# A Dynamic Decision Model of Marriage, Childbearing, and Labor Force Participation of Women in Japan

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**Abstract**

This paper empirically examines the life-time joint decision problem of marriage, childbearing, and labor force participation for women in Japan, motivated by the recent decrease in the number of marriages and the total fertility rate. Using the 1994-99 *Japanese Panel Surveys of Consumers*, the structural estimation result of a dynamic decision model suggests that, overall, women are better-off with the second or subsequent child, but worse-off with marriage, taking care of a baby, and labor force participation, except for financial benefit from earnings. An estimated probability to find full-time position in a year is 12-18%. Simulation result illustrates that less negative effect of marriage leads an increase of marriage, that an improvement of the child-care benefit leads an increase of childbirth from full-timers but only slightly, and that a reduction in negative effect of child-care also leads an increase of childbirth.

Keywords: dynamic programming, female labor supply, fertility, marriage

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# 1 Introduction

In the last two decades, the Japanese society has faced a rapid decline in fertility associated with a steady progress in women's social roles and changes in lifestyle regarding to family formation behavior. Labor force participation rate of women aged 25-59 rose from 48.8% in 1980 to 65.5% in 2000, and an increasing number of women continue to work across marriage and also childbirth. At the same time, people in young generations began to delay or avoid marriage; the ratio of never-married women aged 25-34 increased from 15.9% in 1980 to 41.0% in 2000. The recent decline in married rates has led to a rapid decline in fertility, since nearly 99% of newborn babies are from married mothers in Japan; the total fertility rate fell down from 1.75 in 1980 to 1.29 in 2003, which is one of the lowest rates among advanced countries.

Marriage, childbirth, and labor force participation in a woman's life cycle are likely to affect her welfare. It goes without saying that labor force participation directly contributes to her financial situation. Satisfaction with social and private life might be another factor to be considered. Also, a marriage is considered to bring financial benefits (Becker, 1973; 1974) regarding scale economies of living together in addition to happiness from private life. Children also bring happiness, while raising children is financially costly and time-consuming. Furthermore, labor force participation and family structure are deeply related to a woman's welfare through the allocation of time (Becker, 1965; Gronau, 1973). This is particularly the case in Japan, where the average time a husband spends on housework is "exceptionally short" among advanced countries(Juster and Stafford, 1991); even in full-time dual-earner households, husbands spend only 12 minutes a day on housework and childcare, whereas wives spend 3 hours on home and children each weekday[1]. In addition, the timing of these life events is important due to difficulties in a cancellation of family formation and also limited opportunities of full-time job for women after career interruption.

A number of empirical studies have shown that the female labor supply is closely related to the family background such as income of the husband or the existence of children

[1] 1996 *Survey on Time Use and Leisure Activities*.

(Killingsworth and Heckman, 1986). Most of these studies, however, have analyzed the female labor supply by focusing only on married women and treating family conditions as exogenous. Contrary to this line of studies, there is an increasing awareness of the importance of the simultaneity in decisions regarding labor supply and family formation; these include marital status and childbearing as wells as life-cycle aspects such as the timing and spacing of family formation that affects female labor supply (Moffit, 1984).

Recently, a growing literature has applied estimable stochastic dynamic models of discrete choice for women's life-cycle choice problems (Eckstein and Wolpin, 1989b). Wolpin (1984)'s pioneering work sets up a complete framework of a structural estimation of a dynamic programming model; it analyzes a fertility decision problem along with uncertainty in infant survival in Malaysia. Also, Ahn (1995) empirically analyzes a choice problem of fertility to estimate the perceptive value of children according to gender in Korea. As regards the female labor supply, Hotz and Miller (1988), Eckstein and Wolpin (1989a), and Hsylop (1999) examine the decision of labor force participation of married women. Their models include contraceptive choices with uncertainty (Hotz and Miller, 1988), the existence of children (Eckstein and Wolpin, 1989a), and the uncertainty of job search (Hsylop, 1999). Also, Francesconi (2002) considers fertility and labor supply of full-time and part-time employment.

These studies on fertility and female labor supply in life-cycle have focused on the behavior of women who are continuously married. However, as addressed by the seminal work by Becker (1973, 1974), utility gains from marriage may differ according to financial benefits, and thus, the decision of marital timing could be endogenously chosen depending on the (potential) life-cycle income of the woman and the spouse. Work by Van Der Klaauw (1996) marks the first contribution to an integration of decisions regarding marital status into the labor supply behavior of women. That study finds that utility gains from marriage are affected by female wage rates and the husband's earnings.

This paper investigate women's behavior of family formation and labor force participation in Japan, applying a structural estimation method developed by Judd (1987, 1988). The

analysis integrates marriage, childbirth, and labor force participation into a dynamic decision model of life-time utility maximization problem. The model distinguishes three job status: full-time employment, on the childcare leave to take care of an infant age zero, and part-time employment including other work. The model also involves uncertainty in finding full-time position after career interruption, in order to investigate whether or not job opportunities are limited for women who hope to return to the labor market across childbirth. The model considers costs and benefits of family formation and labor force participation as perceived by women as utility gains and losses from marriage, children by birth order, childcare of infants, and market work, as

The structural estimation result of a dynamic decision model suggests that, overall, women are better-off with the second or subsequent child, but worse-off with marriage, taking care of a baby age zero, and labor force participation, except for financial benefit from earnings. Probability to find full-time position in a year is estimated as 12-18%; this result confirms that women face a difficulty to seek full-time position after career interruption across marriage or childbirth.

Simulation using estimates illustrates that less negative effect of marriage leads an increase of married rates, that an improvement of the childcare benefit leads an increase of childbirth of full-timers but only slightly, and that a reduction in negative effect of childcare also leads an increase of childbirth.

The rest of this paper is organized as follows. Section 2 presents a dynamic model of the joint decision problem for fertile-aged women regarding marriage, childbearing, and labor force participation with uncertain job search for a full-time position; an empirical framework in included. Section 3 discusses the data sources and variables, as well as assumptions and limitations. Section 4 presents and discusses the estimation results of the dynamic choice model, and section 5 illustrates some simulation results based on the estimation result. Section 6 gives concluding remarks.

# 2 The Model

## 2.1 Life-time Optimization Problem

In considering women's choices during one life-cycle, it can be helpful to note that some choices can be re-selected, whereas other choices may not be easily cancelled; parents must take care of children until they come of age, and divorce is (financially and socially) costly or even, at times, legally impossible without spousal consent in Japan. In addition, it is possible that a woman will face difficulty when trying to find a full-time position after she resigns from the labor market [2].

Therefore, a dynamic framework presented here integrates a woman's decisions as regards marriage, childbearing, and labor force participation in a life-cycle. Furthermore, these issues are considered simultaneously. Social environments in Japan are also considered. Several assumptions, described later, are imposed to maintain simplicity of the analytical model, the tractability of the empirical analysis, computability, and due to limitations of data.

It is assumed that, after leaving school, a woman will behave in a manner that will maximize the present value of utility over a known finite horizon $T$ by choosing whether or not to get married, whether or not to have an additional child, and whether or not to work. The woman expects that she will live without uncertainty until the last economic period $T$. The objective of the woman is to maximize

$$E \sum_{t=1}^{T} \delta^{t-1} u(c_t, m_t, b_t, j_t; \beta), \tag{1}$$

where $E$ denotes the expectations operator, $\delta$ is a discount factor, $u()$ is a single-period utility function, $c_t$ is consumption, $m_t$ is marital status, $b_t$ is a vector reflecting children, $j_t$ is job status, subscript $t$ is period, and $\beta$ is a set of parameters. The utility function includes costs and benefits that are measured based on market work, children, and marriage in a woman's

[2] According to Nihon Rodo Kenkyu Kiko (1993), at least 61% of the companies that newly employed women at age 30 or older set an age limit; almost 40% of these companies had age limits of 40 or younger. They speculate that the actual conditions are more severe. In Japan, it is common practice for married women to return to the labor market as part-time workers; regular employment accounts for as little as 29.7% of working wives aged 35-54. In contrast, 76.5% of never-married women are regular employees (the 1992 *Employment Status Survey of Japan*).

social and private life in addition to consumption. The budget constraint is given by

$$c_t = g(y_t, m_t, b_t),$$

where $y_t$ is the household income, and $g$ is a function for how much she consumes goods and services, which depends on the total household income ($y_t$) and family structure ($m_t$, $b_t$).

It is assumed that the husband works full-time in each period, and that no savings and loans are passed on to later periods of time. The former assumption is not very restrictive, because 98% of married men regularly work (i.e., students and housekeepers comprise less than 2%) and 96% of the male employees aged 25-59 are regular employees or executives[3]. Although the latter assumption appears more restrictive[4], earnings are treated as a proxy of consumption in order to focus on the dynamic decision problem regarding female labor force participation and family formation.

### 2.2 State, Choice, and Transition of States

States in each period are characterized by job status $j_t$ (0 when not working, 1 when working full-time, 2 when working part-time, and 3 when taking the legitimated childcare leave of absence to take care of an infant age zero), marital status $m_t$ (0 when unmarried, and 1 when married), and the number and ages of children, $b_t$, that consists of the number of children $n_t$ (0, 1, 2, and 3 for 3 or more) and the age of the youngest child $q_t$ (0, 1, 2, and 3 in case without infants ages 0-2), and thus $b_t = \{n_t, q_t\}$ and the state $s_t = \{j_t, m_t, n_t, q_t\}$.

It is assumed that a woman maximizes the objective by choosing (i) whether or not to get married when she is unmarried: $dm_t = 0$ (to continue to be unmarried) or 1 (to get married); (ii) whether or not to hope for having an additional baby: $db_t = 0$ (not to plan to have an additional child), or 1 (to hope for having an additional child); and (iii) labor force participation: $dj_t = 0$ (not to work), 1 (to work full-time), 2 (to work part-time), 3 (to quit job only when an additional baby is born, and to continue the current job otherwise), or 4

[3] The 1992 *Employment Status Survey of Japan*.

[4] A similar assumption in described in, for example, Eckstein and Wolpin (1989a), Ahn (1995), and Hyslop (1999). If some common ratio of income can be assumed as saved in each period for the retired period after $T$, this assumption does not affect the estimation.

Table 1: Transition of States

Job Status

| $(j_t, dj_t)$ | $j_{t+1}$ | $\Pr(j_{t+1}\|j_t, dj_t)$ |
|---|---|---|
| (0-2, 0) | 0 | 1 |
| (0, 1) | 1 | $\pi$ |
| | 0 | $1-\pi$ |
| (1, 1) | 1 | 1 |
| (2, 1) | 1 | $\pi$ |
| | 2 | $1-\pi$ |
| (0-2, 2) | 2 | 1 |
| (1, 3) | 0 | $P_b$ |
| | 1 | $1-P_b$ |
| (2, 3) | 0 | $P_b$ |
| | 2 | $1-P_b$ |
| (1,4) | 3 | $1-P_b$ |
| | 1 | $P_b$ |
| (3,1) | 1 | 1 |

Marital status

| $(m_t, dm_t)$ | $m_{t+1}$ | $\Pr(m_{t+1}\|m_t, dm_t)$ |
|---|---|---|
| (0, 0) | 0 | 1 |
| (0, 1) | 1 | 1 |
| (1, NA) | 0 | $P_m$ |
| | 1 | $1-P_m$ |

Number of children

| $(n_t, db_t)$ | $n_{t+1}$ | $\Pr(n_{t+1}\|n_t, db_t)$ |
|---|---|---|
| $(n_t, 0)$ | $n_t$ | 1 |
| $(n_t, 1)$ | $\max[3, n_t+1]$ | $P_b$ |
| | $n_t$ | $1-P_b$ |

(to take the childcare leave when an additional baby is born, and to continue the current job otherwise) at the end of period $t$. The choice $dj_t = 4$ is assumed to be available only when the woman works full-time and plans for an additional child[5]. Thus, the joint choice set is defined as $d_t = \{dj_t, dm_t, db_t\}$.

The state at the beginning of period $t+1$ evolves according to the current state and the decision made at the end of the current period. However, as mentioned earlier, the choice (or plan) is not necessarily realized in the following period. Table 1 summarizes probabilistic transformation from the current state $s_t$ and the decision $d_t$ to the next state $s_{t+1}$.

First, the job status $j_t$ evolves according to the decision $dj_t$ partly with some uncertainty. It is assumed that anyone can freely quit, switch to part-time job, or stay the current job. However, transfer to full-time job ($dj_t = 1$) from part-time job ($j_t = 2$) or not working ($j_t = 0$) can be successful only with a probability of $\pi$, due to currently limited opportunities in finding a full-time position. Thus, continuously staying at home involves choosing to continue to not

[5] Choices might be made sequentially considering required leading months to have babies and rather immediate realization to quit job. However, the model treat these choices in a year at once, due to the limitations of the data and tractability and computability of the dynamic model.

work and failing to find a full-time position. Estimation of the probability of $\pi$ is an interest of this paper, because it is suspected that opportunities are limited for women who wish to return to full-time job; this situation could lead women to hesitate to have family in order to pursue careers. Also, the leave of absence for childcare is considered only for full-time job; such leave for part-timers may be treat as quitting job because the leave by part-time workers may not be insured from social security and because finding similar jobs are much easier than finding full-time positions.

Second, this study considers only the choice of marital status for unmarried women. It is assumed that any unmarried woman ($m_t = 0$) is able to get married whenever she wishes ($dm_t = 1$)[6]. Although it is ideal to introduce marital search process, as in Van Der Klaauw (1996), this paper avoids this complicated decision process in order to focus on the joint decision issue with childbearing and market work. Married women are assumed to continue to be married except for accidental death of the husband or divorce, which occur with a given probability, $P_m$.

Third, as regards childbearing, it is assumed that a woman will successfully have an additional baby when hoping for ($db_t = 1$) with a given probability of $P_b$. Unexpected childbearing is not taken into account here, considering an easy access to inexpensive contraception methods and abortion in Japan.

Finally, the number of children $n_{t+1}$ equals either $n_t + 1$ or 3 at each delivery, irrespective of the number of newborn babies delivered at the same time. Age of the youngest child $q_t$ is separately considered for ages 0-2 in order to control additional costs and benefits that go along with raising infants and to account for the spacing of childbirth. The variable $q_t$ evolves according to childbirth and growth of existing children, and $q_t$ equals three whenever there are no children younger than age three.

Now the process is characterized by the state: $s_t = \{j_t, m_t, n_t, q_t\}$ from the set of state

[6] One rationale for this is that the current marriage market in Japan is likely to be in favor of women; for ages 25-34, 56.9% (or 5.3 million) of men are unmarried, while 40.1% (or 3.8 million) of women are unmarried (the 2000 *Population Census of Japan*). Furthermore, for ages 30-34, almost three out of four never-married women think that they do not have to get married until they find ideal partners, whereas half of never-married men hope to get married before reaching a certain age (*The 10th Japanese National Fertility Survey in 1992*).

$S$, and the decision $d_t = \{dj_t, dm_t, db_t\}$ from the set of decision $D(s_t)$ that depends on the current state. The decision rule is determined from Bellman's equation:

$$V_t(s_t) = \max_{d_t \in D(s_t)} \{u(s_t; \beta) + \delta E V_{t+1}(s_t, d_t)\},$$

where $V_t(s_t)$ is the value function at time $t$, given state $s_t$. The expected value function at the next period, given the current state and decision, is defined as:

$$EV_{t+1}(s_t, d_t) = E[\sum_{k=t+1}^{T} \delta^{k-t-1} u(s_k; \beta) \mid s_t, d_t]. \tag{2}$$

It goes without saying that fertile ages are rather limited in one's economic life. In order to focus on the joint decision problem regarding marriage, childbearing, and labor force participation, and also due to the restrictions of data described later, decision periods are limited to the most fertile period which is regarded as being from the initial period after graduating from school to the last decision period, $\tau$. Thus, the optimization problem (1) can be rewritten as

$$\max_{\{d_1, d_2, \ldots, d_\tau\}} E[\sum_{t=1}^{\tau} \delta^{t-1} u(c_t, m_t, b_t, j_t; \beta)] + E[\sum_{t=\tau+1}^{T} \delta^{t-1} u(c_t, m_t, b_t, j_t; \beta) \mid s_{\tau+1}]. \tag{3}$$

The second component after the last decision period in equation (3) can be calculated for every state $s_{\tau+1}$ with a given probabilistic process between the periods $\tau + 1$ and $T$ (the last economic period). Then, the single optimal choice at the last decision period $d_\tau$ is determined for each state $s_\tau$. By backward recursion, the optimal choice for each state can be obtained throughout the decision periods.

### 2.3 Econometric Specification

In order to obtain the solution of the model, single-period utility function is parameterized as

$$u(s_t; \beta) = \widetilde{u}(s_t, d_t; \beta) + \varepsilon_t(d_t) \tag{4}$$

where $\varepsilon_t(d_t)$ is an unobservable state variable that may depend on the choice variables, along the specification given by Rust (1987,1988). I assume a simple utility function of a logarithmic form of consumption with additional effects by each state:

$$u(s_t;\beta) = \ln y(j_t, m_t, t) + \beta' \cdot h(s_t) + \varepsilon_t(d_t). \tag{5}$$

The first component stands for utility from consumption that depends on earnings

$$y(j_t, m_t, t) = \begin{cases} y_1(j_t, t) & \text{for unmarried women} \\ (y_1(j_t, t) + y_2(t))/2 & \text{for married women,} \end{cases} \tag{6}$$

where $y_1(j_t, t)$ represents the earnings of the woman, depending on her job status and age, $y_2(t)$ represents the earnings of the husband depending on age (the husband assumed to work full-time). Thus, time $t$ represents age from now on. Consumption for a married woman is assumed to be an average of the earnings of the couple. The second component consists of additional utility and disutility that arises from labor force participation, children, and marriage, as follows.

$$\begin{aligned} \beta' \cdot h(s_t) \quad = \quad & \beta_1 \cdot I(j_t = 1) + \beta_2 \cdot I(j_t = 2) + \beta_3 \cdot I(m_t = 1) + \beta_4 \cdot I(n_t \geq 1) + \beta_5 \cdot I(n_t \geq 2) \\ & + \beta_6 \cdot I(n_t = 3) + \beta_7 \cdot I(q_t = 0) + \beta_8 \cdot I(q_t = 1) + \beta_9 \cdot I(q_t = 2) \end{aligned} \tag{7}$$

where $h(s_t)$ is a vector of dummy variables converted from state $s_t$, $I()$ is the indication function which assumes a value of 1 if its argument is true, and a value of 0 otherwise. As regards labor force participation, $\beta_1$ and $\beta_2$ indicate utility gains and losses from full-time and part-time jobs; this includes costs (such as reduction of time spent on leisure and housework) and benefits (such as satisfaction gleaned from social position), as perceived by women. Here, the effect of earnings is already included in the first component $y(j_t, m_t, t)$, and this is not included here. Thus, the childcare leave is considered as not working, except for insurance income.

As regards marriage, $\beta_3$ measures the costs and benefits of being married leaving out financial advantage from the husband; one example of an advantage of marriage may be economies of scale by sharing an apartment and cooking (Becker, 1973), and another may be a sense of stability and satisfaction in family and social life. Household work, financial restraint, or restraints on time are considered to be the costs of marriage for women.

As regards children, $\beta_4$, $\beta_5$, and $\beta_6$ indicate marginal utility gains and losses from the first, second, and third and consecutive children, respectively. These utility gains and losses include financial costs, time allocated to raise children, and also perceived costs and benefits from having children; the latter would include happiness gained from family life or possible social pressure to have one's own children as a tradition. $\beta_7$, $\beta_8$, and $\beta_9$ indicate additional utility gains and losses from infants; if their total equals zero, these effects simply control spacing preferences to have multiple children; if the total is positive (negative), it could indicate additional gains (losses) by raising infants.

Alternatively, we consider following specification in order to consider job-specific effects on labor force participation, marriage, and children:

$$\begin{aligned}
\beta' \cdot h(s_t) &= I(j_t = 0,3)\{\beta_1 \cdot I(m_t = 1) + \beta_2 \cdot I(n_t \geq 1) + \beta_3 \cdot I(n_t \geq 2) \\
&\quad +\beta_4 \cdot I(n_t = 3) + \beta_5 \cdot I(q_t = 0) + \beta_6 \cdot I(q_t = 1) + \beta_7 \cdot I(q_t = 2)\} \\
&+ I(j_t = 1)\{\beta_8 + \beta_9 \cdot I(m_t = 1) + \beta_{10} \cdot I(n_t \geq 1) + \beta_{11} \cdot I(n_t \geq 2) \\
&\quad +\beta_{12} \cdot I(n_t = 3) + \beta_{13} \cdot I(q_t = 0) + \beta_{14} \cdot I(q_t = 1) + \beta_{15} \cdot I(q_t = 2)\} \\
&+ I(j_t = 2)\{\beta_{16} + \beta_{17} \cdot I(m_t = 1) + \beta_{18} \cdot I(n_t \geq 1) + \beta_{19} \cdot I(n_t \geq 2) \\
&\quad +\beta_{20} \cdot I(n_t = 3) + \beta_{21} \cdot I(q_t = 0) + \beta_{22} \cdot I(q_t = 1) + \beta_{23} \cdot I(q_t = 2)\}. \quad (8)
\end{aligned}$$

The third component of $\varepsilon_t(d_t)$ is an unobserved component of utility, depending on the choice. Now the sample likelihood function[7] is

$$L = \prod_{n=1}^{N} \prod_{t=t_n}^{\tau_n} p(s_{n,t+1}|s_{n,t}, d_{n,t}; \pi, P_m, P_b) P(d_{n,t}|s_{n,t}; \beta),$$

where N is the number of sample women, $t_n$ is the initial age after graduating from school or the initial age in the sample; $\tau_n$ is the last decision age or the sample age at the survey if before $\tau$; $p$ is the transitional probability from the current state and decision to the next state with a probability of 1, $\pi$, $(1-\pi)$, $P_m$, $(1-P_m)$, $P_b$, $(1-P_b)$, or their combination from Table 1. Probability $P$ to choose $d_t$ is assumed to take the multinomial logit formula

[7] Without observing the full decision data, likelihood function is estimated altogether. JPSC does not include decision of childbirth (or a use of contraception methods). Also, responses to job search behavior seem to be unreliable in the relationship to the actual labor force participation behavior.

with assuming the disturbance $\varepsilon_t(d_t)$ in the utility function (4) that are independently and identically distributed with the type I extreme-value distribution[8].

$$\begin{aligned} P(d_t \mid s_t) &= \frac{\exp\{\ln y(j_t, m_t, t) + \beta' \cdot x_t + \delta EV_{t+1}(s_t, d_t)\}}{\sum_{z_t \in D(s_t)} \exp\{\ln y(j_t, m_t, t) + \beta' \cdot x_t + \delta EV_{t+1}(s_t, z_t)\}} \\ &= \frac{\exp\{EV_{t+1}(s_t, d_t)\}}{\sum_{z_t \in D(s_t)} \exp\{EV_{t+1}(s_t, z_t)\}}. \end{aligned}$$

For the estimation, the expected value function $EV_{t+1}$ of equation (2) is numerically calculated for all states and decisions at each decision period, because the function is not analytically obtained. The estimation method is based on work by Rust (1987, 1988), who developed a structural estimation framework of dynamic discrete decision problems[9].

# 3 Data Description and Empirical Specifications

## 3.1 Data Source

The data are obtained from the 1994-1999 waves of the *Japanese Panel Surveys of Consumers* (JPSC) surveyed annually. In estimating the model, a transition of the state from $s_t$ to $s_{t+1}$ of sample women must be observed. The JPSC is adequate particularly in the sense that surveys pursue women in the fertile ages across marriage. The JPSC started as panel surveys on 1,500 women ages 24-34 in 1993 (Panel-A) and 500 women ages 24-27 in 1997 (Panel-B) from the entire country according to a stratified two-stage sampling method. The Institute of Household Economy (1995) explains that the sample generally represents characteristics of women, including the married rate, at the same ages in Japan.

The JPSC offers rich information of individual and family members' characteristics such as age, education, marital status, and job status. However, "the leave of absence (to take care of a baby age zero)" has been in the choice of the job status in questionnaire in the 1994 wave or after, but not in the 1993 wave[10]. Therefore, the final sample include 6,926 transitional periods-person observations in 1994-95, 1995-96, ..., and 1998-99, omitting observations in

[8] For similar specifications, see Rust (1986), Ahn (1995), and Van Der Klaauw (1996).

[9] The estimation is carried out with the simulated annealing optimization program by Goffe (1996). Needless to say, all remained errors are the author's.

[10] The JPSC does not give the choice of "the legitimated maternity leave (6 weeks before and 8 weeks after the delivery, with at least 60% compensation of monthly earnings)" as the job status.

school and those with non-working husbands. Observations are further grouped according to educational level considering heterogeneity of preferences and also job opportunities; 3,442 observations for the high-school or lower education, 2,629 observations for the two-year junior college education including technical school education[11], and 855 observations for university or better education. Age of the sample is ranged from 24 to 40, and the number of decision periods is 16 from age 24 to 39.

### 3.2 Variables

As regards job status, "full-time" is considered as regular employment, and "part-time" includes part-time employment and all other jobs (such as self-employment and family business); the average annual earnings of "full-time" exceeds three million yen, while that of "part-time" is less than half of that of "full-time". Here, the childcare leave for infants age zero is assumed to be taken only one period right after the childbirth; observations with two or more consecutive periods of the childcare leave without another childbirth, or with the childcare leave without infants ages zero are classified into "not working"[12].

As regards marital status, the class of "unmarried" women includes never married, divorced, and widowed women. The survey did not specifically instruct women about common-law marriage (which is rather rare in Japan). Probabilities regarding the transition from married to unmarried status ($P_m$) are retrieved from national surveys according to 5-year age groups as shown in the Appendix, because of the limited occurrence of these events in the sample. It is assumed that a woman gets married to a husband two years her senior, which is the national average[13]. All children are considered as having lived; in addition, it is assumed that children stay with the mother when a couple divorces[14].

Table 2 presents the characteristics of the sample and distributions as percentages accord-

[11] This type of school accepts students at any level of education and provides 1-2 years of practical education such as accounting or information processing; a majority of students are enrolled after graduating high school.

[12] It is possible that a company offers a leave of absence for child-care beyond the legitimated leave. However, this type of companies are still quite limited, and the leave must be without financial support. Only several observations fall into this category.

[13] *The 1995 Vital Statistics of Japan.*

[14] 93.1% of single-parent households with children at age 5 or younger were single-mother households (1995 *Population Census of Japan*).

Table 2: Sample Characteristics

| | High school | | Junior college | | University | |
|---|---|---|---|---|---|---|
| | Unmarried | Married | Unmarried | Married | Unmarried | Married |
| Sample number | 758 | 2,684 | 801 | 1,828 | 369 | 486 |
| | (22.0%) | (78.0%) | (30.5%) | (69.5%) | (43.2%) | (56.8%) |
| Average age (t) | 29.6 | 31.7 | 28.7 | 32.3 | 28.6 | 32.5 |
| *Children (t)* | | | | | | |
| Number of children | 0.281 | 1.817 | 0.100 | 1.601 | 0.035 | 1.294 |
| with Children | 18.7% | 91.3% | 7.0% | 85.1% | 2.4% | 74.5% |
| Infants age 0 | 0.3% | 11.0% | 0.0% | 13.0% | 0.0% | 15.4% |
| Infants age 1 | 0.4% | 12.7% | 0.2% | 13.3% | 0.0% | 15.2% |
| Infants age 2 | 0.8% | 12.3% | 0.9% | 11.3% | 0.0% | 11.7% |
| Total of ages 0-2 | 1.5% | 36.1% | 1.1% | 37.6% | 0.0% | 42.4% |
| *Change of family state* | | | | | | |
| Marital status | 9.2% | 0.8% | 12.5% | 0.9% | 12.5% | 0.6% |
| Child birth | 2.1% | 9.3% | 1.4% | 11.2% | 1.6% | 14.2% |
| *Job state (t)* | | | | | | |
| No job | 13.9% | 51.0% | 8.2% | 53.1% | 5.4% | 48.8% |
| Full-time | 61.7% | 15.4% | 75.3% | 20.2% | 83.2% | 31.9% |
| (Leave) | (0.0%) | (0.4%) | (0.0%) | (0.9%) | (0.0%) | (2.7%) |
| Part-time | 24.4% | 33.6% | 16.5% | 26.7% | 11.4% | 19.3% |
| *Change of job state* | | | | | | |
| No job (t) to | | | | | | |
| No job (t+1) | 59.0% | 83.6% | 51.5% | 86.2% | 45.0% | 91.1% |
| Full-time (t+1) | 14.3% | 1.4% | 19.7% | 0.9% | 30.0% | 1.7% |
| Part-time (t+1) | 26.7% | 15.1% | 28.8% | 12.9% | 25.0% | 7.2% |
| Full-time (t) to | | | | | | |
| No job (t+1) | 10.7% | 7.7% | 9.0% | 8.4% | 6.5% | 6.5% |
| Full-time (t+1) | 85.3% | 83.8% | 85.4% | 84.6% | 90.6% | 91.0% |
| (Leave) | (0.2%) | (2.7%) | (0.2%) | (5.1%) | (0.3%) | (10.3%) |
| Part-time (t+1) | 4.1% | 8.5% | 5.6% | 7.0% | 2.9% | 2.6% |
| Part-time (t) to | | | | | | |
| No job (t+1) | 12.4% | 13.4% | 12.9% | 17.4% | 26.2% | 14.9% |
| Full-time (t+1) | 11.4% | 5.3% | 14.4% | 5.7% | 14.3% | 4.3% |
| Part-time (t+1) | 76.2% | 81.3% | 72.7% | 76.8% | 59.5% | 80.9% |

ing to marital status and educational level. As regards marital status at time t, 57-78% of the observations are married; less educated women are more likely to be married. Almost 10% of unmarried women get married at the next period. As regards children at time t, 74-91% of married women have at least one children; 36-42% of married women have infants age 2 or younger, and 10-16% of married women gave birth during the transition. Better educated women have less number of children but having more infants than less educated women. Unmarried mothers mostly experience divorce, and childbirths from previously unmarried women usually gets married at the same time.

As regards job status at time t, 86-95% of unmarried women work, while almost half of married women do not participate in the labor market. Better educated women are more likely work full-time, while less educated women are more likely work part-time. Job transition is often associates with family state transition such as marriage or childbirth. Women working part-time are more likely to withdraw from the labor market than those working full-time. Better educated women are more likely to take the childcare leave instead of not working full-time the job than less educated women.

### 3.3 Assumption on Parameters

In estimating the model, several assumptions are imposed to parameters other than those in the utility function and the probability to find full-time position, in order for computability and tractability of parameters of interest, and for better estimation on these parameters due to limited sample coverage of the JPSC.

First, potential earnings are estimated from an exogenous source in order to separate the subjective values of labor force participation and family formation from income effects. Although such estimates may be ideally obtained from the same data source[15], 1994-99 waves of the JPSC include only women ages 24-40 and their husbands mostly in similar generation. In order to obtain better assumptions on potential earnings throughout economic life until retirement, annual earnings are estimated by interpolation of average ages and earnings, by

[15] Ahn (1995) estimated the wage equation from an exogenous source; Hotz and Miller (1988) and Van Der Klaauw (1996) estimated the wage equation in the same data.

5-year age group and education, from the 1993 *Wage Census of Japan*[16].

As illustrated in Figure 1, earning curves differ according to education and gender. Women earn less than men within the same educational level, and earnings of less educated women rise only slightly according to age. Earnings from part-time job are assumed to be one million yen a year in the case of married women; this is because a married woman working part-time tends to restrain her annual income to less than one million yen in order to retain dependant privileges (such as income tax exemptions, exemption of social security payment, and family allowance paid to the husband)[17]. The 1993 wave of the JPSC indicates that the earnings of unmarried women working part-time are 1.4 million yen.

Secondly, as for the terminal condition, the last decision age $\tau$ is assumed to be 39 due to the data limitation (the 1999 wave of JPSC covers ages up to 40) and computational burden from the "curse of dimension". The transition from 40 to the last age of economic life, several assumptions are imposed to calculate the value function. As regards childbirth, most women seem to have children in their twenties and thirties; 98.9% of newborns are from mothers aged 39 or younger[18]. Therefore, it is assumed that a woman will not have additional babies at the age of 41 or older. In addition, the average rates of new marriage and rates of divorced and widowed are applied to the transition from married to unmarried status. Transitional probabilities of job status are applied by the marital status. These rates related to transitions are retrieved from national surveys of Japan to represent women's perception; estimated rates, the data source, and calculation procedure are described in the Appendix. The last economic age $T$ is set to 59, because most private and public organizations had the mandatory retirement system at age 60 in Japan. Earnings of the husband ages 60-61, are conventionally assumed to be 60% of the earnings at age 59, considering that the husband

[16] Microdata from national surveys, including the *Wage Census*, are not usually accessible to researchers. The prediction using the JPSC estimates of a wage equation using age and squared of age by education with a selectivity bias correction coincides for the most part with the prediction using the *Wage Census* for the twenties and thirties, but is unreliably low for the forties and fifties.

[17] When working part time, 64.8% of married women receive .50-.99 million yen, 15.8% receive 1.0-1.49 million yen, and 11.2% receive less than .50 million yen (the 1992 *Employment Status Survey*). According to the 1996 wave of the JPSC, 80.7% of housewives expect that their earnings will be less than some upper limit with or without adjustment if they choose to participate in the labor market in the future.

[18] The 1995 *Vital Statistics of Japan.*

work part-time or receive pension after retirement.

Finally, as for other parameters, the discount factor $\delta$ is set to be 0.90 here, after examining this choice does not alter implications from estimation results. Also, income for women taking the childcare leave is assumed to be 25% of full-time earnings from the governmental employment insurance throughout the sample period[19]. Finally, the probability of a woman's having a child when she plans to ($P_b$) is set to be 0.4[20], in order to apply the same probability to the samples according to educational level. First of all, it should be noted that adjustments in these assumptions as well as an estimation using family income without log-transformation do not affect overall implications from estimation results.

# 4 Estimation Results

## 4.1 Estimation Result of Marriage, Children, and labor force participation

Estimation results of the dynamic model are presented in Table 3 with the utility function using equation (7). This result with the simple utility specification is presented in order to show general features of utility gains and losses from family formation and labor force participation. Effects of children indicate those from the first, second, and third child separately.

First, as regards utility gains and losses from market work, leaving out an effect of earnings, effects of part-time job are significantly negative, while effects of full-time job are insignificant except for the junior college educated sample. According to estimates, university educated women loses the least from full-time job and the most from part-time job compared to others.

Secondly, utility gains and losses from marriage are significantly negative at any educational level. It should be noted that an effect of higher earnings of the husband than those of the wife is separately considered as the average earnings of the couple. Thus, this result suggests that a woman loses utility due to marriage without considering financial benefits,

[19] The childcare leave was legitimated in 1992 without benefits. From 1995, benefits during the childcare leave were legitimated as 25% of monthly earnings initially and raised to 40% in 2000.

[20] Hotz and Miller (1988) estimated the monthly conception probability without contraception as 2.5% (which is equivalent to an annual probability of 26.2% as a compound rate), but they noted that this estimate could be somewhat lower than those from natural fertility population.

Table 3: Estimation Result (1)

| | High school | | Junior college | | University | |
|---|---|---|---|---|---|---|
| Full-time job | -0.046 | (0.043) | -0.112 | (0.048)** | -0.011 | (0.083) |
| Part-time job | -0.387 | (0.037)*** | -0.461 | (0.045)*** | -0.558 | (0.095)*** |
| Marriage | -0.995 | (0.030)*** | -0.750 | (0.033)*** | -0.710 | (0.045)*** |
| First child | 0.126 | (0.118) | -0.033 | (0.151) | 0.466 | (0.238)* |
| Secnod child | 1.158 | (0.132)*** | 1.025 | (0.166)*** | 1.627 | (0.231)*** |
| Third child | 0.566 | (0.110)*** | 0.110 | (0.160) | 0.751 | (0.211)*** |
| Infants age 0 | -11.451 | (1.114)*** | -6.724 | (1.365)*** | -13.665 | (1.493)*** |
| Infants age 1 | 5.188 | (0.963)*** | 2.494 | (1.289)* | 2.405 | (2.077) |
| Infants age 2 | -4.017 | (0.777)*** | -4.520 | (1.005)*** | -2.257 | (1.886) |
| Job probability | 0.209 | (0.011)*** | 0.198 | (0.013)*** | 0.231 | (0.024)*** |
| | | | | | | |
| Sample number | 3,442 | | 2,629 | | 855 | |
| Log-likelihood | -3811.3 | | -2969.2 | | -905.3 | |
| Restricted log-l | -4879.4 | | -3769.7 | | -1232.6 | |
| LR-statistics | 2136.2 | | 1600.9 | | 654.6 | |

Asymptotic standard errors are in parentheses.
***, **, and * indicate the 1%, 5%, and 10% significance levels.

which implies that disadvantages of marriage surpasses advantages such as economies scale of cohabitation as in Becker (1973) and a possible pressure to get married from her relatives and society. One reason may be the imbalance in responsibilities between husband and wife as regards housework and childcare.

Thirdly, utility gains from the first child are rather insignificant, those from the second child are significantly positive, and those from the third child are significantly positive except for the junior college educated. Regarding children, estimated gains from the second children are the highest, and those from the first child are the lowest; according to educational level, gains are estimated the highest with the university educated, and the lowest wit the junior college educated. This result indicates that the first child is costly to offset benefits (e.g., perceived happiness) of having a child, while benefits surpass costs of having the second child, and also the third child with the smaller effect. One explanation of this result is that new mothers require more effort than experienced mothers to take care of the child. However, in the case of the third or subsequent child, it is possible that marginal benefits from an

additional child is reduced whereas marginal costs are not reduced much.

Fourthly, as regards a specific effect to take care of young infants, utility gains and losses are significantly negative on infants age zero, positive (but rather insignificant with the better educated) on infants at age one, and negative (but less significant with the university educated) on infants age two. The considerably large negative estimates on infants age zero indicate that newborn babies are so demanding to take care of. Other effects of infants might include childbirth spacing consideration, in addition to costs and benefits to take care of infants. If a woman with a newborn avoids to have an additional baby continuously, she can benefit from the positive effect of the youngest baby at age one. This is because she may not be physically ready soon after the delivery, and that she is busy taking care of the newborn. On the other hand, the mother can avoid utility losses from the youngest infants at age two if she gives birth to an additional baby after a one-year pause.

Finally, the probabilities of finding a full-time position during the transition are estimated as low as 23% with the university educated, and 20-21% with the less educated. This result confirms the difficulties for women to return to full-time job after career interruption due to marriage or childbearing.

### 4.2 Estimation Result with Job-specific Effects

Table 4 with the utility function using equation (8) with considering differences in costs and benefits to participate in the labor market with bearing housekeeping and/or childcare duties[21].

First, as regards utility gains and losses from labor force participation leaving out financial benefits, utility gains and losses are significantly negative both for full-time and part-time jobs at any educational level. According to estimates, utility losses from market work are smaller with the university educated than with the less educated. As regards job type, part-timers lose less than full-timers with the less educated, and vice versa with university educated. The

[21] Different effects of consumption across job status was also considered as in Francesconi (2002), because market work of a wife might demand additional expenses for the household. However, this effect was insignificant.

Table 4: Estimation Result (2)

| | High school | | Junior college | | University | |
|---|---|---|---|---|---|---|
| *Not working* | | | | | | |
| Marriage | -4.955 | (0.102)*** | -4.531 | (0.131)*** | -2.555 | (0.265)*** |
| First child | -0.117 | (0.151) | -0.015 | (0.183) | -0.132 | (0.368) |
| Secnod child | 0.870 | (0.162)*** | 0.875 | (0.199)*** | 0.768 | (0.383)** |
| Third child | 0.301 | (0.142)** | 0.083 | (0.188) | 0.065 | (0.548) |
| Infants age 0 | -6.765 | (1.157)*** | -9.505 | (1.366)*** | -8.691 | (1.952)*** |
| Infants age 1 | 4.270 | (1.079)*** | 7.679 | (1.209)*** | 5.717 | (2.331)** |
| Infants age 2 | -4.532 | (0.881)*** | -4.936 | (1.230)*** | -4.486 | (3.174) |
| *Full-time* | | | | | | |
| Job | -4.261 | (0.117)*** | -3.924 | (0.130)*** | -1.845 | (0.260)*** |
| Marriage | -0.391 | (0.063)*** | -0.408 | (0.061)*** | -0.500 | (0.054)*** |
| First child | -0.241 | (0.199) | -0.287 | (0.229) | -0.510 | (0.463) |
| Secnod child | 1.274 | (0.189)*** | 1.356 | (0.222)*** | 1.173 | (0.480)** |
| Third child | 0.304 | (0.130)** | 0.332 | (0.164)** | 0.977 | (0.448)** |
| Infants age 0 | -7.176 | (1.345)*** | -10.803 | (1.568)*** | -12.289 | (2.193)*** |
| Infants age 1 | 1.341 | (1.256) | 3.210 | (1.441)** | -1.235 | (2.566) |
| Infants age 2 | -4.519 | (1.114)*** | -3.875 | (1.487)*** | 3.414 | (2.602) |
| Job Probablity | 0.127 | (0.010)*** | 0.123 | (0.012)*** | 0.175 | (0.024)*** |
| *Part-time* | | | | | | |
| Job | -3.726 | (0.123)*** | -3.498 | (0.148)*** | -1.881 | (0.273)*** |
| Marriage | -1.677 | (0.073)*** | -1.741 | (0.097)*** | -1.600 | (0.171)*** |
| First child | 0.338 | (0.120)*** | 0.491 | (0.168)*** | 0.373 | (0.352) |
| Secnod child | 0.850 | (0.122)*** | 1.041 | (0.163)*** | 0.922 | (0.359)** |
| Third child | 0.381 | (0.112)*** | 0.217 | (0.153) | -0.076 | (0.467) |
| Infants age 0 | -12.252 | (1.339)*** | -15.037 | (1.653)*** | -12.890 | (3.033)*** |
| Infants age 1 | 2.535 | (1.059)** | 5.803 | (1.190)*** | 4.289 | (2.313)* |
| Infants age 2 | -5.028 | (0.781)*** | -5.368 | (1.088)*** | -4.889 | (2.648)* |
| | | | | | | |
| Sample number | 3,442 | | 2,629 | | 855 | |
| LR-statistics | 3074.6 | | 2255.3 | | 818.1 | |

Asymptotic standard errors are in parentheses.
***, **, and * indicate the 1%, 5%, and 10% significance levels.

probabilities to find full-time position after career interruption are estimated as low as 17.5% with the university educated, and even 12-13% with the less educated.

Secondly, utility gains and losses from marriage are significantly negative at any educational level and the job status. Again, it is confirmed that disadvantages of marriage surpass advantages. According to the job status, wives working full-time lose the least, and housewives lose the most; according to educational level, university educated wives lose less than less educated wives but this difference seems to be small for working wives.

Thirdly, as regards children, utility gains from the first child is insignificant and rather negative for housewives and mothers working full-time, but positive for mothers working part-time. Those from the second child are significantly positive for any type of mothers. Those from the third child are mostly positive, particularly for high school educated mothers and mothers working full-time.

Finally, as regards young infants, utility gains and losses are significantly negative with the youngest child age zero, mostly significantly negative with the youngest child age two, and positive on the youngest child age one for mothers not working full-time. According to estimates, utility losses to take care of a baby age zero are the smallest for housewives and the largest for mothers working part-time. Smaller costs when working full-time than part-time might be related to differences in social support to working mothers that gives priority to full-timers. Among mothers working full-time with a baby age zero, better educated mothers lose more than less educated mothers; one reason might be sought to skilled or managerial job type that demands better educated women to work overtime. It is noted that mothers on the childcare leave are assumed to receive utilities equivalent to 'not working' at the current period but with 25% benefits.

It is noted that estimated utility gains and losses are marginal effect of each changes in family formation in the same job status. Table 5 compares effects of family formation based on single (childless unmarried) women working full-time by educational level; for example, stated value of "working full-time, married with two children" is the sum of estimates of job,

Table 5: Utility Gains and Losses from Family Formation and Job

| | Unmarried | Married | | | | Costs of | log income at age 30 | |
|---|---|---|---|---|---|---|---|---|
| | no children | no children | one child | two children | three children | infants ages 0-2 | Single | Married |
| *High school* | | | | | | | | |
| Not working | 4.26 | -0.69 | -0.81 | 0.06 | 0.36 | -7.03 | 0.00 | 2.37 |
| Full-time | 0.00 | -0.39 | -0.63 | 0.64 | 0.95 | -10.35 | 2.50 | 2.59 |
| Part-time | 0.54 | -1.14 | -0.80 | 0.05 | 0.43 | -14.74 | 2.00 | 2.45 |
| *Junior College* | | | | | | | | |
| Not working | 3.92 | -0.61 | -0.62 | 0.25 | 0.34 | -6.76 | 0.00 | 2.39 |
| Full-time | 0.00 | -0.41 | -0.69 | 0.66 | 0.99 | -11.47 | 2.58 | 2.64 |
| Part-time | 0.43 | -1.31 | -0.82 | 0.22 | 0.44 | -14.60 | 2.00 | 2.47 |
| *University* | | | | | | | | |
| Not working | 1.84 | -0.71 | -0.84 | -0.08 | -0.01 | -7.46 | 0.00 | 2.45 |
| Full-time | 0.00 | -0.50 | -1.01 | 0.16 | 1.14 | -10.11 | 2.62 | 2.69 |
| Part-time | -0.04 | -1.64 | -1.26 | -0.34 | -0.42 | -13.49 | 2.00 | 2.52 |

Log income: log(total income in ten tousnad yen plus 1.0) for convenience.

marriage, the first child, and the second child when working full-time. The column of "costs of infants ages 0-2" indicates the sum of estimates of the youngest age zero, one, and two; that is, the figure indicates an additional cost to raise an infant without next childbirth in two years. Also, the right two columns inform log of total family income plus one (in order to avoid infinitely negative utility for singles not working) when unmarried and married at age 30 (age 32 in case of the husband) as an example; financial advantages of marriage are 0.07-0.09 when working full-time across marriage.

According to Table 5 a single woman working full-time will be worse-off across marriage and the first childbirth, at any job status and educational level. Utility of a married woman with two or more children is generally higher than that of a single if she is junior college or less educated. However, if she is university educated and not working full-time, she becomes worse-off compared with any number of children.

In order to gain utilities, why do not majority of women choose to have three or more children and working full-time? One reason may be considerable one-time utility losses when raising young infants, at any job status and educational level. Having a new baby requires

utility losses of 6.8-14.7 without a subsequent childbirth in two years. Among the job status, estimated cost is the largest for those working part-time, and the smallest for those not working. Therefore, part-timers withdraw from the labor market more than full-timers to take care of infants age zero.

### 4.3 Prediction using Estimates

In order to look into prediction performance of the estimation, figures 2, 3, and 4 compare predicted and actual married ratio, average number of children, and rate of those not working conditional at the previous state. Predicted values in the figures are calculated using the estimate of the junior college educated sample in Table (4). Overall, the prediction fit the actual data fairly well, at any job status and educational level, as shown in the figures.

## 5 Simulations

In this section, several simulations are presented to draw policy implications related to women's labor force participation and family formation behavior. The simulation looks into the transition in a period conditioned the previous state, rather than the long-run transition in order to minimize the prediction error. The simulation focuses on the behavior of marriage, job choice, and childbirth of women working full-time.

First, the marriage choice of singles is simulated with taking into account of a feature of unequal earnings between men and women. Next, a joint choice of childbirth and labor force participation of childless wives working full-time is simulated, also with considering unequal earnings. Finally, possible policies to help working mothers are evaluated.

### 5.1 Marriage and Earnings

Figure 5 presents simulated newly-married rates out of unmarried women without children and working full-time at the previous period. It is noted that higher marriage rate of better educated women may be affected by the difference in ages left school; that is, less educated women are married before age 24 more than better educated women.

Table 6: Newly-Married Rate and Earnings

| | High school | | | | Junior college | | | | University | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Age | (A) | (B) | (C) | (D) | (A) | (B) | (C) | (D) | (A) | (B) | (C) | (D) |
| 25 | 6.3% | 2.2% | 11.3% | 13.1% | 9.9% | 6.0% | 18.8% | 18.0% | 12.5% | 6.0% | 31.5% | 25.6% |
| 30 | 7.9% | 1.5% | 15.9% | 16.1% | 10.2% | 3.6% | 25.3% | 19.4% | 9.6% | 3.0% | 39.7% | 25.8% |
| 35 | 9.9% | 1.6% | 21.1% | 23.2% | 9.0% | 2.4% | 31.1% | 24.2% | 5.8% | 1.9% | 41.0% | |

The case of unmarried childless women working full-time at the previous state.
(A) Current earnings; (B) Equal earning; (C) Low earning; (D) No marriage disadvantages

According to the figure, almost 10% of junior college educated singles choose to get married every year until mid-thirties, and the rate slightly goes up in the late thirties. High school educated singles increasingly seek marriage with age, and the rate eventually exceeds that of junior college educated women. On the contrary, the rate declines with age in the case of university educated women. Then, better educated singles get married more in the mid-twenties, but less in the late-thirties than less educated singles.

As a reason of delayed (or never) marriage that leads fewer-children in Japan, legal and social advancements for equal treatment between men and women in market work, particularly more equalized wages, are considered to reduce financial necessities for women to get married. Table 6 presents simulated effects of earnings on the newly-married rate ages 25, 30, and 35, who are unmarried without children and working full-time at the previous state. As regards earnings of full-time job, Case (A) assumes the current earnings as assumed in the estimation, Case (B) assumes the same full-time earnings of women as men's, and Case (C) assumes two million yen of annual earnings of full-time job (which is almost equivalent to earnings of high school educated women at the age of 20, and is yet higher than 1-1.4 million yen of part-time earnings) irrespective of age. Also, Case (D) assumes utility gains and losses from marriage to be zero when working full-time, so that a wife does not lose utility across marriage; this may be possible if the husband equally shares housekeeping with the wife working full-time, for example.

The simulation result confirms that less earnings lead more women to get married. The

rate of newly-married is lower with equalized earnings in Case (B), and much higher with low earnings in Case (C) than in Case (A) at any educational level. In Case (B) with equalized earnings, newly-married rates become much lower than in Case (A), and decrease with age at any educational level. On the contrary, in Case (C) with low earnings, the newly-married rates are much higher than Case (A) and increasing with age also at any educational level.

Inequality of wages between women and men have been pushed to be reduced in Japan as a worldwide stream, and it is not a feasible policy to go against this. Case (D) could be an alternative to lead singles to get married; without utility loss of marriage when working full-time, the newly-married rate are almost twice of the one in Case (A) assuming the current earnings, and even higher than the one in Case (C) with equal earnings for high school educated.

### 5.2 First Birth, Job Choice, and Earnings of Full-timers

Decision of childbirth and job choice of married women working full-time is another interest of simulation. Figure 6 illustrates simulated childbirth rates of married women who are childless and working full-time at the previous period. Throughout fertile periods, the better educated give birth less than the less educated; in particular, childbirth rates are considerably low for the university educated. As regards age, childless wives working full-time begins to choose not to have children from mid-thirties.

Table 7 presents a simulation result of the joint choice of job and childbirth at the age of 30, who are childless married women working full-time at the previous state, with the same assumptions as the estimation in Case (A) and with equalized earnings in Case (B).

As regards job choice, almost three out of four choose to continue working full-time when not planning to have a baby, while 15-16% of them choose to be housewives at the next period. When hoping for having a baby, the choice of job status is diversified; 30-39% of them choose to quit for childcare, 18-31% of them choose to take the childcare leave, and 13-33% of them choose to continue working. In total when hoping for a baby, 58% (44%) of the high school educated (the better educated) plan to keep the full-time job with or without

Table 7: Job choice of married women

| | High school | | Junior college | | University | |
|---|---|---|---|---|---|---|
| | (A) | (B) | (A) | (B) | (A) | (B) |
| Birth ratio | 10.6% | 10.2% | 10.4% | 9.8% | 7.1% | 6.9% |
| *Choice when not hoping for birth* | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| Staying full-time | 73.7% | 86.6% | 74.7% | 83.6% | 77.4% | 85.9% |
| To part-time | 11.7% | 5.9% | 9.3% | 5.9% | 6.9% | 4.2% |
| Quitting | 14.6% | 7.5% | 16.0% | 10.5% | 15.7% | 10.0% |
| *Choice when hoping for birth* | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| Staying full-time | 33.4% | 36.9% | 25.9% | 27.3% | 12.5% | 13.7% |
| To part-time job | 1.4% | 0.7% | 1.4% | 1.0% | 1.7% | 1.1% |
| Quitting anyway | 11.2% | 6.1% | 15.5% | 11.3% | 15.1% | 10.3% |
| Quitting when birth | 29.7% | 26.5% | 39.2% | 39.1% | 39.3% | 37.6% |
| Taking the leave | 24.3% | 29.8% | 18.0% | 21.3% | 31.3% | 37.3% |
| *Next job status* | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| No job | 16.8% | 9.8% | 20.0% | 14.4% | 18.4% | 12.5% |
| (Quitting with birth) | (1.8%) | (0.9%) | (2.4%) | (1.6%) | (1.6%) | (1.0%) |
| Full-time job | 74.2% | 85.6% | 72.8% | 80.8% | 75.6% | 83.8% |
| (on the Leave) | (2.6%) | (3.0%) | (1.9%) | (2.0%) | (2.2%) | (2.4%) |
| Part-time job | 9.0% | 4.6% | 7.2% | 4.8% | 5.9% | 3.7% |

The case of childless married women working full-time at age 29 at the previous state.
(A) Current earnings; (B) Equal earnings

the childcare leave, while others choose not to work full-time.

As the result of the joint choice of job status and childbirth, 73-76% of them choose to remain in full-time position, including 1.9-2.6% of the childcare leave. Although differences according to educational level are rather trivial, the university educated rather choose to stay full-time position, the junior college educated choose to be housewives, and the high school educated choose to work part-time more than others.

According to the simulation result with assuming equalized earnings, childbirth is slightly discouraged by 0.2-0.6%. On the other hand, the ratio of those working full-time at the next period increases from 74.2% to 85.6% for the high school educated, from 72.8% to 80.8% for the junior college educated, and from 75.6% to 83.8% for the university educated. However,

Table 8: Support to Working Mothers

| Ratio at age 30 | High school | | Junior college | | University | |
|---|---|---|---|---|---|---|
| *Full-time job* | all | (birth) | all | (birth) | all | (birth) |
| 0% benefit | 73.6% | (56.6%) | 72.4% | (42.8%) | 75.1% | (39.4%) |
| 25% benefit | 74.2% | (57.7%) | 72.8% | (43.9%) | 75.6% | (43.9%) |
| 40% benefit | 74.4% | (58.2%) | 73.0% | (44.4%) | 75.8% | (44.7%) |
| 80% benefit | 74.9% | (59.3%) | 73.4% | (45.4%) | 76.3% | (44.9%) |
| 80% placement | 61.1% | (53.5%) | 60.6% | (42.2%) | 60.3% | (27.6%) |
| Support to age 0 | 76.3% | (59.1%) | 72.8% | (44.5%) | 75.4% | (44.7%) |
| *On the leave* | all | (full-time) | all | (full-time) | all | (full-time) |
| 0% benefit | 2.4% | (40.1%) | 1.7% | (38.7%) | 2.0% | (69.4%) |
| 25% benefit | 2.6% | (42.1%) | 1.9% | (40.9%) | 2.2% | (71.4%) |
| 40% benefit | 2.7% | (43.0%) | 2.0% | (41.9%) | 2.3% | (72.2%) |
| 80% benefit | 2.9% | (44.9%) | 2.1% | (44.1%) | 2.6% | (74.0%) |
| 80% placement | 2.0% | (39.2%) | 1.5% | (37.3%) | 1.9% | (48.9%) |
| Support to age 0 | 3.6% | (42.8%) | 2.6% | (41.7%) | 3.4% | (71.8%) |
| *Childbirth* | all | (full-time) | all | (full-time) | all | (full-time) |
| 0% benefit | 10.5% | (8.0%) | 10.3% | (6.1%) | 6.7% | (3.5%) |
| 25% benefit | 10.6% | (8.2%) | 10.4% | (6.3%) | 7.1% | (4.1%) |
| 40% benefit | 10.7% | (8.3%) | 10.5% | (6.4%) | 7.2% | (4.3%) |
| 80% benefit | 10.8% | (8.6%) | 10.6% | (6.6%) | 7.2% | (4.2%) |
| 80% placement | 9.4% | (8.3%) | 9.5% | (6.6%) | 14.0% | (6.4%) |
| Support to age 0 | 14.4% | (11.2%) | 13.8% | (8.4%) | 10.6% | (6.3%) |

The case of childless married women working full-time at age 29.
(birth) column indicates ratio out of new-mothers at age 30.
(w-birth) column indicates ratio out of full-timers with birth at age 30.
(full-time) column indicates ratio out of full-timers at age 30.
"80% placement" indicates the 80% probability to find full-time position.

major contribution of this increase is the decrease of the choice of "quitting" full-time job without childbirth, although more women choose to stay full-time position with or without the childcare leave. Particularly in the case of the junior college educated, the choice of "quitting with childbirth" declines only by 0.1% conditioned hoping for childbirth. Thus, equalized earnings seems to prevent wives to quit full-time job without childbirth, but not across childbirth.

### 5.3 Policies to Support Working Mothers

It is considered that difficulties in working full-time and childcare at the same time is one of the reason of fewer-children. This section evaluates effects of possible policies (or policies to

call for a change in social environments) on childbirth and job choice of wives working full-time. Table 8 presents simulated effects on continuation of full-time job, taking the childcare leave, and childbirth at age 30, assuming the previous state as married, childless, and working full-time at age 29. The table reports full-time continuation ratio (including the childcare leave), and also the ratio among those give birth; ratio on the childcare leave, and also the ratio among new-mothers staying at full-time position; and ratio of childbirth at age 30 of the whole, and also the ratio among those continuously staying at full-time position.

The benefit during the childcare leave from the governmental employment insurance was not considered in 1992 when the childcare leave was legitimated, became 25% of monthly earnings in 1995, and 40% in 2000. The table reports effects of the benefits of 0%, 25%, 40%, and 80%. According to the simulation result, compared to the no benefit case, 80% of the benefit raises 2.6-5.5% of full-time continuation ratio across first childbirth, with an increase of 4.6-5.4% of the childcare leave among new-mothers staying at full-time position. However, the effect on birth ratio seems to be limited; particularly for the university educated, an increase of benefit from 25% to 80% lead little change in birth ratio.

As an alternative to the childcare leave, a simulation result is reported assuming 80% of the probability of finding full-time position after career interruption, while the estimated probabilities range 12-18% in Table (4), by such policies that legislative changes to give priority to hire mid-career mothers particularly in public sectors, for example. According to the simulation result, the childbirth rate rises from 7.1% to 14.0% for the university educated, but declines from10.6% to 9.4% for the high school educated, and from 10.4% to 9.5% for the junior college educated. It is a puzzle that the childbirth rate drops for the less educated; one possibility is that an increase of full-time job opportunities attract these women so much as to reduce childbirth.

These policies aim to lead women to take a temporal career interruption during taking care of young infants and then return to full-time work. Another possibility is to reduce considerable burden to take care of young infants, particularly infants age zero. Final simulation

is practiced by subtracting 1.0 from $\beta_5$, $\beta_{13}$, and $\beta_{21}$ (estimates on the youngest child age zero for each job status) at any educational level; that is, -12.289 is changed to -11.289 for $\beta_{13}$ in case of university educated mothers working full-time. According to the result, this change increases childbirth ratios from 10.6% to 14.4% for the high school educated, from 10.4% to 13.8% for the junior college educated, and from 7.1% to 10.6% for the university educated.

According to the simulation result, effects of policies to support career interruption across childbirth with financial benefits or with job opportunities might be somewhat limited, or at least varied across educational levels. Instead, social support system to mothers with young infants seems to be effective against the fewer-children problem. However, it does not imply that earnings compensation during the childcare leave is little demanded. First of all, an increased portion of new mothers, albeit the effect is limited, choose to stay full-time position utilizing the childcare leave. Secondly, new mothers on the childcare leave gain utility, although majority of them may not change their choices regardless of the benefit. Thirdly, the childcare leave could be the second-best policy when considering small job market for mid-career hiring; an extension of the childcare leave period might be another concern. Finally, an increased benefits might be necessarily for husbands to take the childcare leave, which is beyond the scope of this paper.

# 6 Concluding Remarks

This paper has examined the lifetime decision problem of Japanese women at fertile periods. A dynamic decision model that integrates marriage, children, and labor force participation behavior has been proposed to estimate utility gains and losses from marriage, children, and labor force participation, in addition to financial benefits from family life, as costs and benefits including perceived values such as happiness to live with family members. The analyzed dynamic decision model seems to predict women's behavior on marriage, childbirth, and labor force participation in fertile ages fairly well.

The estimation and simulation results suggest several interesting features. First, as regards family formation, women are worse-off with marriage and having the first child.

This result suggests that disadvantages of marriage (such as housekeeping duties) surpass benefits (such as economies of scale of cohabitation or social advantages). Scale economies seem to rather work in raising children, because women are better-off with the second child. However, raising young infants age zero are considerably costly to discourage women to have another children. Furthermore, this cost is estimated higher for part-times, possibly because limitations of social support to working mothers that gives priority to full-timers.

Secondly, as regards labor force participation, it causes utility loss when leaving out financial gains, and this loss is estimated larger for less educated women. However, despite of this negative effect, housewives do not necessarily gain utility more than working wives in the same family composition due to a large negative effect of marriage for housewives.

Thirdly, family formation and labor force participation behavior sometimes vary by educational levels. Over all, university educated women give more preference to labor force participation and less to family formation than less educated women. However, this result might be partly affected by higher life-time earnings of university educated women than less educated women. As a result, some policy effects could also vary by educational levels.

Finally, simulations using estimates could suggest several policy implications on the fewer-children issue. Increasingly equalized earnings between women and men are likely to have discouraged singles to get married, and also discouraged childless wives working full-time to have babies. As policies to encourage childbirth, a reduction of burden to take care of young infants may be helpful, in addition to an improvement of childcare leave or mid-career hiring whose effects are rather limited or biased.

The model proposed here seems to be still over-simplified in terms of capturing women's life-stage behavior in various aspects, due to the data, estimation, and computational limitations. Some neglected features might include effects of career interruption and family formation on earnings, heterogeneous preferences or family background such as help of grandmother

living together, matching problem of marriage, and so forth. Other models or estimation technique might have an advantage to analyze issues that must include various factors currently observed, because dynamic decision models of state space are rather restricted to involve various current state. Nonetheless, dynamic decision models contribute to capture an important feature in women's life-cycle irreversible decisions.

**Appendix: Specification of transition rates**

Marital status

| Age Group | Divorced or Widowed Rate (%) | Married Rate (%) |
|---|---|---|
| 1-3 20-24 | 3.22 | - |
| 25-29 | 1.56 | - |
| 30-34 | 0.95 | - |
| 35-39 | 0.72 | 4.31 |
| 40-44 | 0.70 | 1.87 |
| 45-49 | 0.80 | 1.17 |
| 50- | 0.97 | 1.30 |

Return to Labor Market

| Marital status | Return to | Age group | | | |
|---|---|---|---|---|---|
| | | 37-39 | 40-44 | 45-49 | 50- |
| Married | full-time | 2.09% | 2.10% | 1.39% | 0.76% |
| Married | part-time | 13.17% | 13.80% | 9.73% | 6.28% |
| Unmarried | full-time | 8.37% | 10.48% | 6.86% | 3.10% |
| Unmarried | part-time | 10.92% | 10.48% | 9.14% | 8.87% |

The rates related to marital status and childbirth in the table are calculated from numbers of marriages, divorces, widows, and childbirth, obtained from the 1995 *Vital Statistics of Japan*, and population numbers by marital status are obtained from the 1995 *Population Census of Japan*.

The rates of return to the labor market are obtained from the 1992 *Employment Status Survey of Japan*. The resignation rate from full-time position is assumed to 4% if due to marriage, and 14% if due to childbirth, as calculated for female employees, resignation due to marriage and due to childcare are also from the 1992 *Employment Status Survey of Japan*.

All data sources are published by: Statistics Bureau, Management and Coordination Agency, Government of Japan.

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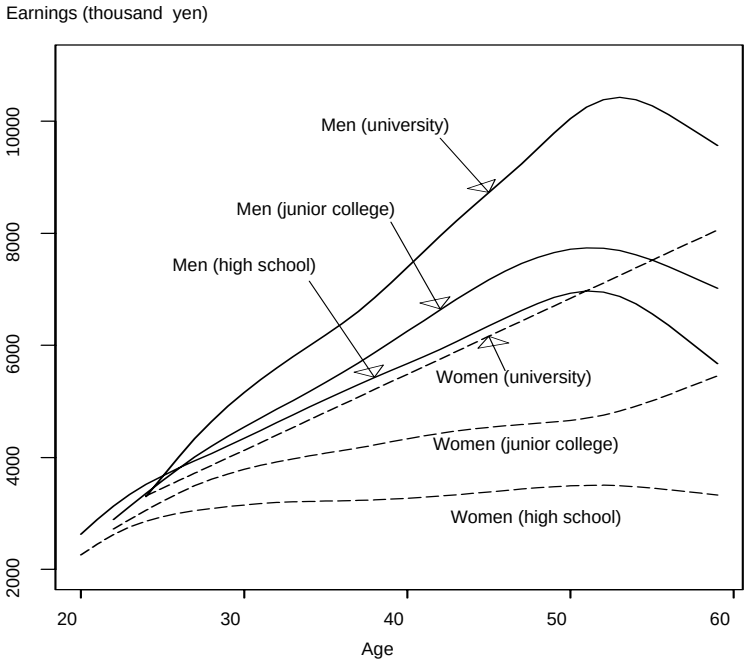


Figure 1: Earnings by Education and Gender

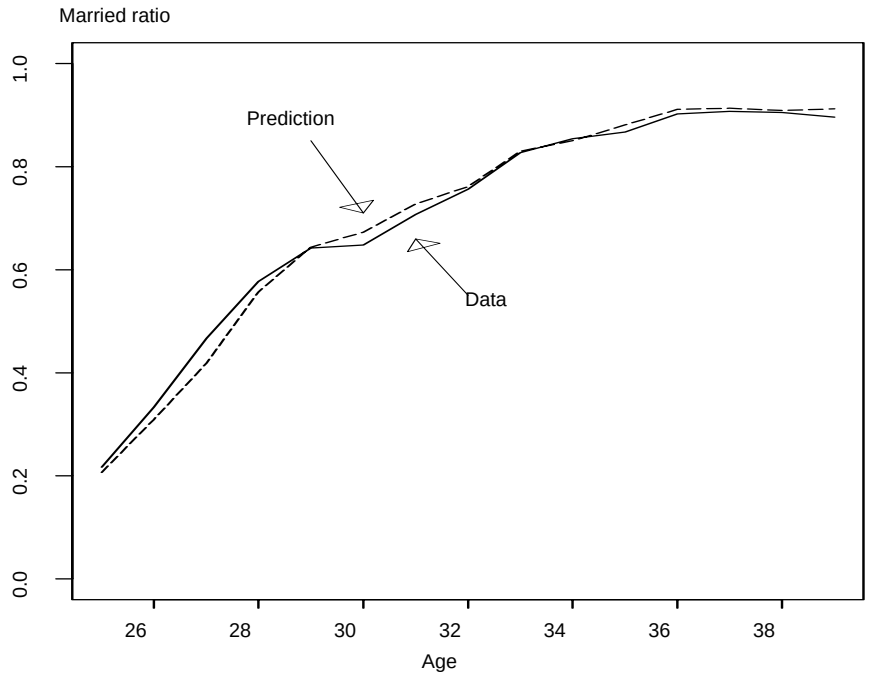


Figure 2: Predicted and Actual Ratios of Married Women

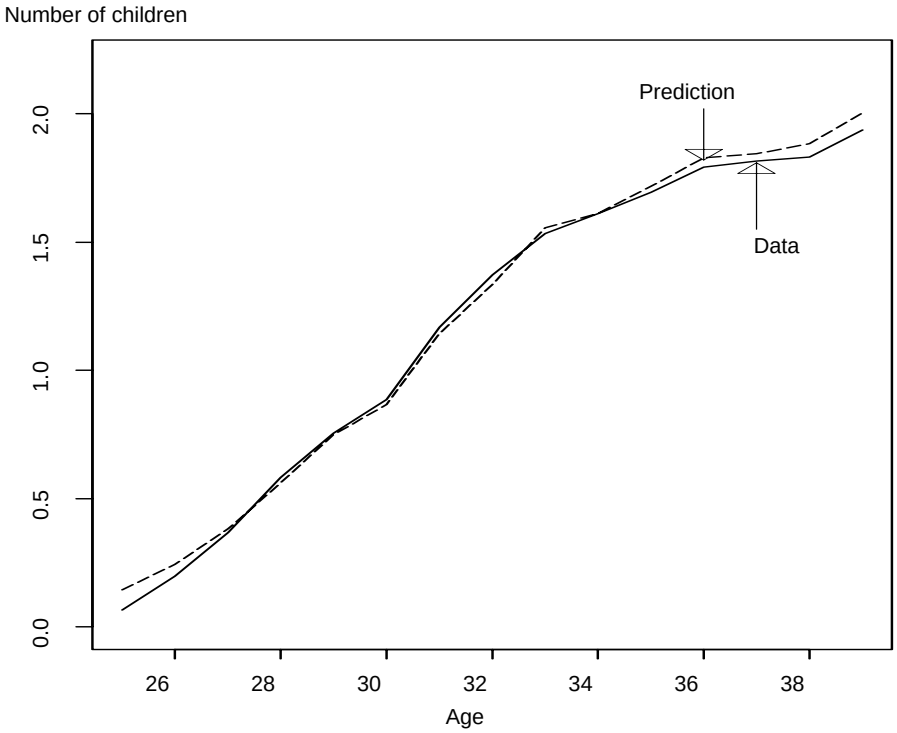


Figure 3: Predicted and Actual Numbers of Children

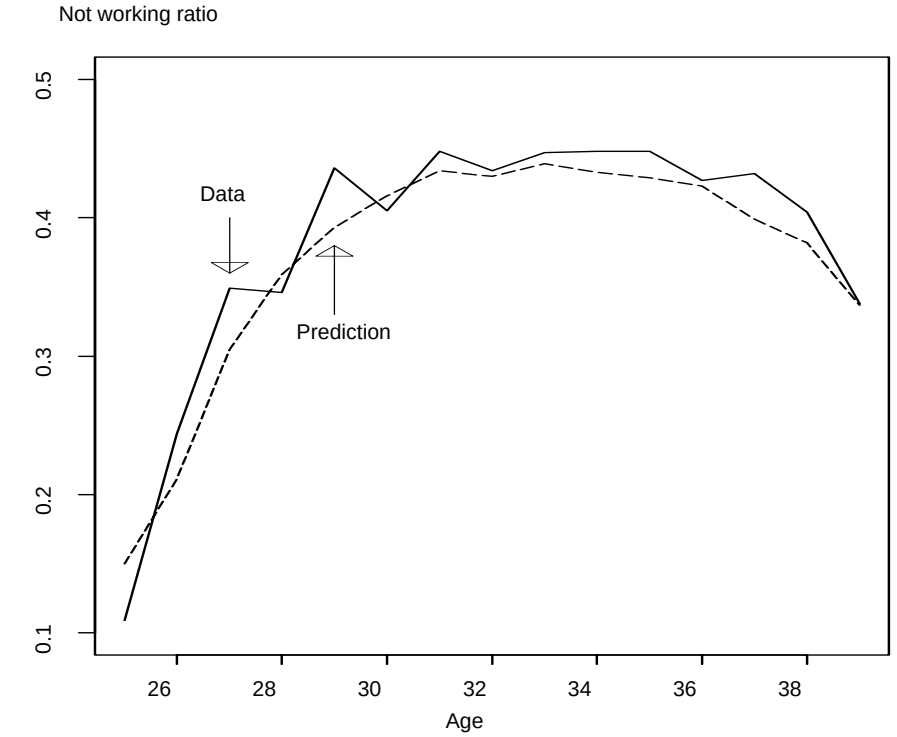


Figure 4: Predicted and Actual Ratios of Women Not Working

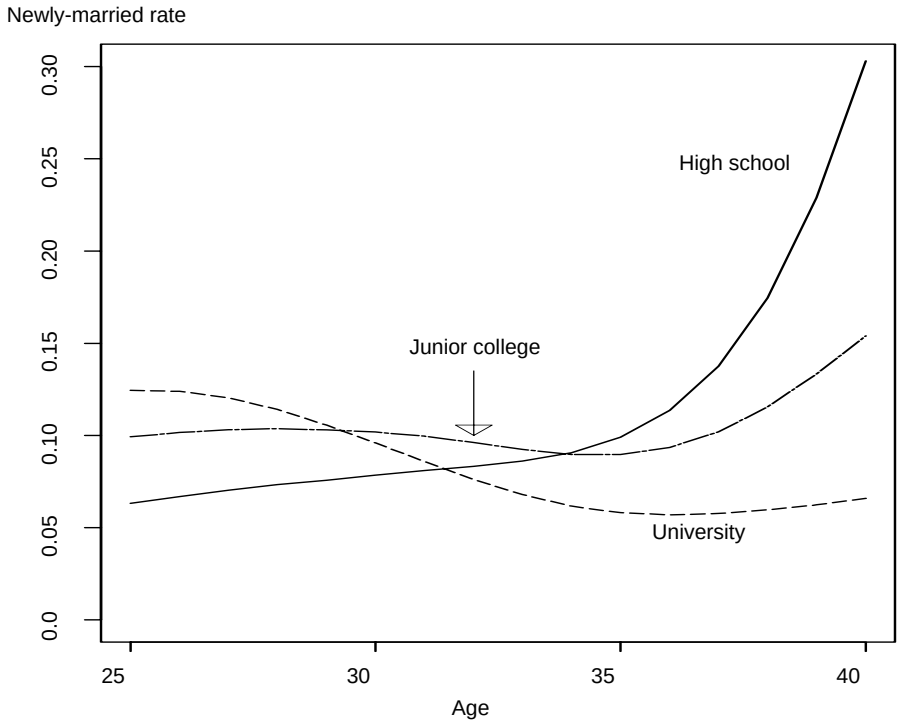


Figure 5: Newly-Married Rates of Singles

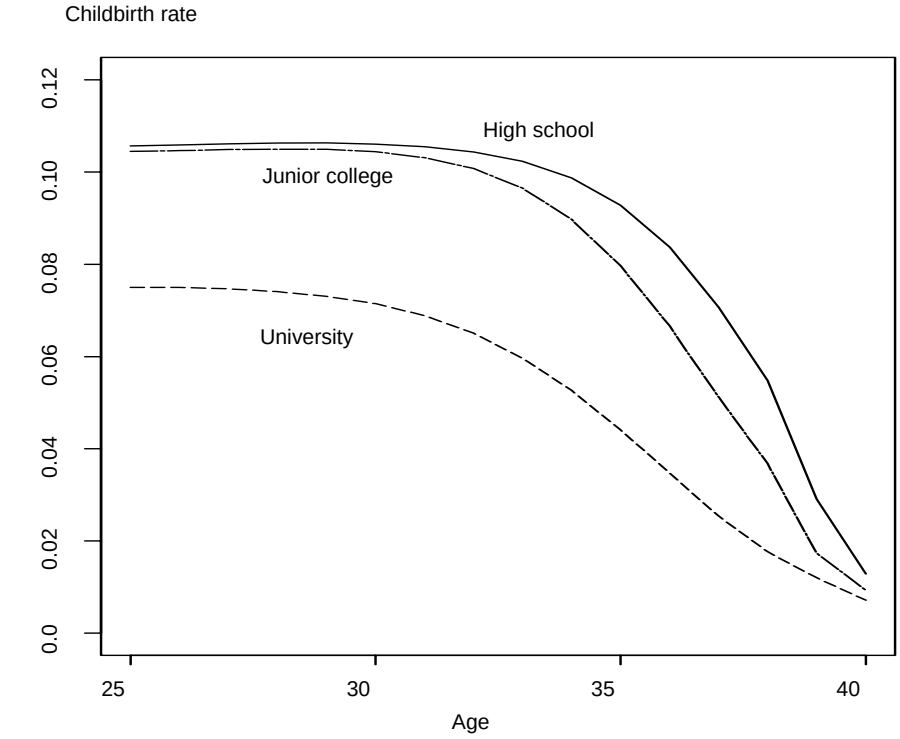


Figure 6: Child-birth Rates of Married Women Working Full-time