

of transition probabilities (Chapter 3), results of future projections (Chapter 4) and will conclude with an examination of the results and future directions (Chapter 5 and 6).

## 2. Overview of the INAHSIM Model

The development of the model can be divided into three phases: 1. Preparation of initial data set, including matching and imputation; 2. Actual simulation assuming the transition probabilities; 3. Statistics to be gathered in the simulation process.

The most crucial feature of the initial data set is its contents. The model discussed in this paper includes information on families such as the relationship between parents and children or husbands and wives, as well as that of households. The model also contains characteristics of each individual such as their health status, employment status and earnings.

The simulation covers various life events that are demographic phenomena such as birth (childbearing from the mother's point of view), death, marriage, divorce, and the accompanying changes in households at the time of marriage or divorce. They also include transition between employment statuses and accompanying changes in earnings, transition between health statuses, young people leaving home and people living together with their elderly parents. These events in a life course happen based on the results of each individual's decision-making<sup>3</sup>. In the model, they are given as transition probabilities.

The statistics can be compiled for all the characteristics of the people in the data set. However, the model in this paper focuses on the tabulation of population structure, demographic phenomena, number of household members, household structure, family structure of aged people, health status, employment status, earnings and the population of "parasite singles," which is the name for never married adults living off their parents in Japanese.

### 2.1 Initial Data

The most important aspect of the microsimulation model is how to create a miniature society that expresses all kinds of individual characteristics in a computer. Because the data set that expresses the miniature society defines everything that the model can

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<sup>3</sup> Death and transition between health statuses occur regardless of individual intentions.

simulate, there is a need to include as many characteristics and as much family and household information as possible. On the other hand, it is necessary to keep the data set as simple as possible, because if it becomes too complicated then it becomes extremely difficult to establish the simulation structure. Above all, it is important to ensure that the data set structure is efficient, because the information on families (husbands and wives, parents and children) and households needs to include information not only on the characteristics of individuals, but also on their spouses, children and people living together.

In Japan, the Family Register and the Basic Resident Register have been set up as systems of recording such information, and these two registers reveal everything about the family and household status. With respect to basic changes to families and households due to the occurrence of life events, these two registers are updated according to six types of notifications: birth registration, death registration, marriage registration, divorce registration, moving-in registration and moving-out registration. Because this system is very efficient and easy to express in a computer, this real-world system was used as a reference when creating the database for the INAHSIM model.

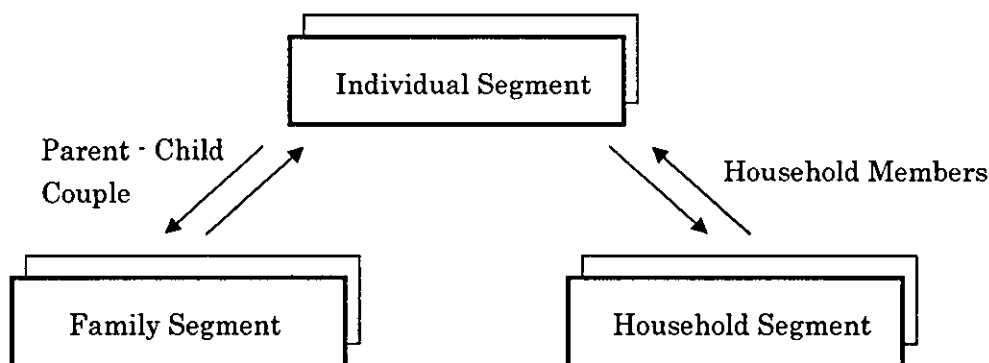
Therefore, the INAHSIM model creates a miniature model of the real world by creating three tables that correspond to individual registers as well as those that correspond to the Family Register and the Basic Resident Register, and by establishing links between these tables using pointers. These three tables are called the individual segment, family segment and household segment, respectively, in the INAHSIM model.

The individual segment includes individual characteristics such as year of birth, sex, marital status, health status, employment status and earnings, in addition to the family segment number that indicates the couple's status as parents, the family segment number that indicates the couple's status as husband and wife, and the household segment number that represents the household of which the individual has membership. The family segment includes characteristics concerning couples such as year of marriage, number of children ever born, the year when the marriage was dissolved, the cause why the marriage was dissolved (divorce or death of a spouse), as well as the individual segment number that corresponds to the husband, wife and their children. The household segment includes household characteristics such as the year when the household was formed, number of household members and household structure, as well as the individual segment number that represents the members in that household.

Figure 1 depicts the relationship between the segments. A family is represented by the linkage between the individual segment and the family segment, while a household is

represented by the linkage between the individual segment and the household segment. Given that families composed of parents and children or married couples do not necessarily live in the same household, there is no direct linkage between the family segment and the household segment.

Figure 1 Basic Structure of Data Set



The initial data set, that is a miniature society 1/1000 the size of Japan's society, was constructed from the sub-sample of the micro data of the 2001 Comprehensive Survey of the Living Conditions of People on Health and Welfare<sup>4</sup>. The survey is a large scale sample survey and its sample unit is a household. Most of the information in the initial data set can be obtained from the micro data without imputation or matching because the survey includes basic characteristics such as information on employment status, health status and earnings.

Since the survey is a sample survey, in the case where parents and children do not live together, those households will seldom be surveyed at once. As a result, it is impossible to gather sufficient information on parents and children who do not live together from the survey. Hence this model used probabilistic matching for parents and children who do not live together, taking into account the probability of the existence of parents or children and the age difference between parents and children.

One of the most distinguishing characteristics of this model is that it has all the information on parents and children who do not live together at the initial data stage. If this information is not included in the initial data, in cases where life events such as

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<sup>4</sup> The data used in the paper were made available to the author by the Statistics Bureau, Ministry of Internal Affairs and Communications of Japan, notice number No.31, dated 27 January 2004.

elderly parents who live separately from their children end up living together, it is impossible to identify the children that ought to live together, making it necessary to look for individuals that correspond to their children in the simulation structure. Whether the information on parents and children who do not live together is included in the initial data or whether it is determined in the simulation process is essentially the same thing, but the simulation structure can be simplified by including this information in the initial data and ensuring its completeness.<sup>5</sup>

As for earnings, the results of the survey are modified. This is because the survey examines the amount of earnings in the previous year and thus it is not consistent with other characteristics such as employment status. More specifically, the earnings are imputed using multiple regression models with sex, age group and employment status as the explanatory variables.

## 2.2 Simulation Cycle

In the microsimulation model, changes in individual characteristics are simulated after the occurrence of life events, such as marriage and getting employment, using the Monte Carlo method in the miniature society, which is created as described above. In this model, individual life events include demographic phenomena such as birth (giving birth from the standpoint of mothers), death, marriage and divorce, and accompanying changes in households (leaving home at the time of marriage, changes in the household at the time of divorce, among others), transition between employment statuses and changes in earnings, transition between health statuses, never married young people leaving home and people living together with their elderly parents.

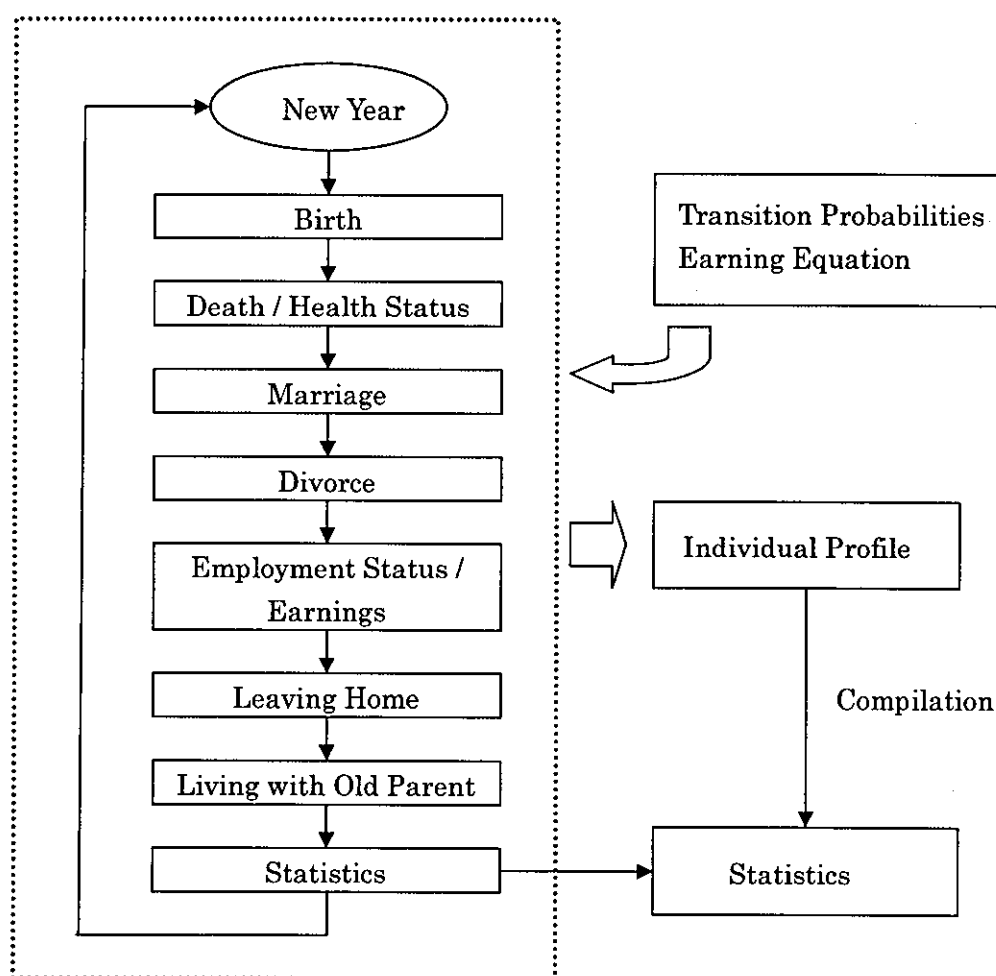
As depicted in Figure 2, these individual life events are assumed to occur in annual cycles in the simulation. Life events that have occurred in this model are birth, death, transition between health statuses, marriage, divorce, transition between employment statuses and changes in earnings, young people leaving home and people living together with their elderly parents; and they are expected to occur in this order. The order in which life events occur is an important point, because in the INAHSIM model simulation cycles are not continuously executed, but rather in discrete timeframes of one year. Since marriage and birth are generally expected to occur after a time lag of more than a year, marriage comes after birth to ensure that these events do not occur in the same year. Considering that changes in households, such as young people leaving

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<sup>5</sup> One of the problems with the prototype of this model, which was developed in the 1980s, was that it was impossible to sufficiently simulate changes in households due to the incompleteness of this aspect. The new INAHSIM, however, intends to resolve this problem through matching at the initial data stage.

home or people living together with their elderly parents, are often influenced by employment status and health status, the model is set so that these events follow demographic phenomena or transition between employment statuses. With respect to birth, this model only takes legitimate children into account because the percentage of illegitimate children<sup>6</sup> is very low in Japan. This model does not take into account international migration either because it is still low<sup>7</sup> in Japan.

Figure 2 Simulation Cycle



<sup>6</sup> The percentage of illegitimate children out of total births was low at 1.87% (2002), which is the reason why this model does not take into account such children. Therefore, birth only occurs between married couples.

<sup>7</sup> The percentage of foreigners in Japan was 1.12% as of October 1, 2002. This model does not take into account international migration because its level is low (the number of persons entering the country that exceed the number of persons leaving the country in 2002 was -115,000 for Japanese persons and +87,000 for foreigners). This must be taken into account when discussing the acceptance of foreigners in the future.

### 3.3 Compiling Statistics

The last step is to observe changes in the miniature society. This can be divided into dynamic statistics, which are compiled after the life events occurred; static statistics, which are compiled after the simulation for each year is performed; and panel statistics, which save individual life histories as individual profiles and are compiled after the simulation has been performed. In the same way that various statistical surveys are conducted in the real world, these statistics can be freely generated as separate from the simulation process.

As for the main statistics that are compiled for this model, time-series statistics include: population by age group, number of parasite singles, number of households by number of household members, number of households by household structure, number of aged persons by family type, number of aged persons by health status, distribution of earnings, number of occurrences of life events such as demography and total fertility rate. Statistics by cohort that are compiled include: percentage of persons who remain never married throughout their lifetime, average age of first marriage and average number of children.

## 3. Transition Probabilities of Life Events

### 3.1 Fertility

Various studies have been conducted on the reasons why the birth rate is declining. Given that the number of illegitimate children is very low in Japan, analyses are often conducted according to the proportion of married women and the marital fertility rate. Looking at changes in these two factors with respect to the declining birth rate in recent years, the impact of the decline of the marital fertility rate is low and most of the decline can be explained by the proportion of married women.

Therefore, this model assumes that only married women give birth and that “birth” occurs based on the marital fertility rate by parity and mother’s age. Given that the changes in marital fertility rate are relatively stable, unlike the total fertility rate, the model assumed that the level of marital fertility rate for 2001 will remain into the future. Fluctuations in the birth rate in this model, therefore, can be attributed solely to the proportion of married women.

In calculating the marital fertility rate, the numerator is the number of births by parity and mother’s age obtained from Vital Statistics of Japan 2001, while the denominator

is the population of married women by age estimated from the 2001 Comprehensive Survey of the Living Conditions of People on Health and Welfare. The sex ratio of boys to girls at birth is 105.5.

### 3.2 Mortality and Health Status

Mortality rates are specified by sex and age. The future life tables, which serve as the basis of the mortality rate, are taken directly from *Population Projections for Japan: 2001-2050, January 2002* (National Institute of Population and Social Security Research 2002).

The health status is classified as good or bad. The probability of a change for the worse by sex and age is assumed for the simulation.

### 3.3 Marriage

As for marriage, it has been said that people are getting married later or that they are not getting married at all. In fact, a look at changes in the percentage of never married persons by age group reveals that it is rising every year, and the average age at first marriage is also rising. A major factor behind this is believed to be the changes in marriage patterns among people of marriageable age, or never married women between the ages of 20-29 and never married men between the ages of 25-34.

Table 1 examines the changes in the first marriage rate among never married persons by sex and age group. The declining trend is evident for each age group, but the drop in the first marriage rate among men and women of marriageable age mentioned above is notable. Looking at the rate of decline from 1990 to 2000, the first marriage rate has fallen by 20-30 percent for these age groups. In contrast, the degree of change has become relatively smaller in other age groups.

**Table 1 First-Marriage Rate for Never Married Persons by Sex and Age Group**

(Groom)		(per thousand)			
Age Group	1970	1980	1990	2000	
20 - 24	46.04	38.04	28.86	29.33	
25 - 29	213.81	129.91	104.57	82.53	
30 - 34	204.51	122.23	101.12	70.98	
35 - 39	73.56	48.17	43.18	42.68	
40 - 44	30.69	16.90	17.38	18.70	
(Bride)					
Age Group	1970	1980	1990	2000	
20 - 24	138.43	109.05	63.28	48.47	
25 - 29	250.22	221.60	168.66	118.60	
30 - 34	86.10	84.70	90.91	80.65	
35 - 39	39.14	33.25	33.67	37.69	
40 - 44	21.23	14.84	12.47	13.08	

(Source) Jinko Toukei Shiryoshu, 2004 (National Institute of Population and Social Security Research)

Therefore, the marriage rate is based on sex, age and whether it is a first marriage or remarriage. It was assumed that the declining trend in the first marriage rate would continue for the specific age groups described above, and that the degree of change in marriage rate for other age groups would be stable into the future.

Although it is not easy to predict the extent to which the decline in the first marriage rate will continue, this model assumed that the first marriage rate for these specific age groups will fall 15% further in the next 10 years. Consequently, the percentage of women born in 1985 who remain never married throughout their lifetime<sup>8</sup> is almost equivalent to the assumption of the population projections made by the National Institute of Population and Social Security Research (2002).

This model simulates the occurrence of marriage using the marriage rate by sex, but the numbers of brides and grooms are not always the same. It is necessary to adjust the numbers of brides and grooms to be equal. The process of the adjustment is as follows: First, select the candidates of brides and grooms using twice the marriage rates by the Monte Carlo method. Then, calculate the average of the numbers of the candidates. One-half of the average number will be the number of couple formation. Next, take a sampling of the candidates for brides and grooms. Finally, form couples between the brides and the grooms sampled.

Furthermore, it is a known fact that men's employment status affects marriage patterns.

<sup>8</sup> The percentage of women born in 1985 who will remain never married throughout their lifetime will be 17.2% in case of the medium variant, while the assumption (medium variant) of the population projections is 16.8%.



Table 2 illustrates the percentage of never married men by employment status and age group. Among the age group of 30-34, 37.5% of full-time employees, 51.0% of part-time workers and 81.2% of the unemployed are never married. There is, therefore, a great disparity in the percentage of never married men depending on employment status. The employment status at the time of marriage cannot be determined by this data alone, because the employment status changes for some people after they get married due to unemployment and other reasons. It is expected, however, that there is a significant disparity in the marriage rate depending on the employment status. If the disparity is estimated by assuming that the employment status will not change from what it was at the time of marriage, the probability of first marriage by age for part-time workers can be considered half the figure for full-time employees and the probability of first marriage is almost zero for unemployed persons.

**Table 2 Percentage of Never Married Males by Employment Status and Age Group**

Age Group	(%)				
	Total	Full-Time	Part-Time	Self Employed	Unemployed
20 - 24	92.9	89.3	91.0	81.4	99.0
25 - 29	68.5	65.9	70.7	45.1	92.4
30 - 34	40.9	37.5	51.0	24.8	81.2
35 - 39	24.9	20.9	40.6	18.4	67.9
40 - 44	17.5	14.0	32.9	12.4	61.9
45 - 49	13.4	9.8	26.3	10.7	54.6

(Source) Comprehensive Survey of the Living Conditions of People on Health and Welfare, 2001 (Ministry of Health, Labour and Welfare)

In view of the above, the marriage rate is specified by sex, age and whether it is a first marriage or remarriage, and the first marriage rate was assumed to fall by 15% for specific age groups (men ages 25-34, women ages 20-29) in the next 10 years. In addition, it is assumed that there would be disparities in the first marriage rate for men depending on their employment status. It is also assumed that the probability of first marriage for part-time workers is set at one-half the probability for full-time employees, and unemployed people will not marry.

In calculating the marriage rate, the numerator is the number of marriages by sex, age and whether it is a first marriage or remarriage obtained from Vital Statistics of Japan 2001, while the denominator is the population specified by sex, age, marital status and employment status estimated from the 2001 Comprehensive Survey of the Living Conditions of People on Health and Welfare.

### 3.4 Changes in Households at the Time of Marriage

Marriage is a major reason why people leave the parental home. Since children leaving

the parental home will significantly affect the future household composition of aged persons, whether couples decide to live with the husband's parents or wife's parents or set up independent households at the time of marriage, it is a critical factor in looking at the future population and household structure. As a result of the growing spread of nuclear families during the period of high economic growth in the 1960s-1970s, there are fewer married couples that live with their parents<sup>9</sup>, but quite a lot of newly married couples do remain to choose so today.

Table 3 shows the proportion of married couples that live with their parents by sex, marital status and age group. Looking at figures for people in their late 20s, which has the highest number of first marriages, the proportion of never married men who live with their parents is 73.3%, while the proportion of married men who do so is 14.3%. As for women, the percentages are 79.9% and 4.0%, respectively. Therefore, it can be estimated that the probability of couples living with the husband's parents is 20% ( $=14.3\% \div 73.3\%$ ) and the probability of couples living with the wife's parents is 5% ( $=4.0\% \div 79.9\%$ ). From the probability of couples living together with their parents, it is assumed that these patterns will continue into the future.

If parents are already living with other married children and their spouses (for instance, a second son getting married after the eldest son, and the eldest son and his spouse are already living with parents) or children are not living with their parents before they get married, it is assumed that these children will not live with their parents.

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<sup>9</sup> Traditionally, a married first son used to live with his parents to take care of them in Japan.

**Table 3 Percentage of Those Living with Parents by Sex, Marital Status and Age Group**

(Male)		(%)					
Age Group	Married		Never Married		Divorced, Widowed		
	Living with Parent	Not Living with Parent	Living with Parent	Not Living with Parent	Living with Parent	Not Living with Parent	
20 - 24	24.1	75.9	74.0	26.0	72.1	27.9	
25 - 29	14.3	85.7	73.3	26.7	49.4	50.6	
30 - 34	15.1	84.9	69.8	30.2	52.0	48.0	
35 - 39	18.6	81.4	66.8	33.2	45.3	54.7	
40 - 44	23.8	76.2	68.1	31.9	44.5	55.5	
45 - 49	24.1	75.9	57.2	42.8	36.2	63.8	

(Female)		(%)					
Age Group	Married		Never Married		Divorced, Widowed		
	Living with Parent	Not Living with Parent	Living with Parent	Not Living with Parent	Living with Parent	Not Living with Parent	
20 - 24	6.7	93.3	80.2	19.8	59.7	40.3	
25 - 29	4.0	96.0	79.9	20.1	39.3	60.7	
30 - 34	2.7	97.3	76.5	23.5	36.9	63.1	
35 - 39	3.7	96.3	69.0	31.0	30.7	69.3	
40 - 44	4.5	95.5	65.9	34.1	26.9	73.1	
45 - 49	4.2	95.8	58.5	41.5	20.3	79.7	

(Source) Comprehensive Survey of the Living Conditions of People on Health and Welfare, 2001 (Ministry of Health, Labour and Welfare)

### 3.5 Divorce

The number of divorces was at 168,969 couples in 1991. This figure continued to rise sharply, reaching 285,911 couples in 2001, but has remained roughly flat for three years, with the number of divorces at 289,836 couples in 2002 and 283,906 couples in 2003. One of the social problems during this period was the increase in the number of divorces among middle-aged couples, who had lived together for over 20 years. Given that the number of these cases has leveled off, it appears that the growth in the number of divorces has come to a halt.

In this model, it was assumed that divorce occurs in accordance with the divorce rate by wife's age, and the divorce rate would remain around the level attained in 2001. In calculating the divorce rate, the numerator is the number of divorces by wife's age, obtained from Vital Statistics of Japan 2001; and the denominator is the number of married couples by wife's age estimated from the 2001 Comprehensive Survey of the Living Conditions of People on Health and Welfare.

### 3.6 Changes in Households at the Time of Divorce

One of the major issues when a divorce is granted is whether the husband or wife gains custody of the children and how changes in households occur. For example, if the wife

gains custody of the children after a divorce is granted in a nuclear family household consisting of a married couple and children, the wife will have to decide whether to become a single-mother household or return to her parents' household. The husband will also have to choose whether to live alone or return to his parents' household.

To begin with, the ratio is fairly stable at 20% of husbands and 80% of wives gaining custody, and it is assumed that this ratio will be maintained into the future. In cases where there are two or more children, it is assumed that either the husband or wife will obtain custody for all the children.

Next, regarding changes in households at the time of divorce, a probability is assigned to the likelihood that either the husband or wife will return to his or her parents' household. Table 3 shows the ratio of men and women living with their parents by marital status. This ratio is higher for men and women who are divorced or widowed than it is for married men and women. This ratio illustrates that a certain proportion of men and women return to their parents' household at the time of divorce.

The proportion of married men aged 30-34<sup>10</sup> who are living with their parents is 15.1% and 2.7% for women. The proportion of divorced or widowed men is 52.0% and 36.9% for women. If it is considered that men and women that live with their parents will continue to do so, the probability that they will return to their parents can be estimated using the equation below. This probability will be around 43% for men and 35% for women.

$$\text{Men: } 43\% = \frac{52.0\% - 15.1\%}{100.0\% - 15.1\%}$$

$$\text{Women: } 35\% = \frac{36.9\% - 2.7\%}{100.0\% - 2.7\%}$$

In addition, this probability is assumed to be the same for all age groups and it is assumed that such behavior will continue into the future.

### 3.7 Employment Patterns and Estimate of Earnings

In recent years, a growing number of people, after graduating high school or college, do not go on to higher education or find employment, but instead work part-time or stay unemployed. The 2003 White Paper on National Life (Cabinet Office ed., 2003)

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<sup>10</sup> This age group has the highest number of divorces.

focuses on new graduates who are part-time workers and analyzes the factors behind the increase. On the corporate side, factors include the decreasing number of job offers to new graduates and the growing number of part-time workers employed in order to cut down personnel costs. Meanwhile, on the students' side, factors include the impact of declining qualifications, changes in perceptions about work, problems with career guidance in high schools and problems with university education. Another reason that has been pointed out is the vicious cycle with declining labor demand and changes in perception among young people.

Regarding changes in perception about work, it appears that one of the underlying factors is the decline in a sense of independence resulting from the continuation of a dependent lifestyle, where young people, if they live with and are economically supported by their parents, can live without having a steady job and have plenty to live on with a part-time job. A growing number of young people are content with their so-called "parasite single" condition, which leads to the important issue of independence among young people.

Table 4 examines the changes in the proportion of new graduates who are either full-time employees or so-called freeters<sup>11</sup>. The proportion of recent college graduates who are freeters was 7.4% in 1990. This figure surged to 31.3% in 2002, an increase of more than 20 points in the past decade. Meanwhile, the proportion of recent high school graduates who are freeters rose from 13.1% to 38.4%, or about 25 points. From these statistics, it appears that employment patterns are greatly changing for both recent college and high school graduates.

**Table 4 Percentage of Full-Time Employees and Freeters (New Graduates)**

Year	Full-Time Employees		Freeters	
	High School	College	High School	College
1980	41.6	75.3	12.9	11.3
1985	39.8	77.2	10.8	10.4
1990	34.4	81.0	13.1	7.4
1995	24.9	67.1	22.1	18.9
2000	18.2	55.8	35.4	32.3
2001	18.1	57.3	35.1	30.6
2002	16.8	56.9	38.4	31.3

(Source) White Paper on National Life, 2003 (Cabinet Office)

<sup>11</sup> "Freeters" in Japanese means young freelance part-time workers. It also includes unemployment.

In this model, the transition probability between employment statuses with respect to employment patterns is specified by sex and age. Since employment patterns are completely different for women with spouses and women without spouses, women are divided into four categories: women with spouses, women without spouses, women who are newly married (women without spouses becoming women with spouses) and women who are newly divorced or widowed (women with spouses becoming women without spouses), and transition probabilities are assumed for these four categories. These transition probabilities are estimated by assuming that the composition of employment status by sex, age and existence of spouses according to the 2001 Comprehensive Survey of the Living Conditions of People on Health and Welfare is locally stable. Therefore, if these transition probabilities are fixed in the long run, it means that the composition of employment status will stay constant.

Given that significant changes have occurred in the employment patterns among new graduates, three scenarios were assumed regarding the changes of employment patterns among young people in the next 10 years, and the impact of each scenario on the future birth rate and population structure was evaluated. To be specific, the three scenarios were defined as follows: (1) employment patterns will not change in the future (medium variant), (2) the number of new graduates who are freeters will rise even more in the future and the proportion of full-time employees at age 25 will drop 20 points from the current figure (low variant) and (3) employment patterns will return close to its pre-1990 state and the proportion of full-time employees at age 25 will rise 20 points from the current figure (high variant).

Earnings are estimated using the multiple regression models with sex, age group and employment status as the explanatory variables. The model is the same as the model used for the imputation of earnings in the initial data.

### 3.8 Never Married Young People Leaving Home

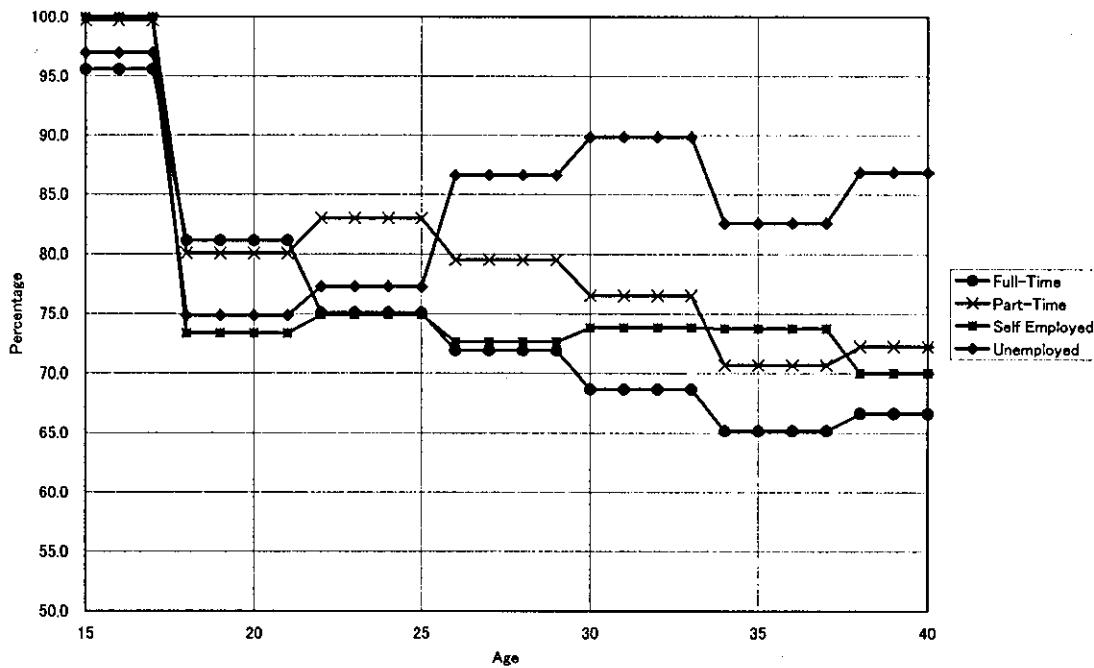
The main reasons why never married young people leave home, other than for marriage, include: going on to higher education, finding a job and changing jobs. In recent years, however, the timing at which never married young people leave home has been delayed due to the growing number of “parasite singles” and other reasons. Figure 3 illustrates the proportion of never married men who live with their parents by employment status and age group. The tendency is that the higher the age, the lower the proportion of never married men who live with their parents, and this proportion is lowest for full-time employees and highest for unemployed people. The proportion of never married, unemployed men living with their parents increases at age 25, because although they left home to go on to higher education, they return and resume living

with their parents due to economic difficulties, among other problems. A similar trend is evident for never married women.

Why this trend occurs is because the feasibility of independent life largely depends on the economic situation. This model, therefore, assigns a probability for never married young people leaving home by sex, age and employment status (16 categories, including all cases where the transitions between four employment statuses occur). Likewise with transition probabilities for employment status, the proportion of never married young people living with parents by sex, age and employment status is assumed to be locally stable when estimating the transition probabilities of those leaving home.

It is assumed that the probability of never married young people leaving home will stay constant into the future, but because it is controlled by employment status, the difference in scenarios for employment patterns will also be reflected in young people leaving home.

**Figure 3 Percentage of Never Married Males Living with Parents by Employment Status and Age Group**



### 3.9 People Living Together with Their Elderly Parents

In Japan, the spread of nuclear families increased beginning with the period of high

economic growth. In many cases, however, parents end up living with their children as they get older and become widowers or their health condition worsens, among other reasons. Children living together with their elderly parents used to be the most common method of families providing life security for aged persons. It remains a vital life security function even today, as social security for aged persons has becoming more enhanced.

This model defines the probability of people living together with their elderly parents, taking into account only sex and age. Furthermore, it is assumed that only single aged persons will live with their children since in many cases, aged persons end up living with their children when their spouses pass away.

As is the case with other transition probabilities, the probability that people will live together with their old parents is estimated assuming that the proportion of aged persons living with their children by sex and age is locally stable. It is assumed that the probability that people living together with their elderly parents will stay constant into the future.

#### 4. Results of Future Projections

To obtain long-term projections using the microsimulation model, 100 simulations were performed using a sample 1/1000 the size of the population (approximately 126,000 cases) for the years 2001-2100 and the average value was calculated for these simulations. As explained before, three scenarios of employment patterns for young people are assumed: (1) employment patterns will not change in the future (medium variant), (2) the proportion of full-time employees at age 25 will drop 20 points from the current figure (low variant) and (3) the proportion of full-time employees at age 25 will rise 20 points from the current figure (high variant).

The following section will give an overview of Japan's future population structure and examine the differences in the three scenarios, with a particular emphasis on the results of the medium variant.

##### 4.1 Total Fertility Rate

The decreasing proportion of new graduates who are full-time employees will lead to a growing number of freeters, which in turn will result in falling income levels among young men. Since many women consider income levels of potential husbands as a selection criterion for marriage, the growing number of freeters will contribute to a



decline in the number of marriages. In Japan, where marriage is a prerequisite to giving birth, the decline in the number of marriages will be directly reflected in the falling birth rate.

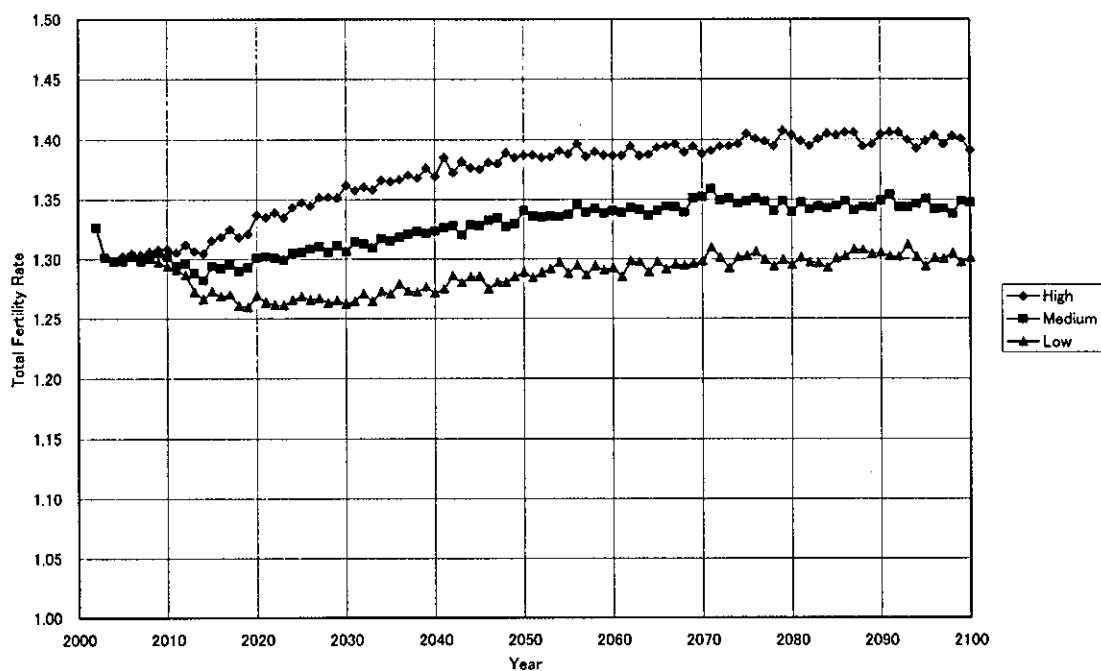
Table 5 shows the percentage of women who remain never married throughout their lifetime by the year of birth. With the growing incidence of people getting married later or not getting married at all, the trend is that the younger the generation, the higher the percentage of persons who remain never married throughout their lives. The increasing percentage of persons who remain never married throughout their lives will have a major impact on the declining birth rate. As the above has described, the decreasing proportion of new graduates who are full-time employees will lead to a reduction in the number of marriages, which will in turn result in an increase in the percentage of persons who remain never married throughout their lives. In fact, for women born in the years 1985-1994, the percentage of persons who will remain never married throughout their lives is projected to be 17.1% in the medium variant, while 18.3%, or 1.2 points higher, in the low variant.

**Table 5 Percentage of Never Married Females in a Lifetime by Birth Year**

	(%)			
	1955 - 64	1965 - 74	1975 - 84	1985 - 94
Medium Variant	8.6	14.1	16.4	17.1
Low Variant	8.6	14.2	17.0	18.3
High Variant	8.6	14.0	15.8	15.7

Figure 4 compares trends in the total fertility rate for the three different scenarios. In the medium and low variants, the birth rate will continue to drop until around the year 2020, but recover thereafter, finally reaching 1.35 in the medium variant, 1.30 in the low variant and 1.40 in the high variant. The reason why the birth rate will continue to decline for the foreseeable future is because the model assumes that the marriage rate will keep falling for the next decade. After the marriage rate stops falling, the number of births will catch up and the birth rate will rise. However, the reversal will be weak and the birth rate will only recover to about 1.35 in the medium variant.

Figure 4 Trends in Total Fertility Rate



Because conditions other than employment patterns for young people, such as perceptions about marriage and giving birth, are same among these three scenarios, this difference can be interpreted as the impact on the birth rate caused by the increase in young freeters. The following section will consider how this impact will affect the future population structure.

#### 4.2 Population by Three Major Age Groups

Figure 5 illustrates the trends in the number of cases of demographic phenomena (birth, death, marriage, divorce). As the population ages, mortality will grow and it is expected that about 1.7 million people will die annually in the 2030s. Given that mortality will exceed the number of births in 2005, Japan's population will start to decline beginning in the year 2005. Meanwhile, the number of births, marriages and divorces is expected to decline in years to come as a result of the declining population.

Figure 5 Trends in Vital Events (Birth, Death, Marriage and Divorce)

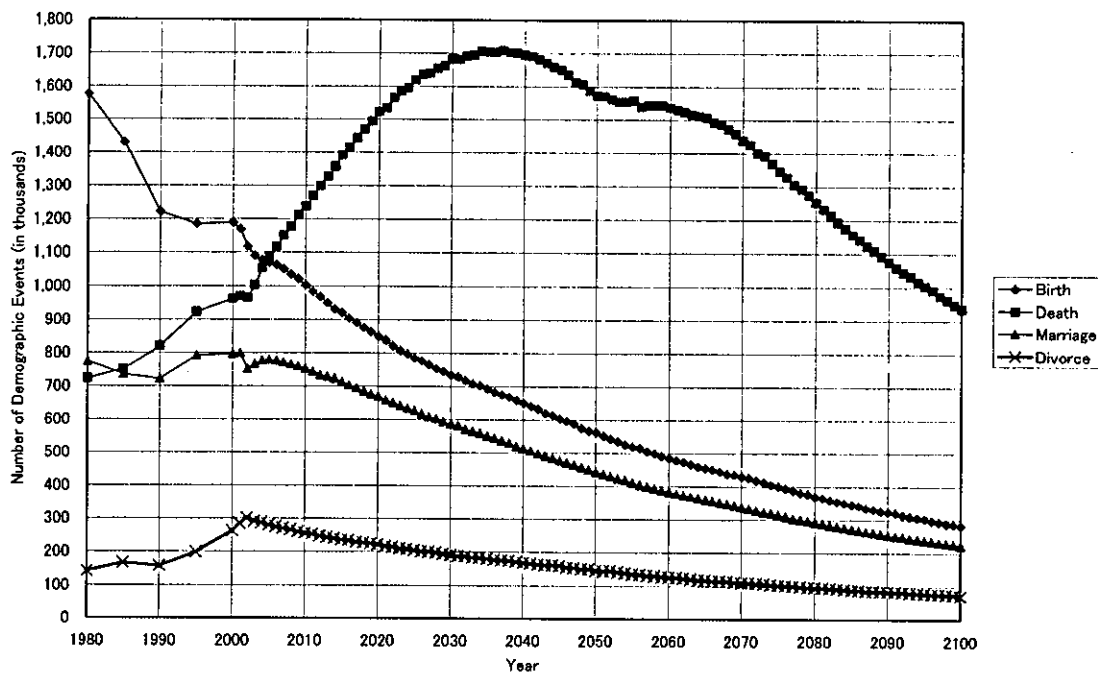
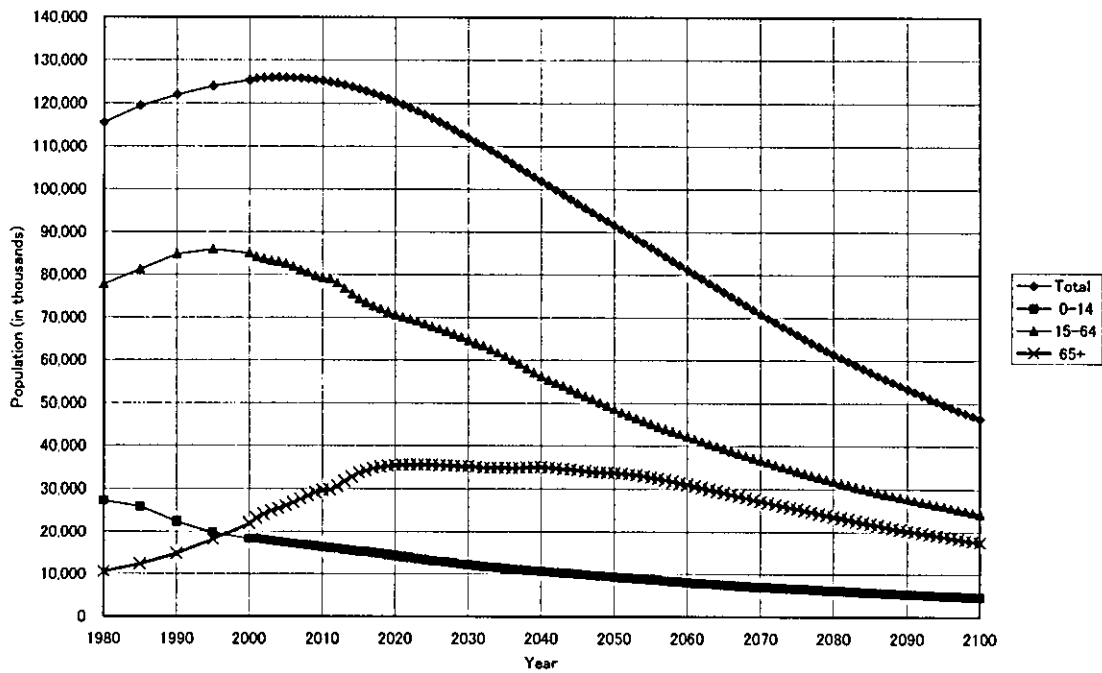


Figure 6 shows the trends in population by three major age groups. Japan's population will reach its peak in 2004 and subsequently become a society with a falling population. Looking at changes in the future population by three major age groups, the child population (ages 0-14) and productive age population (ages 15-64) will decline, but the aged population (ages 65 and over) will continue to grow, even though the overall population is shrinking, until around the year 2020. Consequently, the percentage of the aged population will continue to rise. This percentage, which was 17.5% in the year 2000, is expected to increase to 30.5% in 2025, 36.8% in 2050, 38.3% in 2075 and 37.9% in 2100.

Since the results of projections show that the difference in the total fertility rate is small for the low and high variants ( $\pm 0.05$ ) than the medium variant, there are no big differences in the population size. Even in the year 2050, the difference in the population size is around  $\pm 1$  million and the percentage of the aged population remains around  $\pm 0.4$  points.

Figure 6 Trends in Population by Three Major Age Groups



### 4.3 Number of Parasite Singles

Parasite singles refer to young never married persons (singles) who live off their parents for a long time and do not become independent. If people are in their early 20s, it is not uncommon for them to be never married and are thus not considered parasites, but if they are in their 30s, live off their parents and do not try to get married, then they are regarded as parasite singles. However, the definition of parasite singles is not necessarily clear and many of the statistics are also ambiguous.

This paper, therefore, defines parasite singles as never married persons who live with their parents and are either part-time workers or unemployed. Never married, full-time employees living with their parents also constitute so-called parasite singles, but this paper limits the definition to people with low income who would not have the means to live unless they lived with their parents. Consequently, as long as the parents have enough income, these parasite singles will have enough to live on, but once the parents become pensioners or their health status worsens, then their standard of living may drop substantially. Parasite singles, as defined in this paper, are in a rather economically unstable situation from the future perspective as well.

Figure 7 compares the proportion of parasite singles aged 30 to 34 in each of the three