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Demographic Investigation of the Declining Fertility Process in Japan

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1. Overview of Japanese Fertility Trends in Post-war Period

It is possible to distinguish three stages of the post-war fertility trend in Japan. The first stage of the fertility trend appeared just after the post-war baby boom from 1947 to 1949. During the three years of the baby boom, which was uniquely short, the number of births reached about 2.7 million annually, and the total fertility rate (TFR[1]) was around 4.4. After the baby boom, the period total fertility rate marked a significant decline in both the number of births and total fertility rate, which reached 2.04 in 1957 (see Figure 1). It means that the modern fertility transition from high to low was completed by the late 1950s as the first stage of the fertility trend in Japan.

After the quick transition, TFR stayed around the replacement level of fertility until the mid-1970s, while the number of births gradually increased, corresponding to an increase in population among the reproductive ages. During this second stage of the fertility trend, the only exception was appeared in 1966. In this year, the total fertility suddenly declined to 1.58, the lowest ever recorded in Japanese vital statistics history, due to the year of Hinoe-uma (fiery horse).[2] However, in general, Japanese fertility stays at the population replacement level though the second stage of the fertility trend and it can be regarded as the period of post-demographic transition with relatively stable fertility around the replacement level.

In the early 1970s, another baby boom was experienced which was an echo of the post-war baby boom. TFR recorded 2.14 in 1973. Following this second baby boom, the total fertility rate in Japan started to decline again. Although it showed a temporary increase between 1982 and 1984, it continued to decrease even steeper afterward. In 1989, it became 1.57, below the lowest recorded level in 1966. After that, it continued decreasing further until today, with some fluctuations, to 1.34 in 1999, 36 percent below the replacement level (Figure 1). This fall of fertility in recent years can be viewed as the third stage of the post-war fertility trend with below-replacement fertility.

In the next section, the demographic process in the third stage of the fertility decline in Japan will be examined in more detail.

2. Fertility Decline Since the Middle of the 1970s

The decreases in the fertility rate since mid-1970's in Japan is a direct result of a sharp decline in the marriage rates of those in childbearing ages, which is due to the younger generation's tendency to marry late in life and to remain unmarried[3]. While 80.3 percent of females in their later 20's, were married in 1970, the proportion married have decreased to 49.6 percent in 1995, and further to 45.4 percent in 2000. The proportion of the divorced and widowed in a population may contribute to the decrease in the proportion married in general. However, because the proportion of never married in this 35 year period soared from 18.1 percent in 1970 to 52.4 percent in 2000 (see Figure 2), we could say that a sharp increase in the proportion never married has mostly contributed to the decrease in the proportion married mentioned above. There are also changes in age at first marriage behind the increase in proportion never married (see Figure 3). In other words, since the mean age at first marriage for females increased substantially from 24.2 years of age in 1970 to 26.8 years in 1999, it is likely that the increase in proportion of never married females in their 20's can be attributed to the tendency of females marrying at a later stage in their life.

Before discussing the demographic factors associated with the recent trend of Japanese fertility, we would like to examine characteristics of the period total fertility rate as the sum of age-specific birth rate.

According to the demographic definition, the total fertility rate (TFR) in time t can be written as follows:

$$TFR(t) = \int_{\alpha}^{\varpi} \frac{B(a,t)}{N^F(a,t)} da \quad \ldots(1)$$

where, $B(a,t)$ is the number of births from mother aged a in time t, and $N^F(a,t)$ is the number of females aged a in time t. If we assume that all birth are given by only married women, equation (1) can be shown as follows:

$$TFR(t) = \int_{\alpha}^{\omega} \left(\frac{B(a,t)}{N^{Fmar}(a,t)} \right) \cdot \left(\frac{N^{Fmar}(a,t)}{N^F(a,t)} \right) da \quad \ldots(2)$$

where, $N^{Fmar}(a,t)$ is the number of currently married women aged a in time t.

Therefore, the first factor on the right hand side of equation (2) means the marital fertility rate, $g(a,t)$, and the second factor is the proportion of married female population, $PM(a,t)$. It clearly shows that the total fertility rate is composed of two components: the proportion currently married and the marital fertility rate. The equation (2) is rewritten by using $g(a,t)$ and $PM(a,t)$ as follows:

$$TFR(t) = \int_{\alpha}^{\varpi} g(a,t) \cdot PM(a,t) da \quad \ldots(3)$$

However, equation (3) can be adopted only for the society with a very small proportion of childbirths accounting out of wedlock.

In the case of Japan, the proportion of births given outside of marriage remained small as compared with the Western developed countries. According to the vital statistics, the proportion of illegitimate births in Japan have stayed at around 1 percent from 1960 to 1990, although it showed a clear upward trend since late 1980's. However, it attained only 1.6 percent in 1999, far below two percent (see Figure 4). Therefore, it is possible to analyze the effectiveness of the each component to the change of total fertility rate using the equation (3).

Figure 5-1 shows the age-specific birth rate, $f(a,t)$, in 1975 and in 1995. These age distributions of fertility rate are the product of the marital fertility rate, $g(a,t)$, and the proportion of currently married for women, $PM(a,t)$. From 1975 to 1995, the total fertility rate declined sharply from 1.91 to 1.42. It is also seen that some drastic change appeared on the shape of age pattern of the fertility between these years. The age pattern of fertility in 1975 showed a high peak at age 25, and a relatively lower rate among higher ages. This picture of the change in age shape between 1975 and 1995 suggests that the delay of the age at childbirth occurred with some loss of fertility in this period.

What happened behind age-specific fertility rate can be clarified by using the each components of equation (3) applying to these years. In Figure 5-2 and Figure 5-3 the age-specific marital fertility rate and the proportion of currently married women are shown for the years separately.

The age-specific marital fertility rare, $g(a,t)$, in 1975 shows the trapezoid shape with the flat roof among high reproductive ages from 18 to 25. On the other hand, if we look at the age shape of the marital fertility rate in 1995, it has drastically changed fertility among younger ages, and has slightly changed among ages from 22 to 40. The increase in marital fertility rate among younger ages can be explained by the change in relationships between timing of marriage and pregnancy. While the marriage of the young generation decreased, pregnancy becomes an important factor to people's decision to get married. It may explain the rise of the marital fertility rate among the younger ages in 1995. The differences in marital fertility from age 22 to 40 appeared to be due to the age shift of the childbirth timing, though the amount of the differences are relatively small.

Both patterns of the proportion of currently married for women, $PM(a,t)$, in Figure5-3 show the logistic-like curves. However, the shape of proportion married in 1995 has shifted up along with the age axis. Furthermore, the difference between 1975 and 1995 is very large at 20s and 30s. In this connection, the decrease of the proportion married at 20s and 30s is considered to have strong influence on the decline of total fertility rate in this period.

We can examine the actual magnitude of the effect of decreases in proportion of currently married on the fertility rates in these periods. The decomposition method by Cho-Retherford (1973) was applied for this analysis. In Table 1, the results of the decomposition analyses regarding the changes of TFRs in every ten years starting from 1970. The changes in TFRs are decomposed into changes caused by the differences in proportion married among females and those caused by changes in marital fertility rates. Results of the decomposition classified according to age group are also presented in the table.

According to these results, the TFR from 1970 onward decreased in each period, and notably it is found in the decomposition that the effects from the changes (decreases) in proportion of currently married were always higher than the effects from the changes in marital fertility rates. In particular, the marital fertility rates from 1980 onward moved in a direction to increase the TFR. In other words, a tendency toward fewer childbirths in this period resulted mainly from the increasing proportion of unmarried people especially in their 20's, but not from the declining trends in fertility rates of married couples.

According to the result, 0.24 in 0.39 which is a whole decline in total fertility rate between 1970 and 1980 was brought by the change of proportion married, and 0.14 was brought to it by the change in marital fertility. Between 1980 and 1990, the amount of 0.36 in the decline in TFR is attributed to changes in the proportion of currently married in various age groups and amount of 0.16 is contributed to the rise conversely by the changes in marital fertility. The same result was also observed about the decline of total fertility rate from 1990 to 1999.

The positive value of the latter can be interpreted that marital fertility rose over the period, contributing to a rise in TFR. In other words, the entire decline in TFR between these years can be attributed to a decline in the proportion of women of childbearing age who are currently married; and, in addition, if it were not for the increase in marital fertility, it would make the decrease in TFR even lower.

Therefore, it is clear that the immediate demographic cause for fertility decline since the mid-1970s is the dramatic drop in the proportion of women currently married of childbearing ages. The sharp drop in the proportion currently married among younger generations was caused by the rise in the proportion of never married (see Figure 2). The proportion of never-married population for female rose from about 70 percent to 86 percent for women aged 20-24 and from about 20 percent to 52 percent for those aged 25-29 between 1975 and 1999. Such change in the marital pattern is reflected also in a gradual increase in the mean age at first marriage since the beginning of the 1970s up to now (see Figure 3). Compared with these changes in marriage behavior, there have been very few changes in fertility behavior among married couples according to various surveys on fertility. The average number of births in the group of married couples who have almost no possibility of bearing more children is called the completed fertility value. Table 2 compares changes in this value for couples whose duration of marriage is 15-19 years, and is based on the result of National Fertility Surveys conducted by the National Institute of Population and Social Security Research. It is apparent from this table that the completed fertility value, which had greatly decreased after the war, reached 2.2 persons in 1972, among the couples married for 15-19 years (couples who got married in about 1955, after the end of the baby boom). After that, it has remained fairly stable at 2.2 persons per couple. Since the current survey also shows 2.2 persons, this same value has continued since the 1970's.

In sum, the recent fertility decline in Japan was mainly caused by the lengthening of never-married period at younger ages, which was accompanied, in turn, by the delay of marriage, the first birth, the second birth and so on. However, it must be said that this tentative conclusion is based on the analysis relying on the period fertility measure as the "hypothetical" cohort measure. It is well known in demography that postponement of marriage and birth distorts the period total fertility rate. Bongaats and Feeny (1998; 2000) clearly demonstrated such process using their formula that allows the adjustment of the period total fertility rate for this distortion. However, the method developed by Bongaats and Feeny considers only the timing of birth. Since the changes in marriage formation strongly affected the Japanese birth rate, it should be explained by the formula including the change in prevalence of marriage and the change in the timing of marriage.

3. Cohort Change in Marriage Formation on Period Fertility

Since marriage and childbirth are viewed to occur in the course of life time within a certain cohort, the trend of period fertility may be well analyzed by seeing the factor associated with the process of marriage formation along with cohort experiences. In the following, we analyze the period fertility by some scenarios assuming the various cohort changes in marriage formation. First, let's explain relationships between period and cohort fertility rates from the demographic points of view. Then we will discuss the result of calculations.

The relationships between period and cohort fertility can be shown as follows:

$$f_p(t,a) = f_c(t-a,a) \quad \ldots(4)$$

where, $f_p(t,a)$ is the age-specific fertility rates for women aged a at time t, and $f_c(t-a,a)$ is the age-specific fertility rates at age a for cohorts of women born at time t-a. Therefore, we get the period total fertility rate ($PFTR(t)$):

$$PTFR(t) = \int_0^w f_p(t,a)da = \int_0^w f_c(t-a,a)da \quad \ldots(5)$$

We already showed that the period fertility is constructed by two components, the marital fertility rate and the proportion currently married, according to equation (3) in previous section. Therefore, we can decompose the cohort fertility rate, $f_c(t-a,a)$, as follows:

$$f_c(t-a,a) = g_c(t-a,a) \cdot PM_c(t-a,a) \quad \ldots(6)$$

Substituting this for the function in (5), we have the period total fertility rate as the sum of product of the two cohort functions.

$$PTFR(t) = \int_0^w g_c(t-a,a) \cdot PM_c(t-a,a)da \quad \ldots(7)$$

Using equation (7), the expected period fertility rates corresponding to various assumptions on course of cohort marriage and marital fertility experience can be examined. A comparison between the expected and the observed period fertility provides some insight into what have happened in the course of the recent fertility decline. We constructed some scenarios for changes in marriage formation.

The first scenario is that the cohort marital behavior would not have changed since cohort born in 1955. Namely, in this scenario, birth cohorts born in 1955 and after have same values for the proportion of currently married for all ages.

Let $PFTR\ (t)^1$ represent the simulated period total fertility rates at time t. Let $g_c(t-a,a)$ denote a surface defined on the age-time place of the Lexis diagram giving the cohort age-specific marital fertility rates for women aged a at time t. Let $PM^{1955}(a)$ represent the age-specific proportion of currently married at age a for cohorts of women born in 1955. Then, expected value of period total fertility rate is

$$PFTR\ (t)^1 = \int_0^w g_c(t-a,a) \cdot PM_c^{1995}(a)da$$

Suppose that $PM^{1955}(a)$ is constant with respect to t for all a. Under scenario 1, then the expected value of period total fertility rate moves only corresponding to the changes in the cohort marital fertility rates, $g_c(t-a,a)$. If we compare with the observed period fertility, $PTFR^{obs}(t)$, the difference between scenario 1 and the observed can be attributed to the change in marriage.

The second scenario in this analysis is that the shape of the age pattern of cohort proportion of currently married has been moved along with the age axis according to those observed for cohorts,[4] however the level of proportion of never married at age 50 has been fixed for all cohorts at the same level as in 1955 birth cohort. In other words, in Scenario 2 the original schedule of age-specific proportion of currently married only changes the timing, but the ultimate prevalence of marriage at age 50 does not change among cohorts. The formula of the period total fertility rate for Scenario 2 is as follows:

$$PFTR(t)^2 = \int_0^w g_c(t-a,a) \cdot PM_c^{DM}(t-a,a)da$$

where $g_c(t-a,a)$ is the actually observed cohort marital fertility rates, and $PM_c^{DM}(t-a,a)$ is the estimated proportion of currently married based on the mathematical formula of the Boltzmann function.[5] The expected period total fertility rates based on Scenario 2 contain the effectiveness of the timing change in marriage formation along with cohorts.

In the third scenario we assumed that the shape of the age pattern of cohort proportion of married and the prevalence of marriage at age 50 have been changed according to those observed for the cohorts.[6] This scenario is the same as the previous one except that the prevalence of marriage varies over time depending on the real experiences of each cohort. Formula for this scenario is

$$PFTR(t)^3 = \int_0^w g_c(t-a,a) \cdot PM_c^{DPM}(t-a,a)da$$

where $g_c(t\text{-}a,a)$ is the actually observed cohort marital fertility rates as same as scenario 2, and $PM_c^{DPM}(t-a,a)$ is the estimated proportion currently married, based on the mathematical formula of the Boltzmann function[7] controlling both age shift and prevalence parameter. Therefore, the expected period total fertility rates based on the third scenario represent the joint effect of the changes in marriage timing and in ultimate marriage prevalence along with cohorts.

For calculation, we used the vital statistics and the census results. However, the proportion of women by marital status in each age must be estimated due to the distant of the census and to the delayed and incomplete marriage registration in the vital statistics. We used the estimates by Ishikawa (2000).[8]

Figure 6 shows the results of various estimates based on the three scenarios and the observed period total fertility rate from 1970 to 1997. It can be seen that the recent fertility decline involved two different dimensions, the decline in the cohort marital fertility rates and change in the marriage formation.

From 1973 to around 1980, the decline of period total fertility can be attributed to the decline of cohort marital fertility rate. In contrast, from 1980 to 1984, the result of calculations by scenario 1 shows a rising trend, which indicates that during this period cohort marital fertility actually increased, and the effect of the marriage delay become major in the period total fertility rates.

From 1984 to 1997, the expected fertility rates based on scenario 1 showed the tendency to become stable. Because of the assumption with no change in marriage behavior, the difference between observed PTFR and expected PTFR was brought by the change in marriage behavior including the postponement of marriage and an increase in time remaining unmarried. When we take the effect of marriage postponement into consideration as in scenario 2, the expected PTFR declines more slowly than the observed and comes to the middle between the observed PTFR and PTFR based on scenario 1. Accordingly, the postponement of the marriage attached strongly to the PTFR and this "tempo" effect explains half of the total decline of the actual PTFR. In addition, when we introduce the increase of the proportion never-married at age 50 to the model as the scenario 3, the resulting PTFR performs very similar trend to the observed PTFR. These results as a whole indicate that the latest fertility decline was shaped by both quantum effect from the decline of marriage prevalence and the temp effect from marriage postponement. In other words, the latest declining trend of PTFR in Japan was mainly caused by the postponement of marriage and the increase of those who spend their life as never-married.

4. Review and Prospect of Cohort First Marriage Rate in Japan

How have these proportion of married at each ages changed over female cohorts? Is it a phenomenon due to the change in the marriage timing or a phenomenon due to the rise in the proportion of never-married in cohort? How can we see the trend of the future marriage? To answer these questions, it is important to know how the pattern of marriage has changed so far.

Prior to examining the first-marriage rates closely, we calculated the age-specific first-marriage rate for each female cohort from 1935 onward. Because there is a delay in registration of the number of first marriages obtained from vital statistics, we account for this delay in registration when calculating the age-specific first-marriage rates (Figure 7).

Then, based on the calculated first-marriage rates for the cohorts, we estimated the mean age at first marriage and the proportion of never married at age 50 for each cohort. When making the estimates, we had to consider the cohorts whose marriage behavior has not finished. For example, the subjects born in 1960 are 35 years old as of 1995, and could undoubtedly marry after that. For the first-marriage rate distribution for those who are 35 years old or older for this kind of birth cohort, we estimated the age distribution for first marriages using the generalized log-gamma model. The resultant relationship between average age at first marriage and proportion never married, for each cohort born from 1935 to 1965, is shown in Figure 8.

Incidentally, the proportion never married is the remainder of accumulated first-marriage rates in which age-specific first-marriage rates are accumulated up to age 50. The points marked by x in the Figure are the mean age at first marriage and the proportion never married for those who were born in 1935 to 1946. Except for the two cohorts born in 1945 and 1946, these cohorts are stable in terms of the fact that they tended to marry at an early age uniformly. For example, their mean age at first marriage is about 24, and their proportion never married is above 4%. The bulleted points in the Figure are the cohorts born from 1947 to 1960.

Although these cohorts started exhibiting marriage behavior changes from the late 1960's, gradual increases in mean age at first marriage and proportion never married are seen. Similar trends are also presumed for cohorts born from 1961 to 1965. Thus, we can understand that females born in 1935 or later tend to continue increasing their age at first marriage and proportion never married, while we see a certain change in pattern from the baby-boom generation onward.

Therefore, we may come to the conclusion, from the trends in changes of mean age at first marriage and proportion never married for these birth cohorts, that the mean age at first marriage and proportion never married for the cohort will be an extension of the trends in changes that have been shown by past birth cohorts.

5. Remarks: Prospects of Marriage and Period Total Fertility

Although first-marriage rates by age for the recent cohorts is an extension of changes in the past, it is difficult to predict specifically to what extent the average age at first marriage and proportion never married will reach.

When we observed first-marriage rates by age according to each cohort and calculated their growth rates between the cohorts, we paid attention to the fact that the rate of increase in first-marriage rates shows a strongly positive growth tendency at later ages, while negative growth rate is shown in the rate of increase in first marriage by age for younger age groups.

There are more cases of restoration to grow in first-marriage rates by age. That is to say, if the proportion never married is at a low level, average age at first marriage will increase because first-marriage rates increase for older age groups. It is also likely that the proportion never married tends to increase, since a large increase in average age of first marriage is not produced on the grounds that a lot of first marriage cases will not take place for older age groups if there are less cases of restoration to grow first-marriage rates.

The fertility in Japan decreased below the replacement level since mid-1970's. The demographic conclusions that are derived from this analysis is as follows. First, it was clarified that the change in marriage greatly influenced the decline of fertility at least after 1980 via the decomposition analysis. However, there is a possibility that the change staying up on the cohort is excessively measured from this analysis because the rise of the birth rate in higher age groups is the one that the postponed birth appeared. Therefore, it is needless to say that it is a temporary conclusion, and the analysis by the cohort is necessary.

In the cohort analysis, effects from two different kinds of change in marriage behavior are examined, the effect of the marriage postponement, and that of increase in the proportion never married. On the other hand, an increase in proportion single will cause decrease in the fertility rate in permanent manner in Japan where extramarital births is extremely few. Through the scenario analysis, it was shown that the influence of an increase in proportion single was as large as those from the rise of the age at marriage. It is not likely that the fertility rate of Japan will rise to the replacement level in near future. However, if the rise of proportion never married stops, and the postponement of marriage settles, some fertility recovery can be expected so that the impact of prolonged below-replacement fertility on the society anticipated in near future may be reduced.

Notes

[1] The TFR is defined as the average number of births a woman would have if she were to live through her reproductive years (age 15-49) and bear children at each age at the rates observed in a particular year or period (Bongaarts and Feeney, 1998).

[2] This is a superstition that girls born in this year are likely to have misfortune. About a quarter of normal annual births were either shifted to other years or were lost in this year. This unusual demographic phenomenon indicated that people had acquired highly efficient mea-

sures and skills of fertility control by that year.

[3] These studies aimed to explain the decline of fertility since middle of 1970's from social and economic perspectives include Atoh (1994), Kaneko (1993), and Tsuya(1994). In addition, it is thought that the explanation of the second demographic transition in a European society becomes reference in understanding the recent fertility decline in Japan. These studies include Lesthaeghe (1983, 1998) and van de kaa (1987).

[4] These data are shown in Figures A1, A2 and A3.

[5] Various functions were examined for the applicability of the distribution function that consisting of some parameters to the age schedule of proportion married, and the Boltzmann function was adopted as the best function.

[6] The estimated proportion married based on the third scenario is shown in Figure A4 for all cohorts.

[7] We have utilized Boltzmann function to estimate the proportion currently married.

[8] Ishikawa (2000) estimated age-specific proportions for the never married population, currently married population, widowed population and divorced population for each year from 1958 to 1997.

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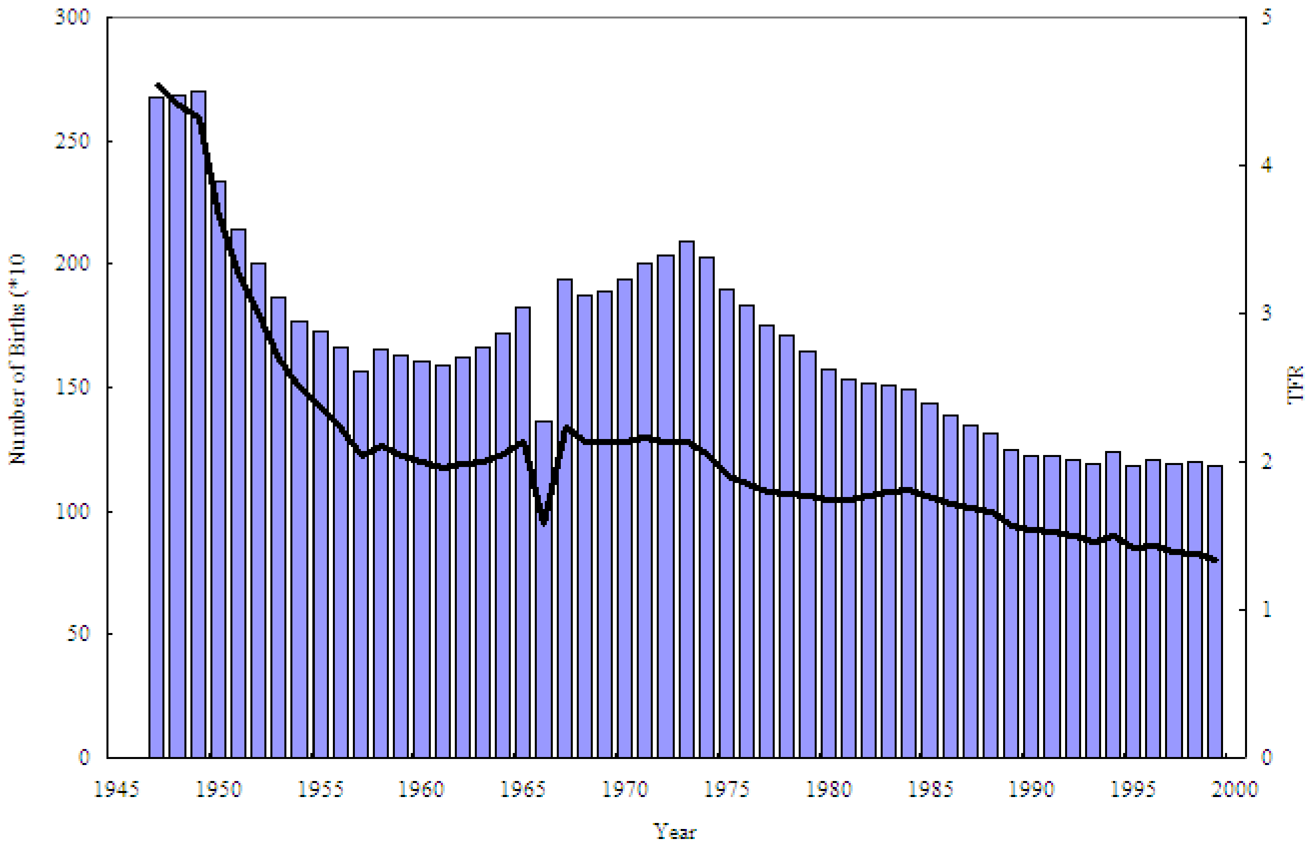
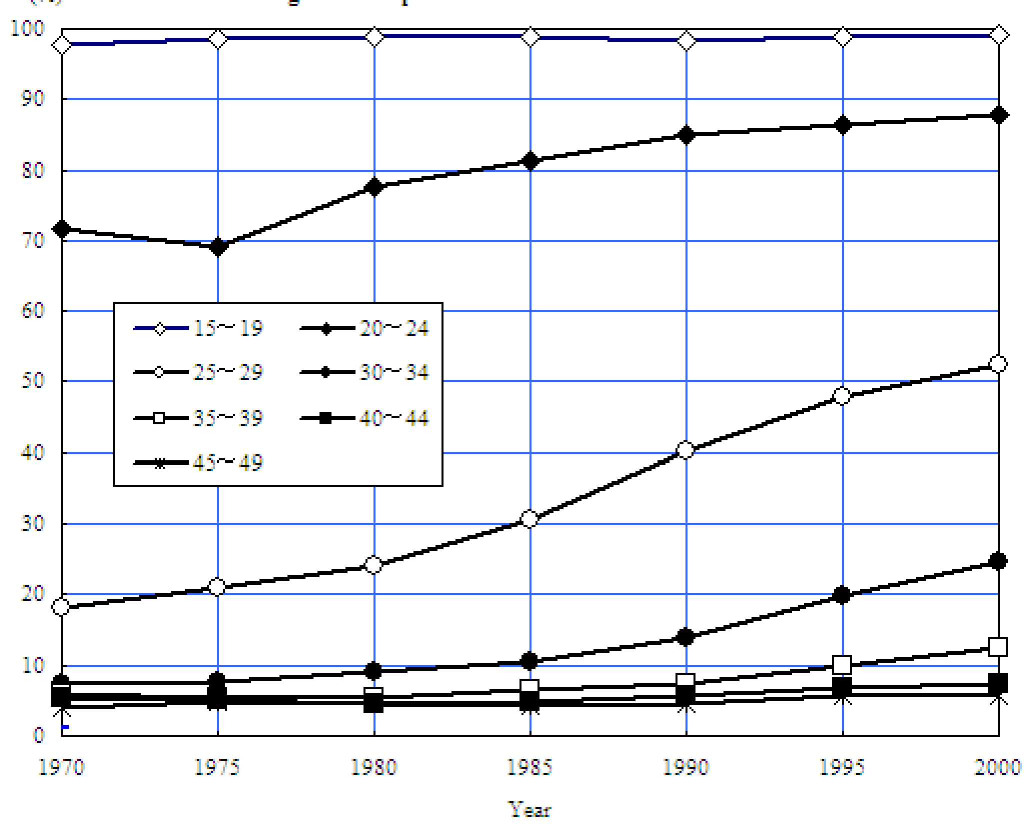
Figure 1. Trends in Number of Births and Total Fertilty Rate



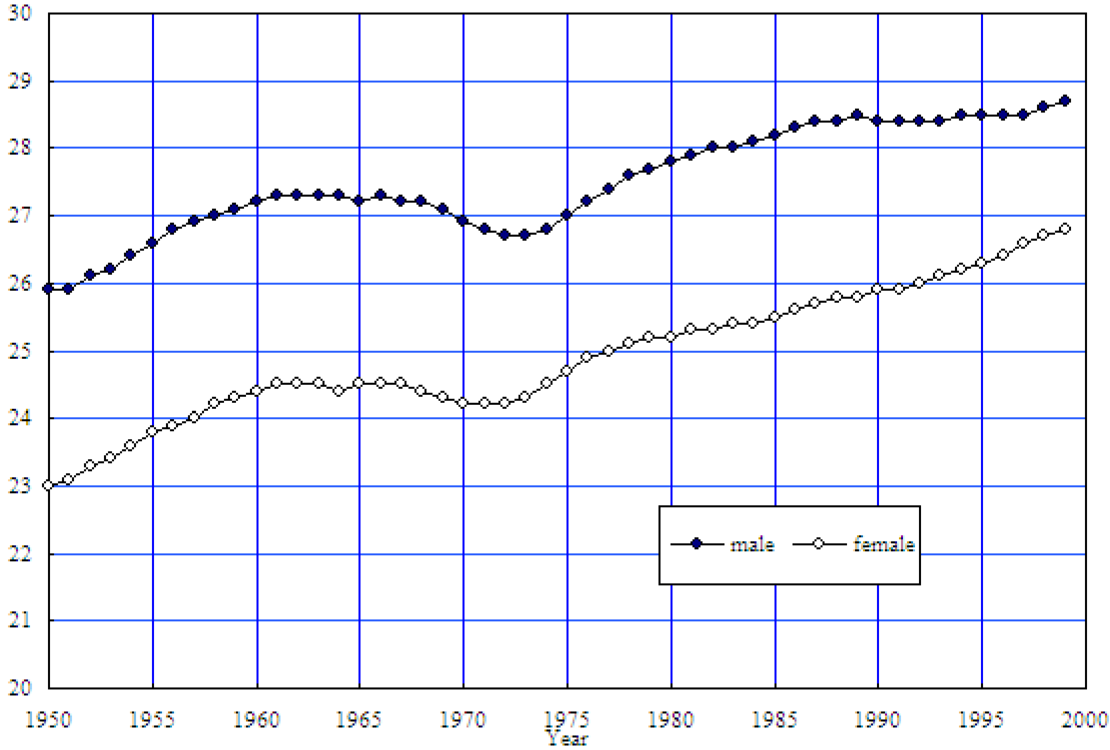
Source: Ministry of Health, Labour and Welfare, Vital Statistics, various years

Figure 2. Proportion Never-Married for Females



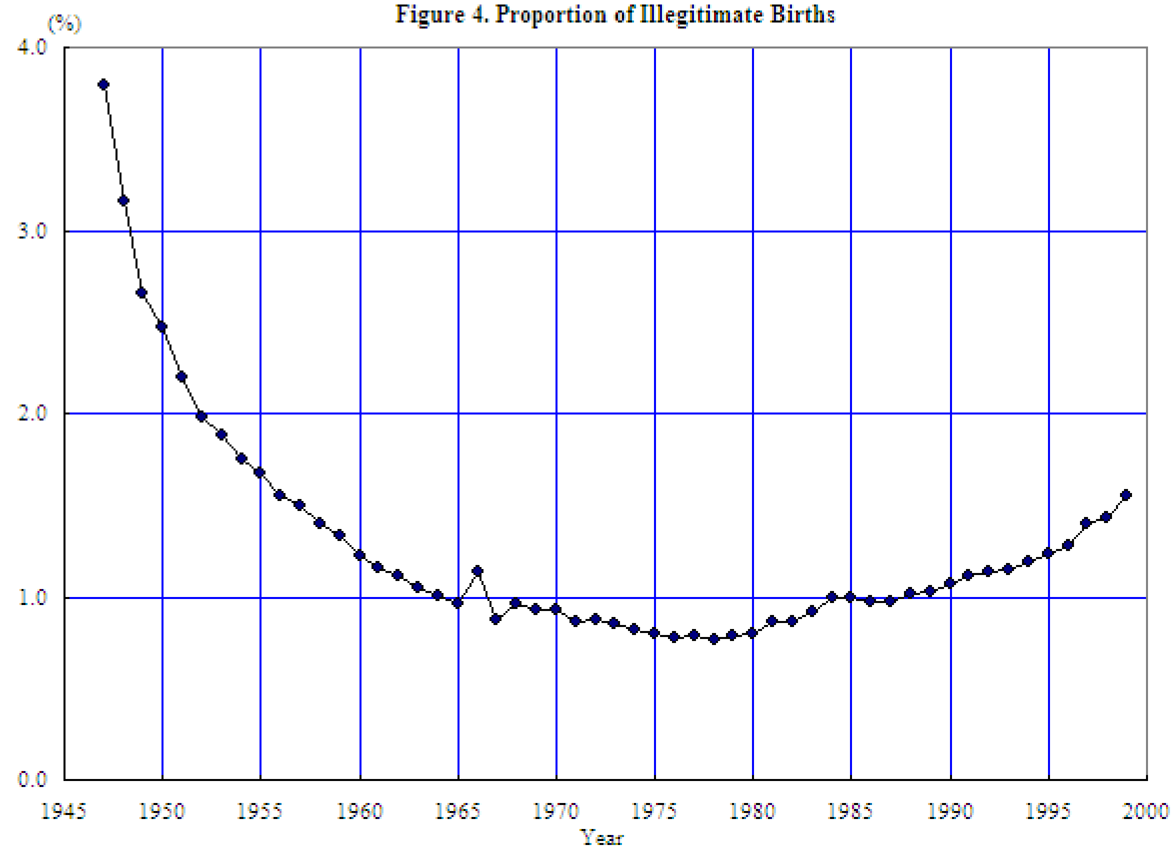
Source: Bureau of Statistics, Population Census of Japan, various years

Figure 3. Mean Age at First Marriage



Source: Ministry of Health, Labour and Welfare, Vital Statistics, various years

Figure 4. Proportion of Illegitimate Births



Source: Ministry of Health, Labour and Welfare, Vital Statistics, various years

Figure 5-1. Age-Specific Birth Rate: 1975 and 1995

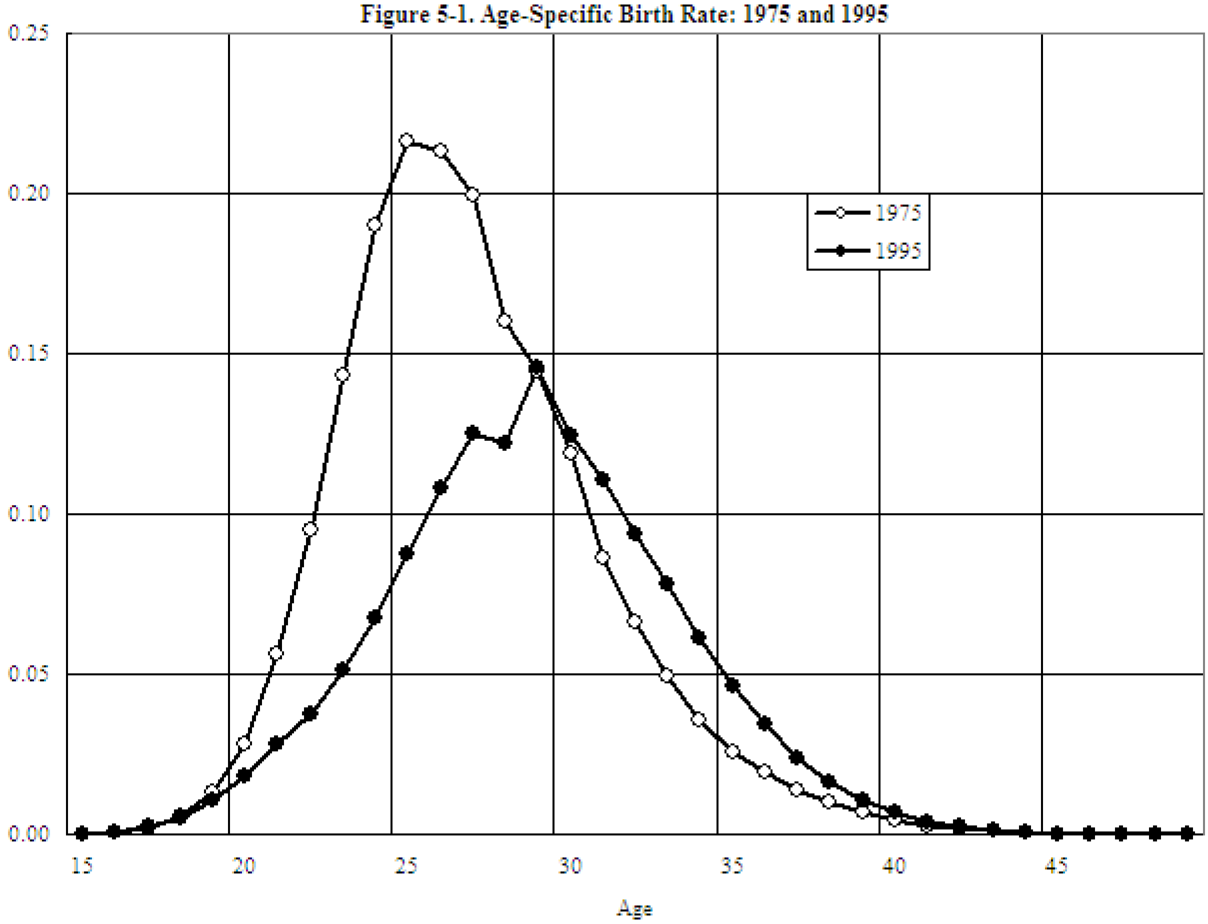


Figure 5-2. Marital Fertility Rate: 1975 and 1995

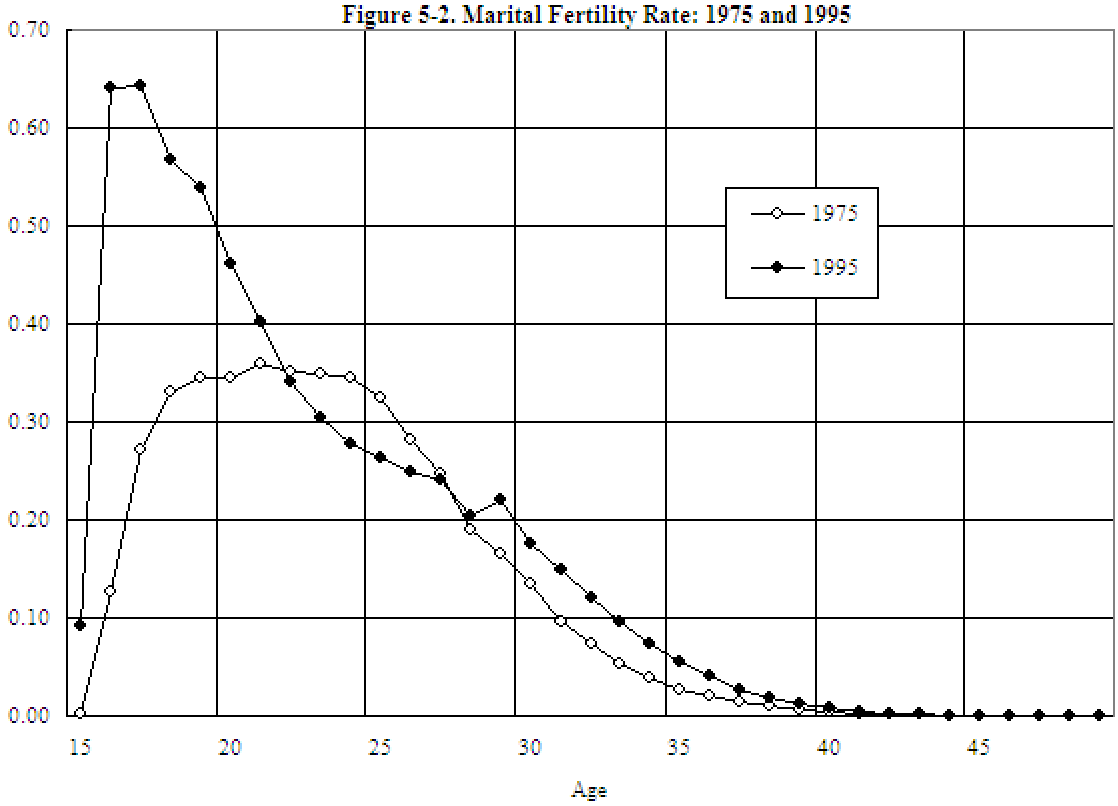


Figure 5-3. Proportion Currently Married by Age Group: 1975 and 1995

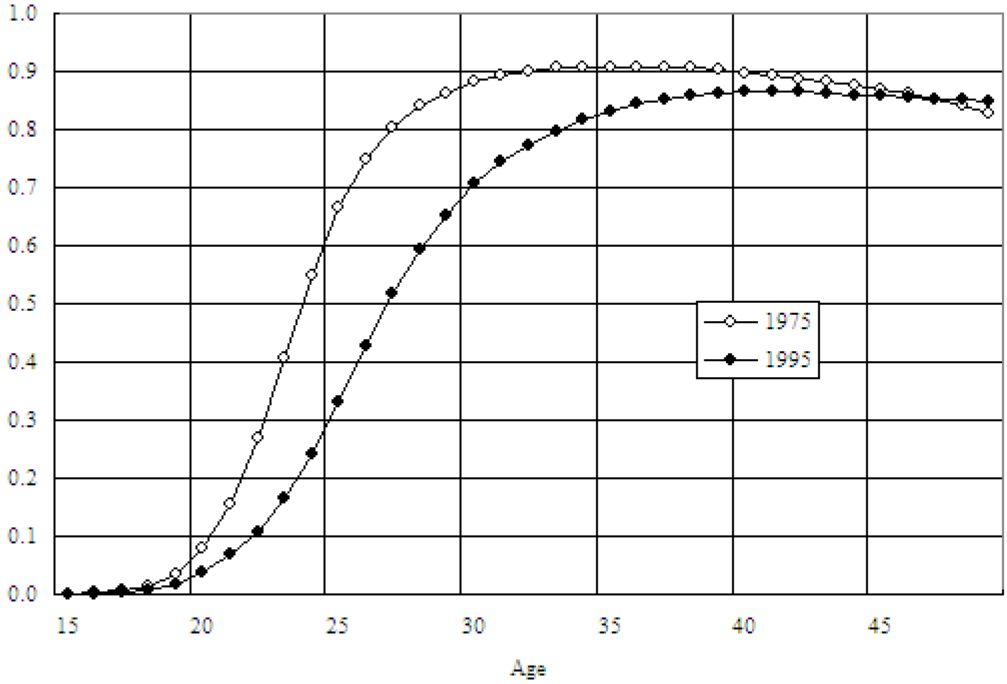


Table 1. Decomposition of the Changes in Period Total Fertility Rates: 1970-1999

Year	1970		1980		1990		1999
PTFR	2.13	→	1.75	→	1.54	→	1.35
Change		-0.39		-0.20		-0.19	
			Effects from changes in proportion married				
Total(all ages)		-0.24		-0.36		-0.24	
15-19		-0.01		-0.01		0.01	
20-24		-0.14		-0.13		-0.05	
25-29		-0.09		-0.20		-0.14	
30-34		-0.01		-0.03		-0.06	
35 and over		0.00		0.00		0.00	
			Effects from changes in marital fertility				
Total(all ages)		-0.14		0.16		0.05	
15-19		0.01		0.00		-0.01	
20-24		0.01		-0.02		0.01	
25-29		-0.05		-0.01		-0.06	
30-34		-0.07		0.14		0.05	
35 and over		-0.04		0.05		0.05	

Note: Caluculations are based on five-year age groups.

Table 2. Completed Fertility of Couples, with Marriage Duration of 15-19 years

Year of survey		Mean number of children ever born
1st NFS	1940	4.27
2nd NFS	1952	3.50
3rd NFS	1957	3.60
4th NFS	1962	2.83
5th NFS	1967	2.65
6th NFS	1972	2.20
7th NFS	1977	2.19
8th NFS	1982	2.23
9th NFS	1987	2.19
10th NFS	1992	2.21
11th NFS	1997	2.21

Note: These data are based on National Fertility Surveys.

Figure 6. Trends of Various Period Total Fertility Rates: Observed PTFR, Model 1, Model 2, and Model 3

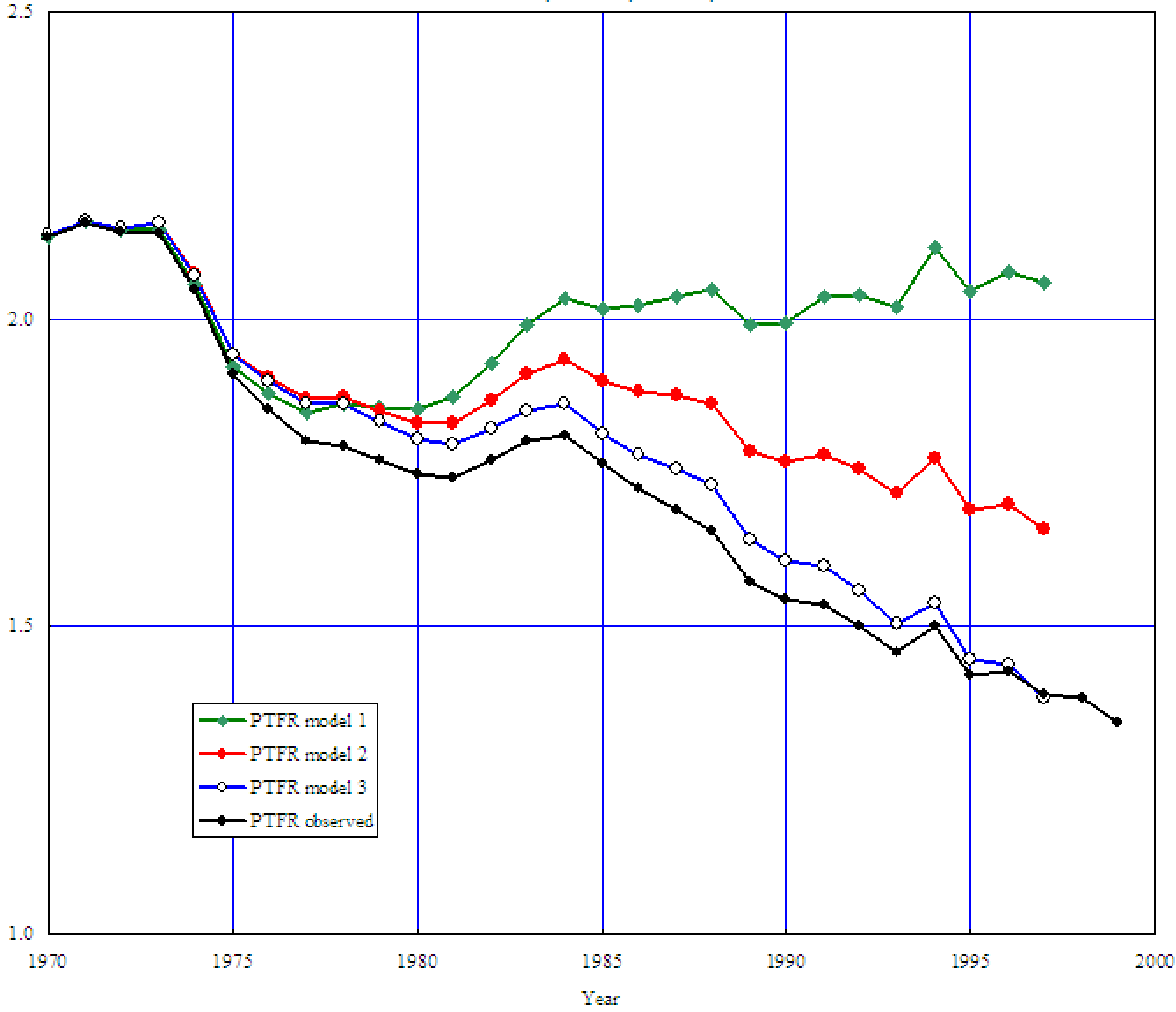


Figure 7. Age Pattern of Cohort First Marriage Rate

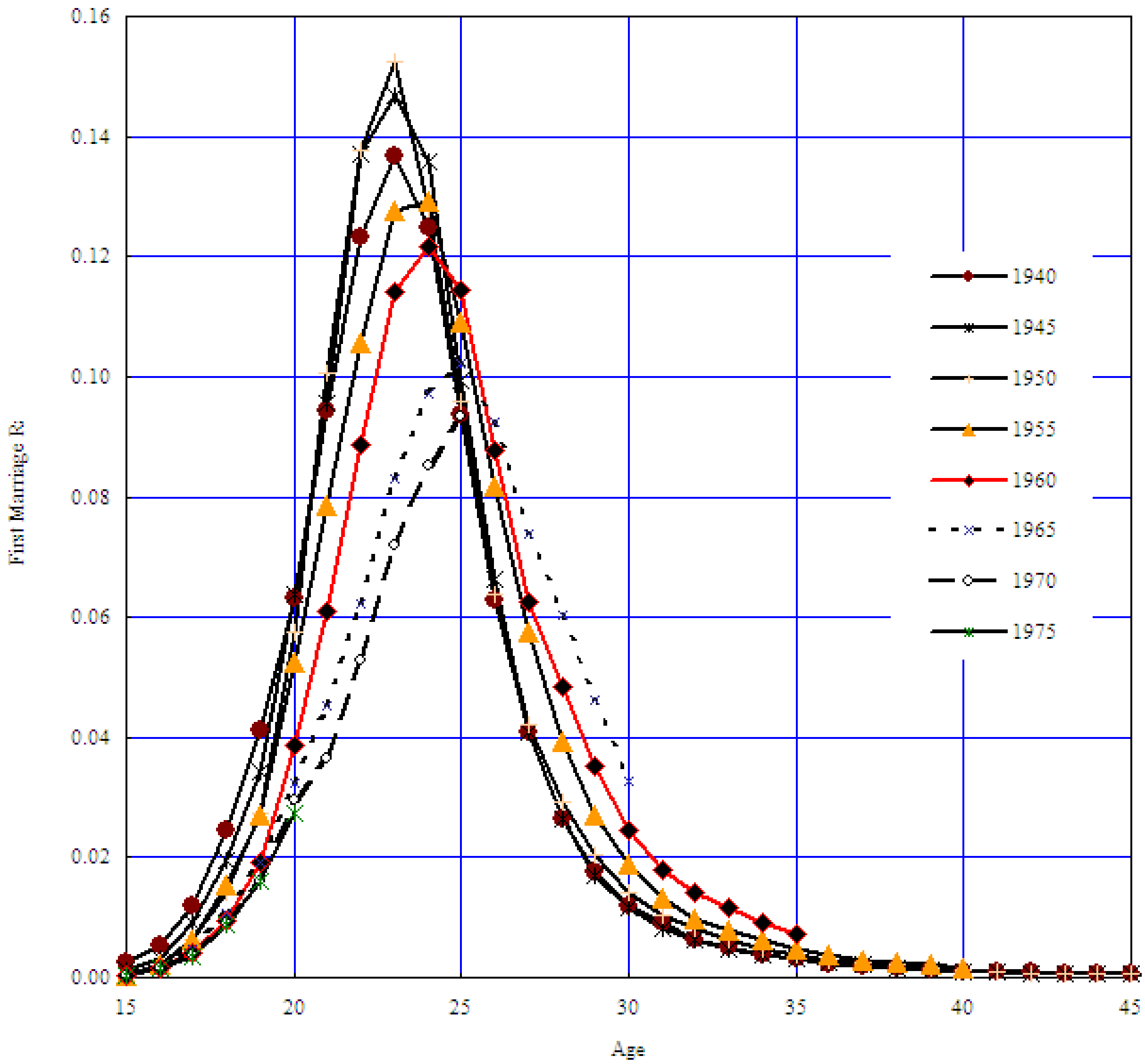


Figure 8. Trends of the Mean Age at First Marriage and Proportion Never-Married at Age 50 Based on Birth Cohort

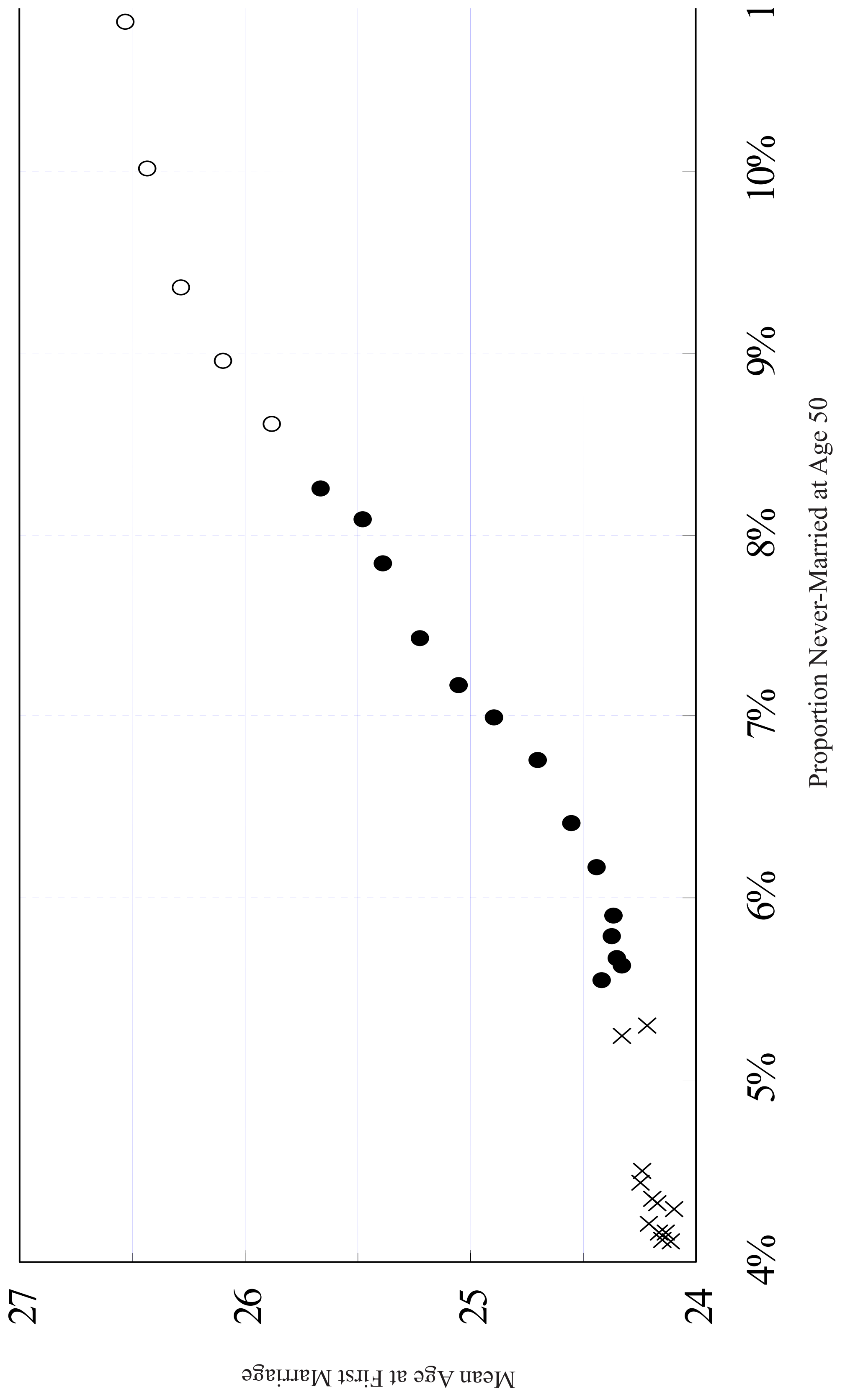


Figure A1. Proportion Ever-Married for Cohorts: Scenario 2

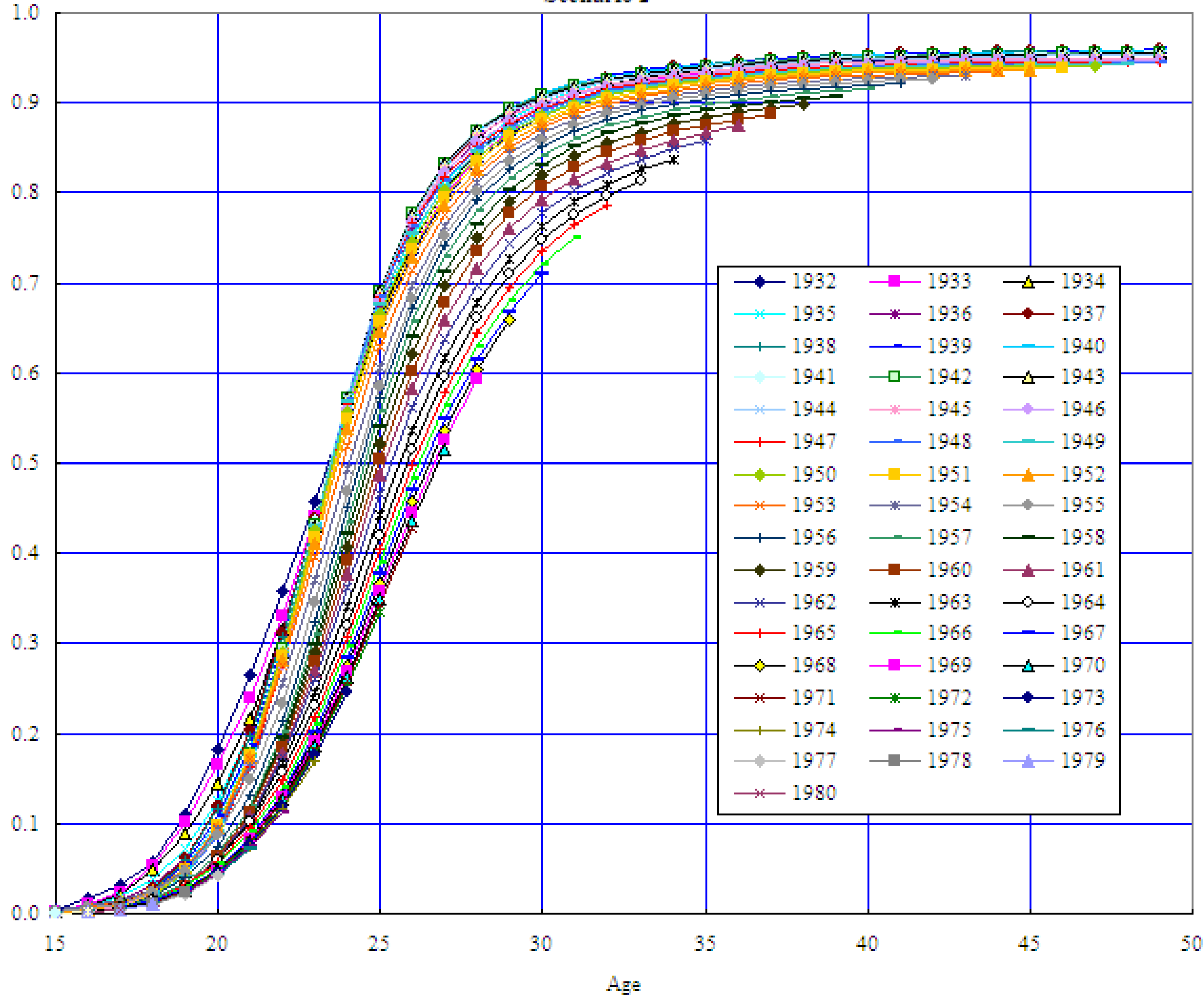


Figure A2. Proportion of Currently Married for Cohorts
Scenario 2

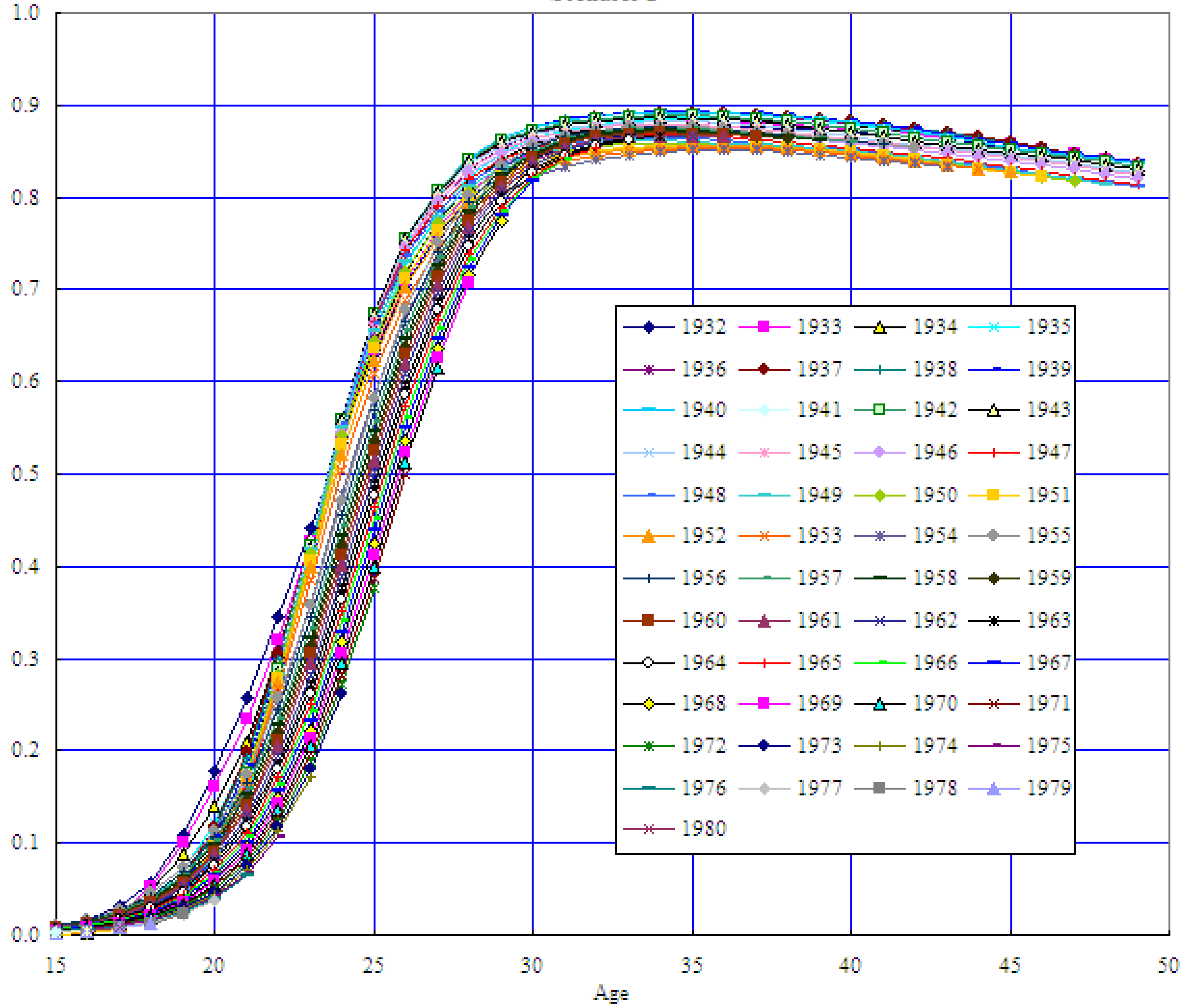


Figure A3. Proportion Ever-Married for Cohorts: Scenario 3

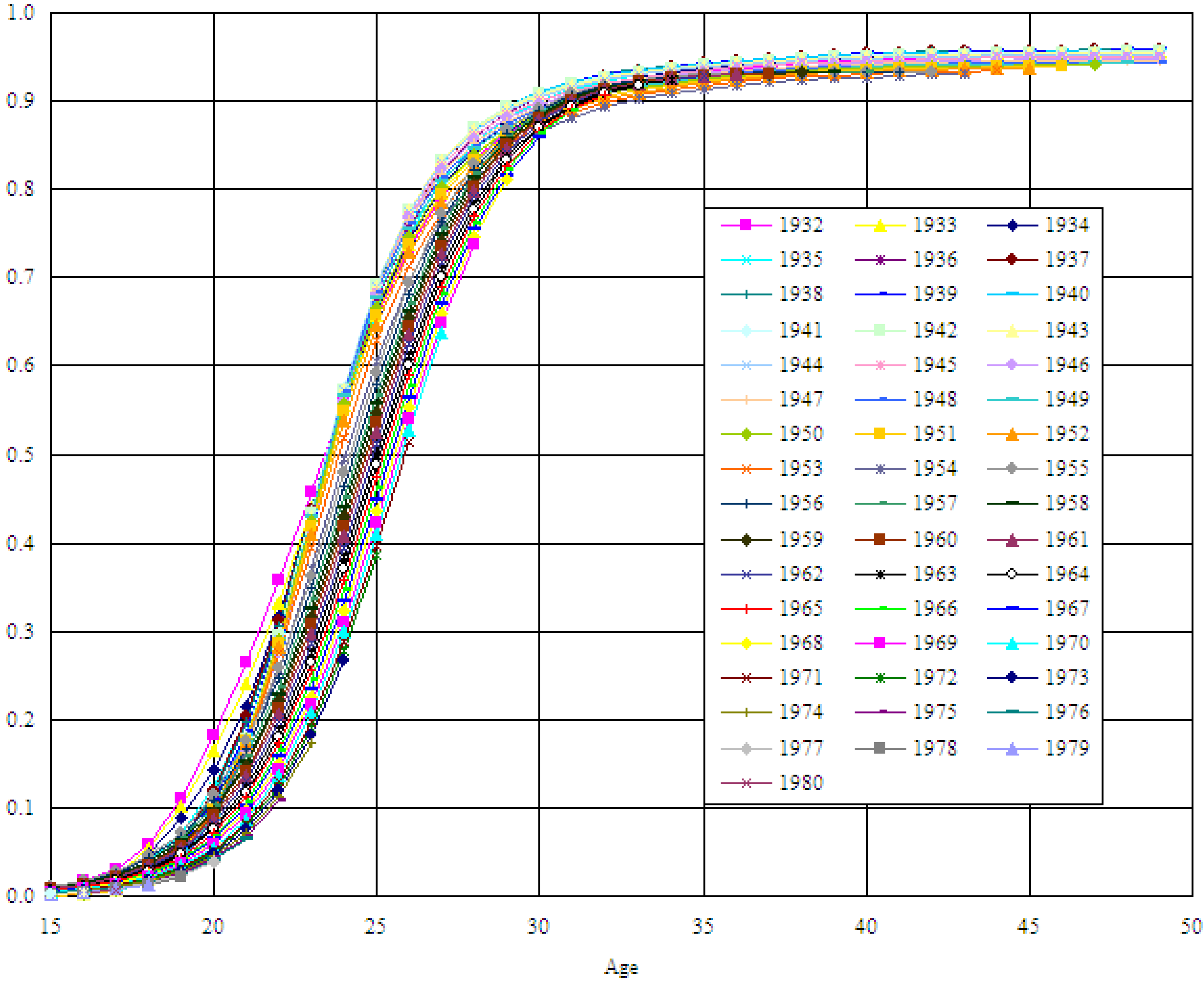


Figure A4. Proportion Currently Married for Cohorts: Scenario 3

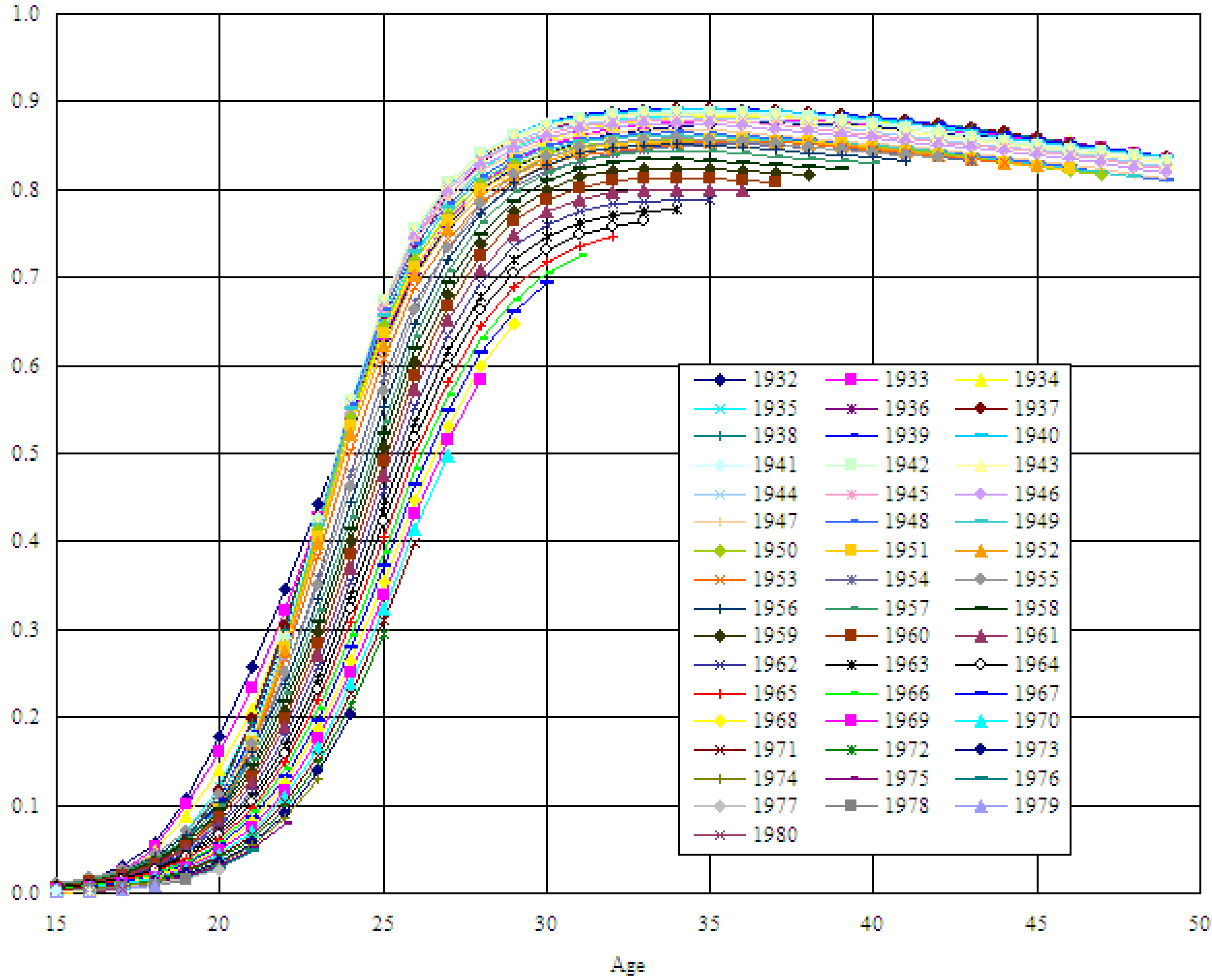


Figure B1. Estimated Age-Related Parameter for the Boltzmann Function

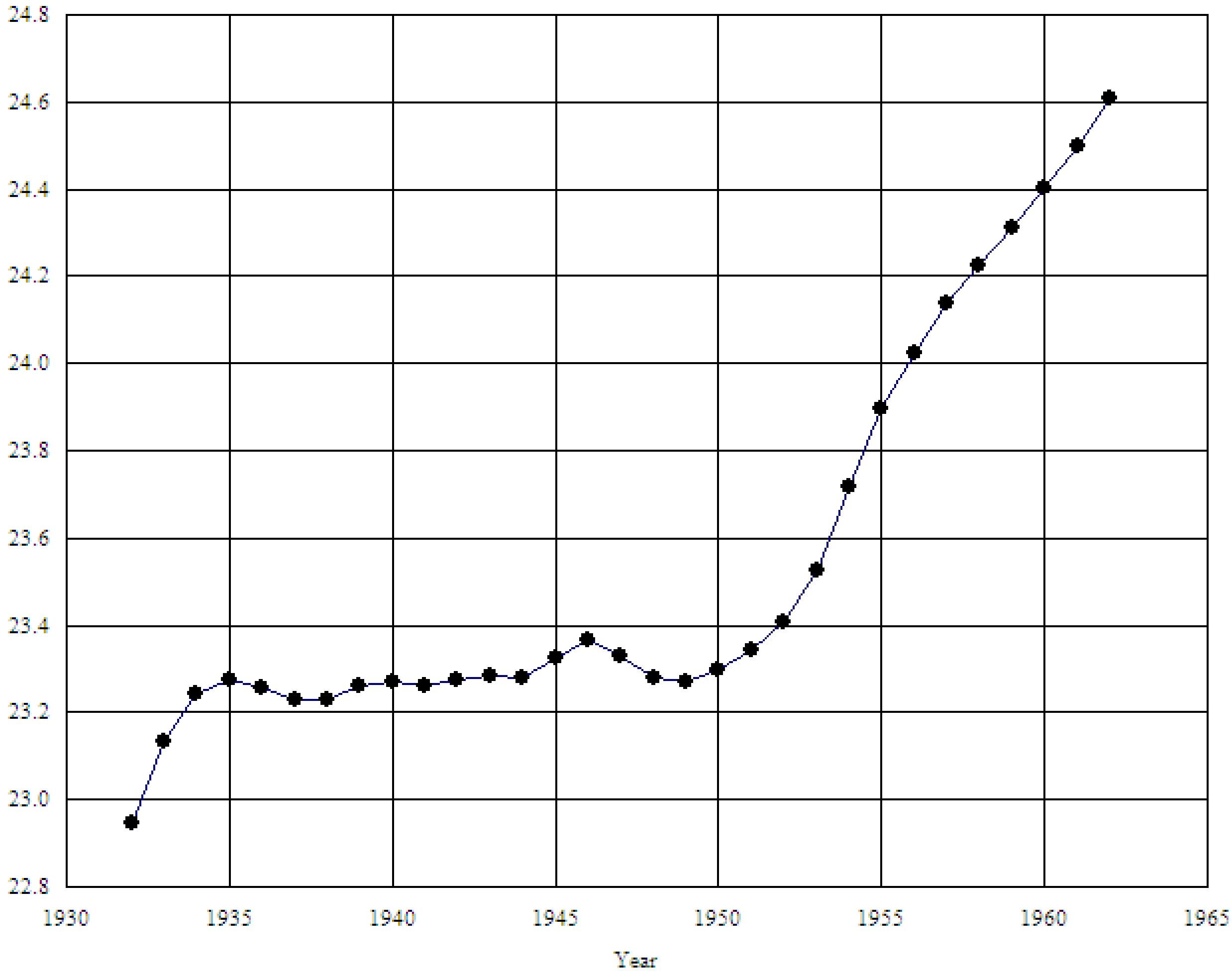


Figure B2. Estimated Parameter for the Proportion Married by the Boltzmann Function