279,066	80–84	0.645023	0.629025
85–89	164,985	85≦	0.334021	85–89	180,004	85≦	0.387078	0.360549
90≦	82,748			90–94	85,347			
				95≦	28,331			

process from stationary populations, but they are very minimal in importance. Supposed parameters are medians of these estimates.

Where survival rates are almost 1 in the young cohorts, I provide the mortality in logarithmic scale as Figure 3.1. We can see the following characteristics.

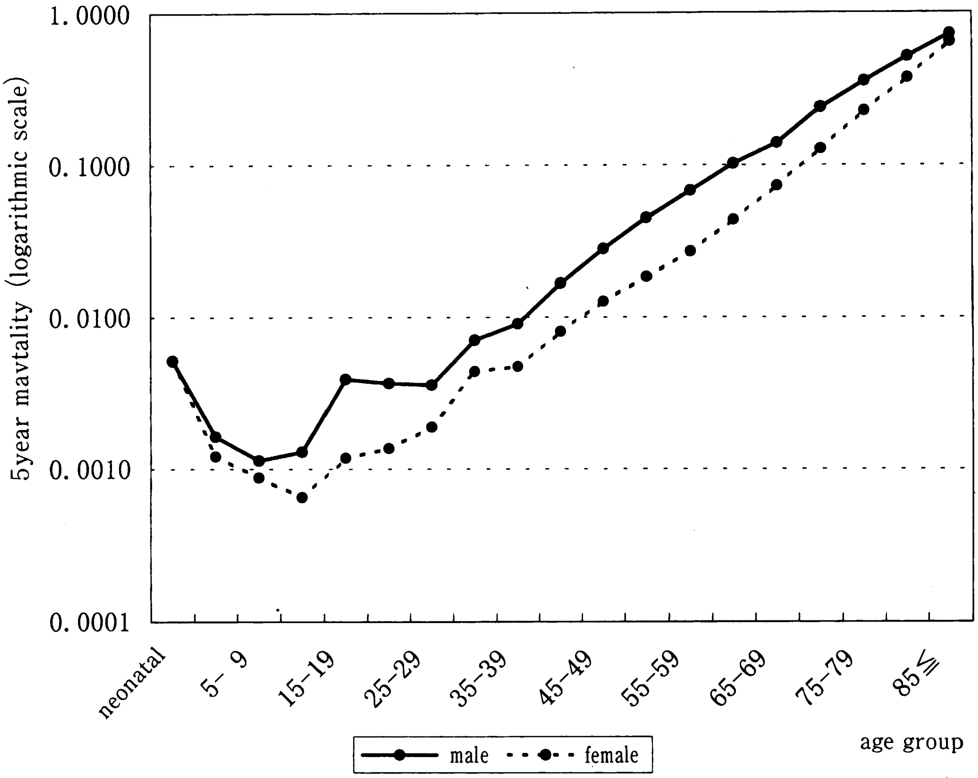


Figure 3.1 5 year mortality by age group sex (median 90–95)

1) Male mortalities are higher than female mortalities in any age group. (Biological characteristic)

2) Neonatal and infant mortality, and mortality in adolescence are two peaks of mortality in young generations. After maturity, mortality increases with aging. (Common characteristic with most countries)

3) The male mortality curve has a moderated swell in the middle age range. This characteristic is common in Japan and regarded as the effect of hard work at middle age and relatively few suicides in old age.

3.2 Estimation of Migration segmented by Age Group

All necessary values to estimate migrations by age group and sex were prepared. Estimated migrations by age group and sex were obtained as the difference between the real population by age group and sex and the estimated population by age group and sex according to the method shown in 2.1.

Table 3.4a and Table 3.4b show the processes and results.

Table 3.4a Migration by age group 1990–95 (male)

age group 1990 x	population 1990 $_nP_x$	5 year survival rate median	age group 1995 x	estimated population P'	real population $_nP_x$	net migration	rate of migration
neonatal	67,754	0.994859	0–4	67,406	58,954	-8,452	-0.12475
0–4	65,341	0.998368	5–9	65,235	58,858	-6,376	-0.09758
5–9	66,421	0.998863	10–14	66,346	62,633	-3,713	-0.05590
10–14	72,040	0.998702	15–19	71,947	79,584	7,638	0.10602
15–19	103,538	0.996098	20–24	103,134	118,484	15,350	0.14826
20–24	113,820	0.996348	25–29	113,404	109,739	-3,665	-0.03220
25–29	102,532	0.996436	30–34	102,166	93,053	-9,114	-0.08888
30–34	84,475	0.992957	35–39	83,880	76,887	-6,993	-0.08278
35–39	91,197	0.990980	40–44	90,375	86,563	-3,812	-0.04180
40–44	114,154	0.983280	45–49	112,246	111,900	-346	-0.00303
45–49	102,564	0.971950	50–54	99,687	100,111	423	0.00413
50–54	94,684	0.955362	55–59	90,458	90,814	356	0.00377
55–59	89,692	0.932145	60–64	83,606	82,240	-1,366	-0.01523
60–64	70,040	0.898329	65–69	62,919	61,780	-1,138	-0.01625
65–69	45,824	0.860247	70–74	39,420	38,420	-1,000	-0.02182
70–74	31,645	0.761152	75–79	24,086	24,160	74	0.00234
75–79	24,863	0.645694	80–84	16,054	15,637	-417	-0.01675
80–84	13,508	0.486833	85–89	6,576	6,494	-82	-0.00608
85≦	6,409	0.281811	90≦	1,806	1,899	93	0.01447
Total	1,292,747		Total	1,300,750	1,278,212	-14,085	-0.01090

Table 3.4b Migration by age group 1990–95 (female)

age group 1990 x	population 1990 $_nP_x$	5 year survival rate median	age group 1995 x	estimated population P'	real population $_nP_x$	net migration	rate of migration
neonatal	63,444	0.994836	0–4	63,116	56,244	-6,872	-0.10832
0–4	62,201	0.998789	5–9	62,125	56,131	-5,995	-0.09638
5–9	63,250	0.999122	10–14	63,194	59,855	-3,339	-0.05280
10–14	69,066	0.999350	15–19	69,021	75,652	6,631	0.09600
15–19	97,172	0.998819	20–24	97,057	117,075	20,018	0.20601
20–24	114,253	0.998632	25–29	114,097	109,471	-4,626	-0.04049
25–29	101,090	0.998111	30–34	100,899	90,727	-10,172	-0.10063
30–34	80,341	0.995631	35–39	79,990	73,809	-6,181	-0.07693
35–39	84,520	0.995307	40–44	84,124	81,566	-2,558	-0.03026
40–44	107,885	0.991976	45–49	107,019	105,630	-1,389	-0.01288
45–49	101,004	0.987365	50–54	99,728	98,903	-825	-0.00817
50–54	96,573	0.981612	55–59	94,797	93,624	-1,173	-0.01215
55–59	91,609	0.972996	60–64	89,135	87,245	-1,890	-0.02063
60–64	75,942	0.956654	65–69	72,650	71,381	-1,269	-0.01671
65–69	62,009	0.927282	70–74	57,500	56,669	-830	-0.01339
70–74	48,283	0.872163	75–79	42,110	41,004	-1,106	-0.02292
75–79	38,730	0.773772	80–84	29,968	29,281	-687	-0.01775
80–84	23,501	0.629025	85–89	14,782	14,528	-255	-0.01083
85≦	13,625	0.360549	90≦	4,912	5,414	502	0.03683
Total	1,331,054		Total	1,346,228	1,324,209	-15,146	-0.01138

The number of births during this period is put into neonatal at 1990, which is only used to estimate the population of the 0–4 cohort, and is not included in the total population figure for 1990.

The natural increase is estimated 23,177 (0.88% of total population). This result is effected by the characteristics of population in Osaka City, in which the population in the 20s is relatively larger than other regions, and relatively smaller in the 30s.

Migration rates were also calculated and are shown in Table 3.5 and Figure 3.2.

Table 3.5 Estimated rate of migration by age group and sex 1990–95

Age group 1995 x	Net migration male	Net migration female	difference (male–female)
0–4	−0.12475	−0.10832	−0.01642
5–9	−0.09758	−0.09638	−0.00120
10–14	−0.05590	−0.05280	−0.00310
15–19	0.10602	0.09600	0.01002
20–24	0.14826	0.20601	−0.05775
25–29	−0.03220	−0.04049	0.00829
30–34	−0.08888	−0.10063	0.01174
35–39	−0.08278	−0.07693	−0.00585
40–44	−0.04180	−0.03026	−0.01153
45–49	−0.00303	−0.01288	0.00985
50–54	0.00413	−0.00817	0.01230
55–59	0.00377	−0.01215	0.01591
60–64	−0.01523	−0.02063	0.00540
65–69	−0.01625	−0.01671	0.00046
70–74	−0.02182	−0.01339	−0.00843
75–79	0.00234	−0.02292	0.02526
80–84	−0.01675	−0.01775	0.00099
85–89	−0.00608	−0.01083	0.00475
90≦	0.01447	0.03683	−0.02236
Total	−0.01090	−0.01138	0.00048

The total migration rate is about − 1.1%, and the net out-migration rate is slightly more in female than male.

The most noted characteristics in the pattern by age are as follows;

1) Net out-migration rate is large in the generations that are younger than 15 and those aged from 25 to 39.

2) In the later half of the teens and younger half of the twenties age groups, a large net in-migration rate should be noticed. In these generations, since the number of the population itself is large, this shows that the number of net in-migration should be also large (see figure 3.3a). In the younger half of the

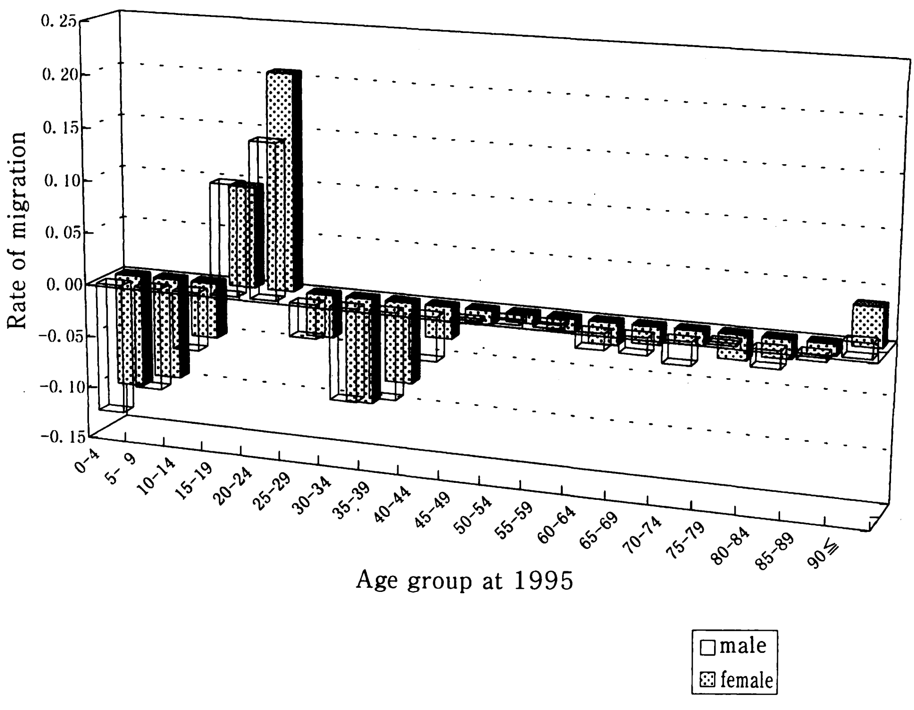


Figure 3.2 Estimated rate of migration by age group and sex 1990-95

twenties age group, the net in-migration rate in the female is larger than the male.

We can suppose two reasons as the causes of in-migration in youth: entering schools and obtaining jobs. However, the female student ratio in the higher education organization is not obviously higher than the male one. Therefore, we can suppose that the main factor influencing the large net in-migration rate for young female is obtaining jobs.

The noted characteristics for the middle ages are

1) a decrease in the net out-migration rate

2) the male net out-migration rates are smaller than the female. In the fifties age range, the male migration rate shows the existence of net in—migration.

The basic factor to stop the out-migration is the existence of workers who work in the head offices of companies or service industries in Osaka City, who do not have enough leisure time, and who can earn a high income. The age of these workers would be around these generations. The second characteristic, *i. e.* the

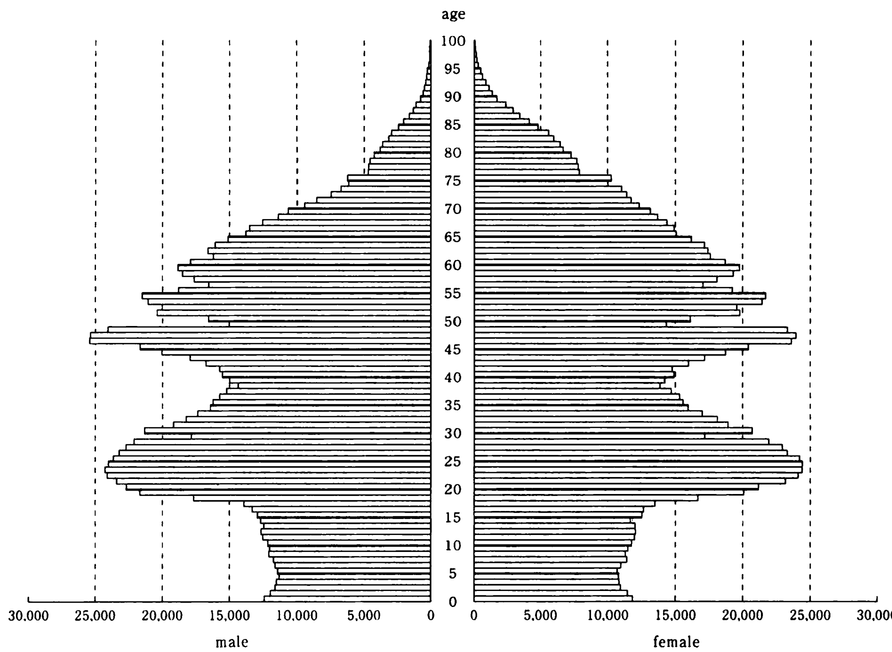


Figure 3.3a Population Pyramid of Osaka City (1 October 1995)

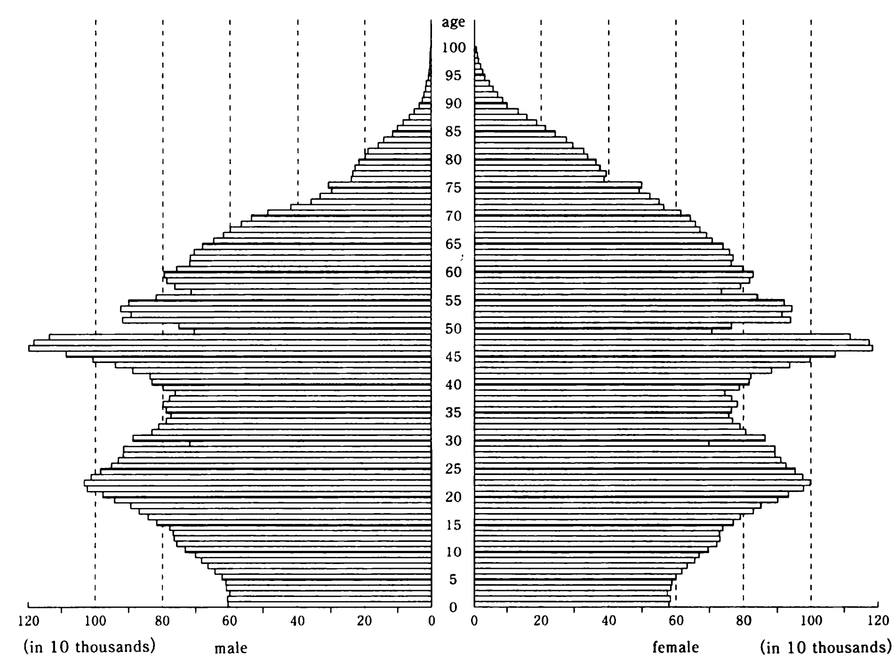


Figure 3.3b Population Pyramid of Japan (1 October 1995)

fact that male net out-migration rates are smaller than the female, support this hypothesis

In the old age groups, out-migration caused by retirement can be observed in the 60s and 70s age range.

4. Concluding Remarks

To conclude, we have observed the following characteristics in migration in Osaka City.

1) Noted facts are the in-migration in youth caused by obtaining jobs and the out-migration in childhood and the generation rearing children.

2) Although the potential natural increasing power may be weakened by these factors, a natural increase still remains. Therefore the main factor of decrease is the migration change, especially out-migration of the generation rearing children.

3) The main attractive force to encourage in−migration is the convenient residence for commuting to the work place.

In brief, this work has pointed out that dynamic migrations by age exist in spite of stability in the total population.

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