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Abstract

This paper empirically examines marriage, childbearing, and labor force participation behavior of fertile-aged women in Japan, applying an estimable dynamic model of discrete choice. Using microdata from the 1994-99 Japanese Panel Surveys on Consumers, the structural estimation result suggests that, overall, women are worse-off with marriage and part-time work without financial benefits. Women are better-off having two or more children, but considerably worse-off because of the burden of raising infants. In addition, probabilities of finding full-time work after career interruption are estimated at about 18% for university-educated women and 12–13% for less-educated women.

JEL classification number: J12, J13

1 Introduction

In the last two decades, Japanese society has faced a steady decline in fertility associated with the increasing participation of women in the labor force. Nowadays, young people increasingly delay or avoid marriage: the percentage of never-married women aged 25–34 increased from 15.9% in 1980 to 41.0% in 2000. The total fertility rate fell from 1.75 in 1980 to 1.29 in 2003. During that time, the labor force participation rate of women aged 25–59 rose from 48.8% in 1980 to 65.5% in 2000.

Numerous empirical studies have shown that the supply of female workers is related closely to characteristics of the family background such as the husband's income or presence of children (Killingsworth and Heckman, 1986). Nevertheless, many studies have analyzed the supply of female laborers by specifically addressing only married women and treating the family structure as exogenous. Countering such studies, there is increasing awareness of the importance of simultaneity in decisions regarding labor supply and family formation, and the timing and spacing of life-cycle choices of family formation that affect the female labor supply (Moffitt, 1984).

A growing literature has applied estimable stochastic dynamic models of discrete choice for women's life-cycle choice problems (Eckstein and Wolpin, 1989b). Wolpin's (1984) pioneering work established a complete framework of a structural estimation of a dynamic programming model; it analyzed a childbearing decision problem along with uncertainty in infant survival in Malaysia. In addition, Ahn (1995) empirically analyzed a choice problem of childbearing to estimate the perceptive value of children according to gender in Korea. In examining the labor force participation choice of married women, Hotz and Miller (1988) included contraceptive choices with uncertainty. Eckstein and Wolpin (1989a) considered the presence of children. Hyslop (1999) included job-search uncertainty. In another study, Francesconi (2002) considered fertility and labor supply of full-time and part-time employment.

These studies on fertility and the female labor supply in life-cycle specifically addressed the behavior of women who are continuously married. However, as reported in the seminal work by Becker (1973, 1974), utility gains from marriage may differ according to financial benefits. Therefore, the marital timing decision could be chosen endogenously depending on the (potential) life-cycle income of a woman and her spouse. Van Der Klaauw (1996) made the first contribution to an integration of marital status decision into the labor supply behavior of women, demonstrating that utility gains from marriage are affected by a woman's wage rate and her husband's earnings.

This study investigates women's behavior of family formation and labor force participation in Japan by applying an estimable dynamic model of discrete choice. The proposed model integrates decisions regarding marriage, childbearing, and labor force participation into a lifetime utility maximization problem. The model includes four job states: not working, full-time employment, on childcare leave, and part-time work, with uncertainty in finding a full-time position. Using the model, this paper investigates the degree to which job opportunities are limited for women after career interruption. Application of the structural estimation method developed by Rust (1987, 1988) allows estimation of perceived utility gains and losses from labor force participation, marriage, children by birth order, and childcare of infants.

The structural estimation result suggests that, overall, women are worse-off with marriage and part-time work without financial benefits. Women are better-off having two or more children, but considerably worse-off because of the burden of raising infants. In addition, probabilities of finding full-time work after career interruption are estimated at about 18% for university-educated women and 12–13% for less-educated women. This result confirms that women face difficulties in finding full-time work after career interruption across marriage and childbirth. Simulation using estimates illustrates that a removal of utility loss from marriage engenders an increase in marriage rates, and that a reduction in utility loss from raising infants engenders an increase in childbirth.

The remainder of this paper is organized as follows. Section 2 presents an empirical framework of a dynamic decision model for fertile-aged women regarding marriage, childbearing, and labor force participation with limited job opportunity. Section 3 presents discussion of the data sources, variables, and assumptions. Section 4 presents the estimation result of the model, and Section 5 illustrates some simulation results to draw policy implications. Section 6 gives concluding remarks.

2 The model

2.1 Life-time optimization problem

The analytical framework presented here integrates a typical woman's life-cycle joint decision of marriage, childbearing, and labor force participation, in consideration of the social environment in Japan. It is assumed that, after graduating school, a woman behaves in a manner to maximize the present value of utility over a known finite horizon T by choosing whether or not to marry, whether or not to have a child or children, 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

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

where E denotes the expectations operator, δ is a discount factor, $u()$ is a single-period utility function, c_t is consumption, j_t is job state, m_t is marital state, b_t is a vector reflecting children composition, subscript t is period, and β is a set of parameters.

The utility function includes perceived costs and benefits of labor force participation, marriage, and children in her social and private life in addition to consumption. Labor force participation is inferred to bring satisfaction with social and private life in addition to financial benefits from earnings. In addition, a marriage is considered to bring financial benefits because of scale economies that accompany married life together, e.g., sharing an apartment and cooking duties (Becker, 1973; 1974) and also resolving wage inequality between men and women, as well as a sense of stability and satisfaction in family and social life. Children also bring happiness, but raising infants needs a lot of time and devotion. Furthermore, labor force participation and the family structure are deeply related to a woman's welfare through the allocation of time (Becker, 1965; Gronau, 1973); this is particularly true in Japan, where husbands typically spend an "exceptionally short" time performing housework in comparison with those of other advanced countries (Juster and Stafford, 1991).

The budget constraint is given as

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

where y_t is the household income and g is a function of consumption depending on the total household income (y_t) and family structure (m_t, b_t). It is assumed that a husband works full-time in each period, and that no savings or debts persist to later periods. 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 male employees aged 25–59 are regular employees or executives[1]. Although the latter assumption appears more restrictive[2], the family income is treated as a proxy of consumption to retain the focus of this analysis on the life-cycle decision problem of labor force participation and family formation.

2.2 State, choice, and transition of state

States in each period are characterized by job state j_t (0 when not working, 1 when working full time, 2 when working part time, and 3 when taking the legitimated childcare leave to take care of an infant of age zero), marital state 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 without infants aged 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 the woman maximizes the objective by choosing (i) whether or not to marry when she is unmarried: $dm_t = 0$ (to remain unmarried) or 1 (to marry); (ii) whether or not to bear a child: $db_t = 0$ (not planning childbearing), or 1 (planning childbearing); and (iii) labor force participation: $dj_t = 0$ (not to work), 1 (to work full time), 2 (to work part time), 3 (to quit work for childbearing, and to continue the current job state otherwise) only for working women hoping childbirth, or 4 (to take childcare leave accompanying childbirth, and to continue the current job state otherwise) only for women working full time and planning childbearing, at the end of period t[3]. Choices $dj_t = 0$ and 2 are not allowed for full-time workers on childcare leave. Consequently, the joint choice set is defined as $d_t = \{dj_t, dm_t, db_t\}$. It should be noted that the timing of these life events is also important because some choices may not be reversed easily. For example, parents must care for children until they come of age. In addition, divorce is

[1] The 1992 Employment Status Survey of Japan.

[2] A similar assumption in imposed 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 retirement period after T, this assumption does not affect the estimation.

[3] Choices might be made sequentially with regard to the required gestation period and rather immediate act of quitting work. Notwithstanding, the model treats that these choices are made one period before, because of the limitations of the proposed model and data from annual surveys.

Table 1: Transition of States

Job State

(j_t, dj_t)	j_{t+1}	$\Pr(j_{t+1} \mid j_t, dj_t)$
(0-2, 0)	0	1
(0, 1)	1	π
	0	$1-\pi$
(1&3, 1)	1	1
(2, 1)	1	π
	2	$1-\pi$
(0-2, 2)	2	1
(1&3, 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

Marital state

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

Number of children

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

costly, both financially and socially, and time-consuming; it can also be legally declined without spousal consent in Japan. A final example is that a woman will likely face difficulty in finding full-time work after career interruption[4].

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, some choices are not necessarily realized in the next state, and some states may evolve without choices. Table 1 summarizes probabilistic transformation from the current state s_t and the decision d_t to the next state s_{t+1}, as follows.

Regarding job state, j_t evolves according to decision dj_t. It is assumed that anyone can freely quit work, move to part-time work, or retain their current job state. However, transfers to full-time work ($dj_t = 1$) from other state can be successful only with a probability of π because of limited opportunities for full-time work after career interruption. For that reason, remaining not working involves choosing to continue not to work and the failure to get a full-time position (unemployed). Childcare leave is considered only for full-timers. Such leave for part-timers is

[4] 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).

treated as quitting work because childcare leave for part-timers may not be insured and because finding similar work is much easier than finding a full-time position.

Regarding marital state, the model includes the assumption that any unmarried woman ($m_t = 0$) is able to marry whenever she wishes ($dm_t = 1$)[5]. Married women are assumed to continue to be married except in cases of accidental death of the husband or divorce, which occur with a probability of P_m.

Concerning childbearing, the model incorporates the assumption that a woman will bear an additional child when desired ($db_t = 1$) with a given probability of P_b. Unexpected childbirth is not accounted for here, considering free access to inexpensive contraception methods and abortion in Japan.

Regarding 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. The age of the youngest child q_t is considered separately for ages 0–2 to control additional costs and benefits that go along with raising infants and to account for the spacing of childbirths. The variable q_t evolves according to childbirth and growth of existing children.

The model process follows that of Rust (1987, 1988); it is characterized by the state: $s_t = \{j_t, m_t, n_t, q_t\}$ from the set of state S, and the decision $d_t = \{dj_t, dm_t, db_t\}$ from the set of decision $D(s_t)$ which 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

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

An important consideration is that possible fertile periods are shorter than women's economic periods. In order to specifically address the joint decision problem with childbearing, and also

[5] One rationale for this assumption is that the current marriage market in Japan is likely to favor the wishes of women; for ages 25–39, 44.8% (or 5.6 million) of men are unmarried, whereas 30.2% (or 3.7 million) of women are unmarried (the 1995 Population Census of Japan). Furthermore, for ages 30–34, almost three out of four never-married women believe that they do not need to marry until they find ideal partners, whereas half of never-married men hope to marry before reaching a certain age (The 10th Japanese National Fertility Survey in 1992).

because of the restrictions of data described later, decision periods are limited to fertile periods from the initial period (after graduating school) to the last decision period, τ. Consequently, the optimization problem (1) can be rewritten as

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

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 periods $\tau + 1$ and T. Then, the single optimal choice at the last decision period d_τ is determined for each state s_τ. By backward recursion, the optimal choice for each state can be obtained throughout the decision periods.

2.3 Econometric specification

A simple single-period utility function of a logarithmic form of consumption with additional effects depending on state can be written as

$$u(s_t, d_t; \beta) = \ln y(j_t, m_t, t) + \beta' \cdot h(s_t) + \varepsilon_t(d_t), \quad (4)$$

where $\varepsilon_t(d_t)$ is an unobservable state variable that may depend on choice variables. Letting time t represent the woman's age, the first component stands for utility gains from consumption, which is assumed to be an average of the earnings of the couple in the case of married women:

$$y(j_t, m_t, t) = \begin{cases} y_1(j_t, t) & \text{for unmarried women} \\ \{y_1(j_t, t) + y_2(t)\}/2 & \text{for married women,} \end{cases} \quad (5)$$

where $y_1(j_t, t)$ represents the earnings of the woman as a function of her job state and age, and $y_2(t)$ represents the earnings of the husband depending on age. The second component comprises additional utility gains and losses that arise from labor force participation, marriage, and the presence of children:

$$\beta' \cdot h(s_t) = \beta_1 \cdot I(j_t = 1) + \beta_2 \cdot I(j_t = 2) + \beta_3 \cdot I(m_t = 1) + \beta_4 \cdot I(n_t \geq 1) + \beta_5 \cdot I(n_t \geq 2)$$
$$+ \beta_6 \cdot I(n_t = 3) + \beta_7 \cdot I(q_t = 0) + \beta_8 \cdot I(q_t = 1) + \beta_9 \cdot I(q_t = 2) \quad (6)$$

where $h(s_t)$ is a vector of dummy variables converted from state s_t, and $I()$ is the indicator function, which assumes a value of 1 if its argument is true, and a value of 0 otherwise. With regard to labor force participation, β_1 and β_2 indicate perceived utility gains and losses from full-time and part-time work because earnings are included in the first component $y(j_t, m_t, t)$. Mothers on childcare leave are assumed to receive utility equivalent to 'not working' at the current period, in addition to the benefit of 25% of the usual monthly salary by virtue of the government's employment insurance program.

For marriage, β_3 measures utility gains and losses from marriage, ignoring financial benefits attributable to the presence of the husband. Examples of costs of marriage for women are household duties, financial restraints, or time allocation restraints.

With regard to children, β_4, β_5, and β_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 and time allocated to raise children, along with perceived costs and benefits from having children. The variables β_7, β_8, and β_9 indicate additional utility gains and losses from raising infants: if their total effect equals zero, these effects simply control spacing preferences of childbirths; if the total is positive (negative), it could indicate additional gains (losses) by raising infants.

Alternatively, we consider the following specification to reflect job-specific effects on marriage and children:

$$\begin{aligned}
\beta' \cdot h(s_t) = {} & I(j_t = 0, 3)\{\beta_1 \cdot I(m_t = 1) + \beta_2 \cdot I(n_t \geq 1) + \beta_3 \cdot I(n_t \geq 2) \\
& + \beta_4 \cdot I(n_t = 3) + \beta_5 \cdot I(q_t = 0) + \beta_6 \cdot I(q_t = 1) + \beta_7 \cdot I(q_t = 2)\} \\
& + I(j_t = 1)\{\beta_8 + \beta_9 \cdot I(m_t = 1) + \beta_{10} \cdot I(n_t \geq 1) + \beta_{11} \cdot I(n_t \geq 2) \\
& + \beta_{12} \cdot I(n_t = 3) + \beta_{13} \cdot I(q_t = 0) + \beta_{14} \cdot I(q_t = 1) + \beta_{15} \cdot I(q_t = 2)\} \\
& + I(j_t = 2)\{\beta_{16} + \beta_{17} \cdot I(m_t = 1) + \beta_{18} \cdot I(n_t \geq 1) + \beta_{19} \cdot I(n_t \geq 2) \\
& + \beta_{20} \cdot I(n_t = 3) + \beta_{21} \cdot I(q_t = 0) + \beta_{22} \cdot I(q_t = 1) + \beta_{23} \cdot I(q_t = 2)\}. \qquad (7)
\end{aligned}$$

The sample likelihood function[6] 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 women in the sample , t_n is the initial age in the sample, τ_n is the

[6]Without observing the full decision data, the likelihood function is estimated. The Japanese Panel Survey of Consumers (JPSC) data do not include childbirth decisions (or use of contraception methods). Moreover, responses to job search behavior appear to be unreliable in their relationship to actual labor force participation behavior.

last decision age or the sample age at the survey before τ, and p is a transitional probability from the current state and decision to the next state with a probability of 1, π, $(1-\pi)$, P_m, $(1-P_m)$, P_b, $(1-P_b)$, or their combination from Table 1. Probability P to choose d_t takes the multinomial logit formula with the assumption of disturbances $\varepsilon_t(d_t)$ in the utility function (4) that are distributed independently and identically with type I extreme-value distribution[7].

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

For estimation, the expected value function EV_{t+1} of equation (2) is calculated numerically for all states and decisions at each decision period because the function is not obtained analytically [8].

3 Data description and assumptions

3.1 Data source

Data are obtained from the 1994–1999 rounds of the Japanese Panel Surveys of Consumers (JPSC) surveyed annually. The JPSC started as panel surveys of 1,500 women aged 24–34 in 1993 (Panel A) and added 500 women of aged 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 marriage rate, of similar individuals in Japan.

The JPSC offers rich information pertaining to individual and family members' characteristics such as age, education, marital status, and job status. However, "childcare leave" was not in the choice set of the job status in questionnaire in the 1993 round[9]. Therefore, the final sample includes 6,926 observations from transitional periods in 1994–95, 1995–96, ..., and 1998–99, omitting observations in school and those with husbands not working (unemployed or in school). Observations are further grouped according to educational level in light of the heterogeneity of

[7] For similar specifications, see Rust (1987), Ahn (1995), and Van Der Klaauw (1996).

[8] Estimation is also conducted with the simulated annealing optimization program by Goffe (1996). Needless to say, all remaining errors are the author's.

[9] The JPSC offers no choice of "legitimate maternity leave" (6 weeks before and 8 weeks after delivery, with at least 60% compensation of monthly earnings) as job status.

preferences and job opportunities; 3,442 observations of high-school or less educated, 2,629 observations of the two-year junior college educated including technical school education[10], and 855 observations of university educated or more educated.

3.2 Variables

With regard to the job state, "full time" is considered to be regular employment, and "part time" includes part-time employment and all other work (such as self-employment or work in a family business); in the case of women, the average of annual full-time earnings is greater than three million yen, whereas part-time earnings are less than half that of full-time. Here, childcare leave is assumed to be taken in only one period with childbirth; observations with two or more consecutive periods of childcare leave without another childbirth, or with childcare leave without infants of age zero are classified as "not working"[11]. The total family income are shown in ten-thousand-yen units, with one yen added to avoid infinitely negative utility for singles who are not working.

For marital state, "unmarried" women includes those women who have never married, along with those who are divorced and widowed. Probabilities regarding the transition from married to unmarried state P_m are retrieved from national surveys according to 5-year age groups, as shown in the Appendix, because of limited observations in the sample. In addition, it is assumed that a husband is two years senior to his wife, as implied by the national average[12]. All children are assumed to survive until the end of economic period, residing with the mother in cases of divorce[13].

Table 2 presents the characteristics of the sample according to marital state and educational level. In terms of family formation, 57–78% of the observations are married before the transition; less-educated women are more likely to be married, and almost 10% of unmarried women marry after the transition. Furthermore, 74–91% of married women have at least one child: 36–42% of married women have 2-year-old or younger infants, and 10–16% of married women gave

[10] 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.

[11] It is possible that a company offers the childcare leave beyond the legitimate leave. Nevertheless, this type of company is still quite rare, and such leave is typically unpaid leave. Only several observations fall into this category.

[12] The 1995 Vital Statistics of Japan.

[13] Of single-parent households with children aged 5 or younger, 93.1% 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 status						
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%

birth during the transition. Better-educated women have fewer children, but have more infants than others. Unmarried mothers mostly experience divorce; and childbirths from previously unmarried women are usually associated with marriage.

In terms of the job state before transition, 86–95% of unmarried women work, whereas almost half of married women do not work. Better-educated women are more likely work full time, whereas less-educated women are more likely to work part time. It should be noted that job transitions are often associated with family state transitions such as marriage or childbirth. Women who work part time are more likely to quit work than those working full time. Better-educated women are more likely to take childcare leave than less-educated women.

3.3 Assumptions

In estimating the model, several assumptions are imposed on some parameters for estimation because of limited age coverage of the JPSC and computational limitations.

First, potential earnings are estimated from the 1993 Wage Census of Japan by interpolation of average ages and earnings, by 5-year age group and education because the JPSC surveys only women in their twenties and thirties along with their husbands, who are mostly of the same generation[14]. As illustrated in Fig. 1, earnings curves differ according to education and gender. Within the same educational level, women earn less than men; earnings of less-educated women rise only slightly with age. Earnings from part-time jobs are assumed to be one million yen a year in the case of married women because a married woman working part time tends to restrain her annual income to less than one million yen to retain dependent privileges (including income tax exemptions, exemption from social security payments, and family allowances paid to the husband)[15]. Earnings of unmarried women working part time are estimated to be 1.4 million yen using JPSC data.

Secondly, the final decision age τ is assumed to be 39: no childbirths are assumed to take

[14] Microdata from national surveys, including the Wage Census, are not usually accessible to researchers. 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 prediction using the Wage Census for the twenties and thirties. Nevertheless, it is unreliably low for the forties and fifties. Ahn (1995) estimated the wage equation from an exogenous source.

[15] 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 round 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 at some future time.

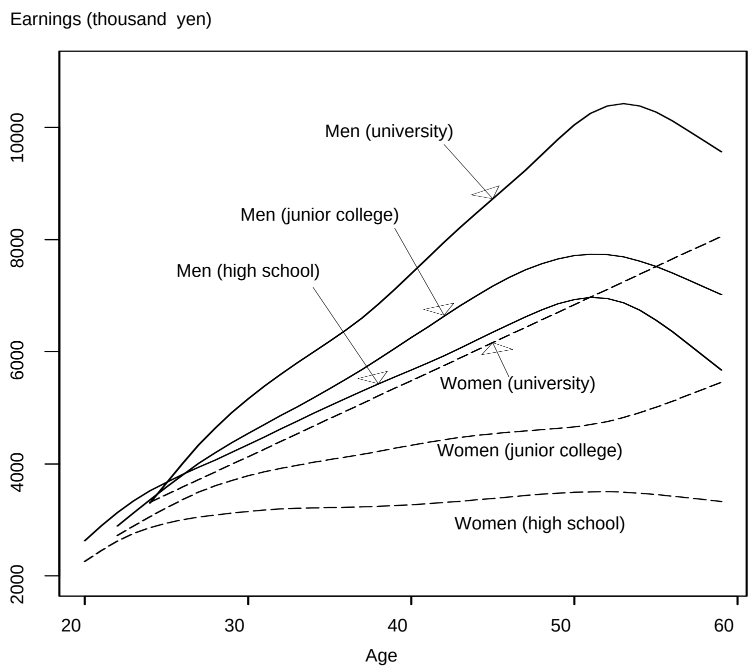

Figure 1: Annual Earnings by Education and Gender

place at the mother's age of 41 or older[16]. Ages of individuals of the sample ranged from 24 to 40. In addition, we sought to reduce the computational burden attributable to the "curse of dimension." The selected number of decision periods is 16, from age 24 to 39. The last economic age T is set to 59 because most private and public organizations had a mandatory retirement system at age 60 in the 1990s. From age 40 to the last age of economic period, a probabilistic process that is compatible with national averages is assumed for job and marital state transition, as described in the Appendix. Earnings of husbands aged 60–61 are conventionally assumed to be 60% of the earnings at age 59, considering that the husband works part time or receives a pension after retirement.

Finally, regarding other parameters, the discount factor δ is set to be 0.90 here. Examination of this choice shows that it does not alter implications from estimation results. Furthermore, income for women taking childcare leave is assumed to be 25% of full-time earnings from the government's employment insurance program throughout the sample period[17]. The probability of childbirth when a woman desires to bear a child (P_b) is set as 0.4[18], in order to apply the

[16] In Japan, 98.9% of newborns are born of mothers aged 39 or younger (the 1995 Vital Statistics of Japan).

[17] Childcare leave was legitimated in 1992 without benefits. From 1995, benefits during childcare leave were mandated as 25% of monthly earnings initially. That level was raised to 40% in 2000.

[18] Hotz and Miller (1988) estimated the monthly conception probability without contraception as around 2.5%

Table 3: Estimation Results (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)*
Second 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.

same probability to subsamples according to education.

4 Estimation results

4.1 Estimation results for marriage, children, and labor force participation

Table 3 presents estimation results with the simple utility function using equation (6), to show general features of utility gains and losses (or costs and benefits) from labor force participation and family formation. Several features implied by the results are listed.

First, regarding utility gains and losses from labor force participation ignoring financial benefits, effects of labor force participation are negative, whereas negative effects of full-time work are relatively small. University-educated women lose the least from full-time work and lose the most from part-time work compared to others.

Secondly, utility gains and losses from marriage are negative for all educational groups. It is noteworthy that benefits from higher earnings of husbands are not included here. This result suggests that, without considering financial benefits, women have reduced utility as a result of marriage, suggesting that disadvantages of marriage surpass putative advantages such

(equivalent to an annual probability of 26.2% as a compounded rate), but they noted that "this is somewhat low relative to those from natural fertility populations".

as economies of scale achieved through cohabitation. One salient disadvantage may be the imbalance in housework responsibilities between the husband and wife.

Thirdly, regarding children, estimated utility gains from the second child are the largest, and those from the first child are the smallest or even negative (but not significant). According to educational level, estimated gains are the largest with the university-educated sample, and the smallest with the junior-college-educated sample. This result suggests that the costs surpass benefits (or perceived happiness) of having the first child, whereas benefits surpass the costs of having the second child, and also the third child (but with a similar smaller effect). One explanation for this result is that new mothers require more effort than experienced mothers to care for the first child; also, marginal benefits from the third child are relatively low while marginal costs are relatively unchanged for the third child.

Fourthly, effects of the presence of infants are estimated negative for infants of age zero, positive for infants of age one, and negative for infants of age two (but effects of infants age 1-2 are not significant with the university-educated sample). The considerably large negative estimates for infants of age zero suggest that nursing newborns is costly and time consuming. Other effects of infants might include childbirth spacing considerations[19], and costs and benefits of care for infants.

Finally, the probability of finding full-time work during the transition are estimated to be as low as 23% for the university-educated sample, and 20–21% with less-educated samples. This result confirms difficulties for women to find full-time work after career interruption, but university education improves that situation slightly.

4.2 Estimation results with job-specific effects

It is possible that utility gains and losses attributable to family formation differ depending on the job state[20]. Table 4 presents estimation results with the utility function using equation (7). The result suggests several features that supplement those of the previous results.

First, effects of full-time and part-time work are negative for all educational groups: part-

[19]If a woman with a newborn avoids conceiving additional babies in a serial fashion, she loses the positive effect of the youngest baby at age one. She may not be physically prepared for activity soon after the delivery, and 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.

[20]Different effects of consumption across job status were also considered as in Francesconi (2002) because market work of a wife might demand additional expenses for the household. Nevertheless, this effect was not significant.

Table 4: Estimation Results (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)
Second 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-timers						
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)
Second 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 Probability	0.127	(0.010)***	0.123	(0.012)***	0.175	(0.024)***
Part-timers						
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)
Second 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.

timers lose utility more than full-timers with less-educated samples, and vice versa with the university-educated sample. Probabilities of finding full-time positions after career interruption are estimated to be as low as 17.5% for the university-educated sample, and 12–13% with less-educated samples. Secondly, regarding negative effects of marriage, wives who work full time lose the least; housewives lose the most. According to educational level, university-educated wives lose less than other wives, but this difference seems to be small for working wives. Thirdly, utility gains from the first child are positive for mothers who work part time, whereas they are negative, but not significant, for others. Finally, utility losses incurred through care of a baby of age zero are the smallest for housewives and the largest for mothers working part time, possibly because of social support programs for working mothers that give priority to full-timers. Consequently, part-timers are more likely to withdraw from the labor market than full-timers across childbirth. Among mothers working full time with babies of age zero, better-educated mothers lose more utility than others.

It is noteworthy that the estimated utility gains and losses are marginal effects of respective change in family formation in the same job state. For purposes of comparison across job state, Table 5 compares a single-period utility according to job and family type referring to single (childless unmarried) women working full time. For example, the stated value of "working full time, married with two children" is the sum of estimates on work, marriage, the first child, and the second child when working full time. The column of "costs of infants age 0–2" indicates the sum of estimates of the youngest age zero, one, and two: the figure implies an additional cost to raise an infant without subsequent childbirth in the next two years. Furthermore, figures adding the log of total family income (plus one) at age 30 are presented to include financial benefits from work and marriage.

According to Table 5, junior-college or less-educated singles working full time are worse-off across marriage and the first childbirth, but better-off with two or more children. University-educated women are better-off across marriage with two or more children only when continuing full-time work. This result is not altered in consideration of financial benefits, as shown in the table. Then, why do most women not choose to have three or more children and work full time to garner utility? The salient reason is the considerable one-time utility loss incurred when

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

	Unmarried	Married				Costs of
	no children	no children	one child	two children	three children	infants age 0–2
High school	without log-income					
Not working	-	-0.69	-0.81	0.06	0.36	-7.03
Full-time	0.00	-0.39	-0.63	0.64	0.95	-10.35
Part-time	0.54	-1.14	-0.80	0.05	0.43	-14.74
Junior College						
Not working	-	-0.61	-0.62	0.25	0.34	-6.76
Full-time	0.00	-0.41	-0.69	0.66	0.99	-11.47
Part-time	0.43	-1.31	-0.82	0.22	0.44	-14.60
University						
Not working	-	-0.71	-0.84	-0.08	-0.01	-7.46
Full-time	0.00	-0.50	-1.01	0.16	1.14	-10.11
Part-time	-0.04	-1.64	-1.26	-0.34	-0.42	-13.49
High school	with log-income					
Not Working	-	1.67	1.55	2.42	2.72	-7.03
Full-time	2.50	2.20	1.96	3.23	3.54	-10.35
Part-time	2.54	1.31	1.65	2.50	2.88	-14.74
Junior College						
Not Working	-	1.78	1.77	2.64	2.72	-6.76
Full-time	2.58	2.23	1.94	3.30	3.63	-11.47
Part-time	2.43	1.15	1.65	2.69	2.90	-14.60
University						
Not Working	-	1.74	1.61	2.37	2.44	-7.46
Full-time	2.62	2.19	1.68	2.85	3.83	-10.11
Part-time	1.97	0.88	1.26	2.18	2.10	-13.49

Compared to childless unmarried women who work full time.
The job state of not working for singles is not considered.

raising infants. Having a new baby requires total utility losses of 6.8–14.7 in the following two years without subsequent childbirth.

5 Policy implications from simulation

This section presents simulations that draw policy implications for women's labor force participation and family formation behavior. The expected one-period-ahead transition, which conditioned the previous state, is simulated, rather than the long-run transition. Thereby, prediction error is reduced. Before proceeding, the prediction performance of the estimation is shown in figures 2, 3, and 4, which compare predicted and actual percentages of married women,

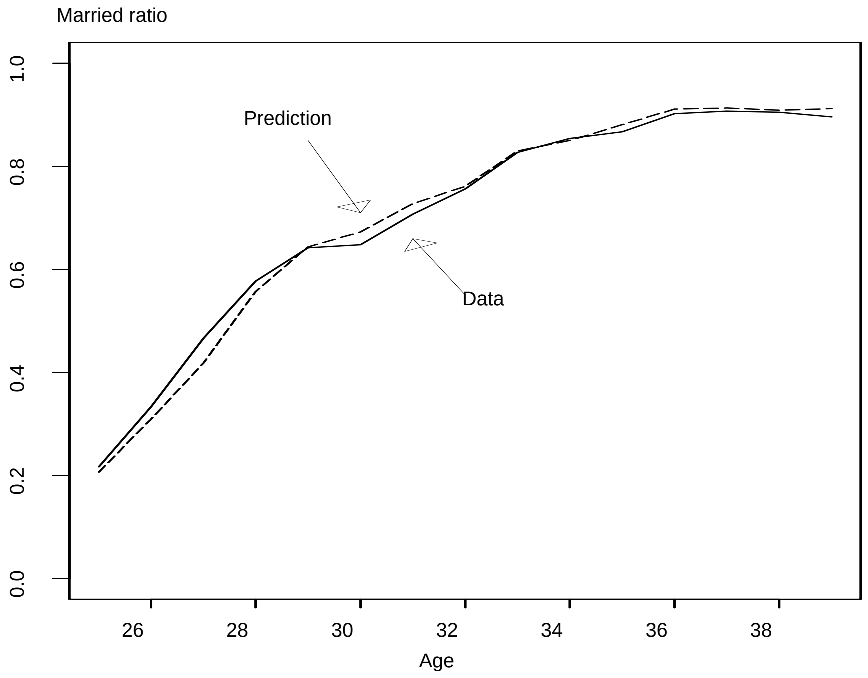

Figure 2: Predicted and Actual Percentages of Married Women

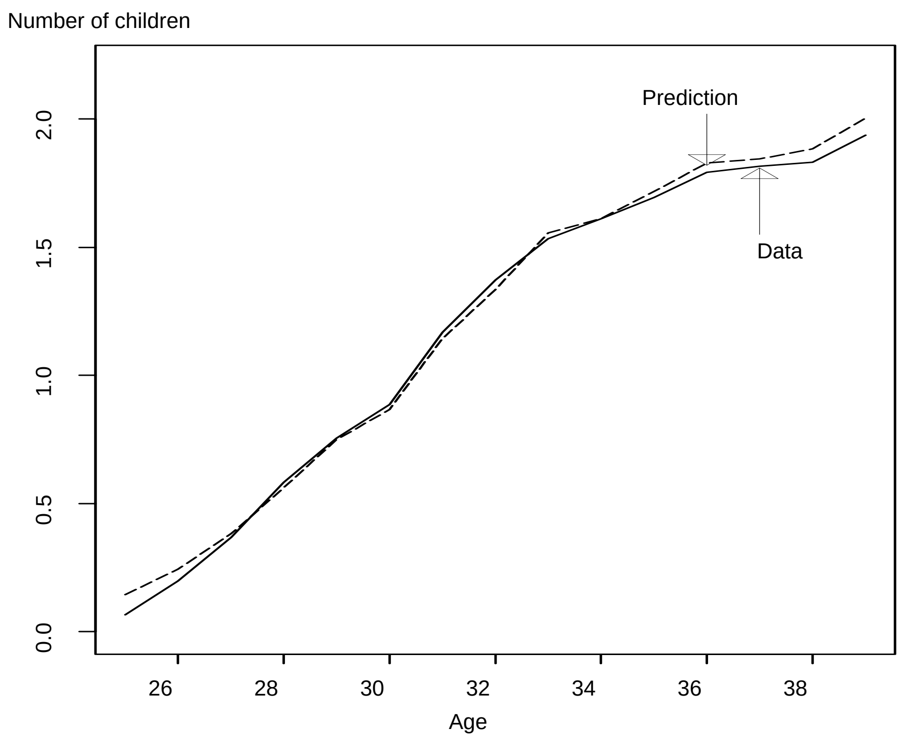

Figure 3: Predicted and Actual Numbers of Children

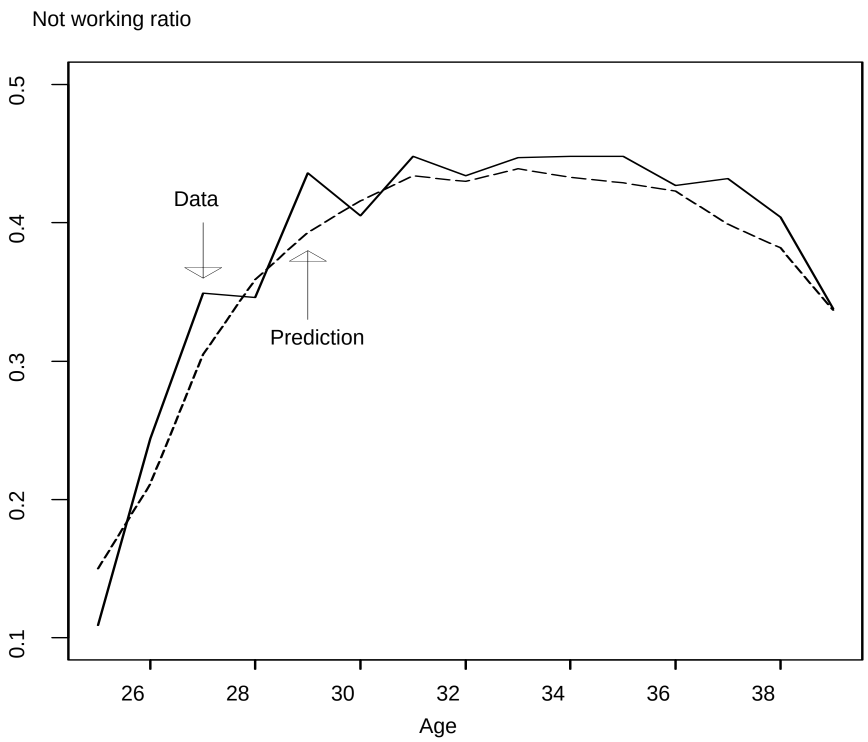

Figure 4: Predicted and Actual Percentages of Women Not Working

average numbers of children, and percentages of those not working, using the estimate of the junior-college-educated sample in Table 4 as an example. Overall, the prediction seems to fit the actual data fairly well. Simulation specifically addresses the behavior of marriage, job choice, and childbirth behavior of women working full time.

5.1 Marriage, earnings, and disadvantages of marriage

Figure 5 presents simulated newly-married rates out of childless unmarried women working full time in the previous period. The figure shows that newly-married rates are lower for less-educated women in their mid-twenties (possibly because less-educated women are married before age 24 with greater frequency than better-educated women), but those rates become higher in the late thirties. High-school educated singles increasingly seek marriage as they become older; junior-college-educated singles consistently seek marriage; and university-educated singles tend to seek marriage less as they become older.

Earnings equality between men and women mitigates the financial necessity of marriage for women, thereby engenders contributing to a declining birth rate in Japan. Table 6 presents simulated newly-married rates for women who are 25, 30, and 35 years old, assuming: current

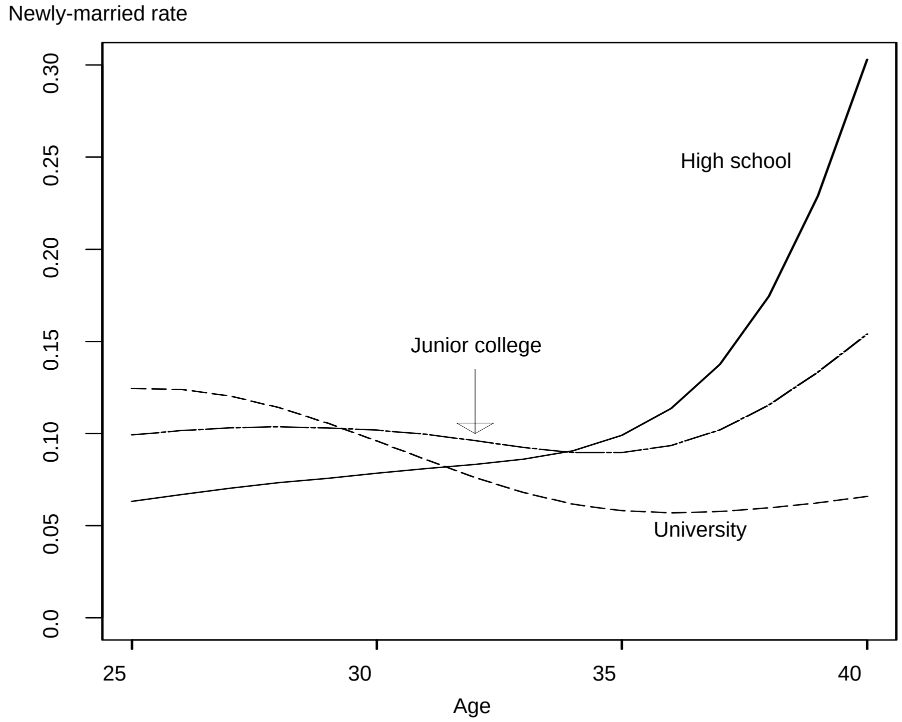

Figure 5: Newly-Married Rates of Singles

Table 6: Newly-Married Rates and Earnings

	High school			Junior college			University		
Age	(A)	(B)	(C)	(A)	(B)	(C)	(A)	(B)	(C)
25	6.3%	2.2%	5.7%	9.9%	6.0%	12.5%	12.5%	6.0%	20.4%
30	7.9%	1.5%	5.4%	10.2%	3.6%	10.8%	9.6%	3.0%	17.4%
35	9.9%	1.6%	8.4%	9.0%	2.4%	13.4%	5.8%	1.9%	19.4%

Childless unmarried women working full time at the previous state.
(A) current earnings, (B) equalized earnings between men and women,
(C) equalized earnings and no marriage disadvantages

earnings in case (A), equal full-time earnings between men and women in case (B), and equal full-time earnings and no utility losses from marriage when working full time in case (C), which might be realized if a husband equally shares housekeeping with a wife who works full time.

That simulation result confirms that equal earnings would reduce incentives for singles to marry, as shown in case (B), irrespective of age and education. Then, fewer marriages seem to be inevitable with more equal earnings. As an alternative, in case (C) without utility loss of marriage when working full time, the newly-married rates become much higher than those in case (B), and even higher than the current case for better educated women.

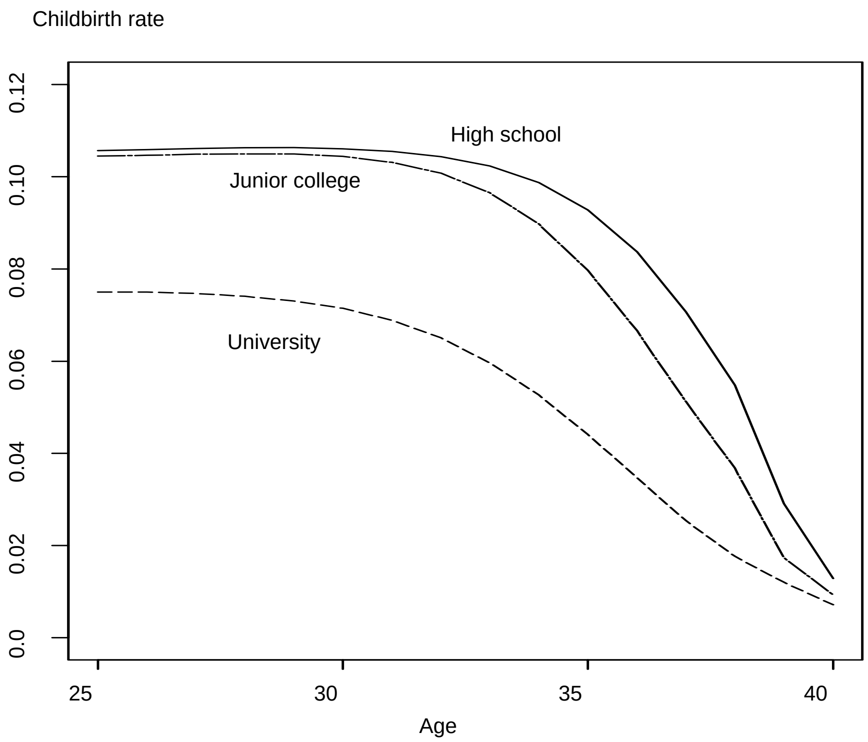

Figure 6: Childbirth Rates of Married Women Working Full-time

5.2 First birth, job choice, and equalized earnings

After marriage, the next target of simulation must be childbearing decisions for married women who work full time. Figure 6 illustrates simulated childbirth rates of childless wives working full time at the previous period. Childbirth rates decrease in the thirties, and are much lower with university educated women than for others.

Table 7 presents a simulation result of the joint choice of the job state and childbirth at age 30 in case (A) with current earnings and case (B) with equalized earnings, as before.

Regarding job choice, almost three out of four women choose to continue working full time when not wishing childbearing. When wishing childbearing, on the other hand, job state choices are diverse: 30–39% of them choose to quit work for childcare, 18–31% of them choose to take childcare leave, and 13–33% of them choose to continue working. In all, 58% (44%) of high-school-educated (better-educated) women plan to continue working full time with or without taking childcare leave. Differences according to educational level remain unclear, but university-educated women typically prefer full-time work, junior-college-educated women prefer to be housewives, and high-school-educated women prefer to work part time more than women of

Table 7: Childbirth, Job Choice, and Earnings of Married Women

	High school		Junior college		University	
	(A)	(B)	(A)	(B)	(A)	(B)
Childbirth rate	10.6%	10.2%	10.4%	9.8%	7.1%	6.9%
Choice when not wishing 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 wishing 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 with childbirth	29.7%	26.5%	39.2%	39.1%	39.3%	37.6%
Taking childcare 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%
(quit with childbirth)	(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 childcare 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%

Childless married women working full time at age 29 at the previous state.
(A) applies current earnings, (B) applies equalized earnings

other groups.

According to the simulation result assuming equalized earnings, childbirth is slightly discouraged by 0.2–0.6% points. On the other hand, percentages of those working full time at the next period increase from 73–76% to 81–86%. Notwithstanding, equalized earnings prevent childless wives, but not new mothers, from quitting full-time work. Particularly in the case of junior-college-educated women, the choice of “quitting with childbirth” declines only by 0.1% points among those wishing childbearing.

5.3 Policies to support mothers with infants

A final simulation elucidates effects of possible changes in social support programs to mothers who wish to work full time. Women are assumed to be married, childless, and working full time at age 29 at the previous period. Table 8 presents simulated women’s states at age 30; (1) proportion of those give birth (and also the proportion to those who continue to work full time);

(2) proportion of those continue work full time (and also the proportion to those give birth); and (3) proportion of those take childcare leave (and also the proportion to those continue to work full time across childbirth). Three types of possible supporting system are considered; various levels of financial benefit during childcare leave, more opportunities of full-time work, and less costly nursing of babies of age zero.

This simulation first examines the case of 80% of monthly benefits during childcare leave from the government's employment insurance program: 25% of monthly salary from 1995 and 40% from 2000. Compared to the no benefit case, 80% of the benefit raises the full-time continuation ratio by 2.6–5.5% points across the first childbirth and increases childcare leave among new-mothers staying at full-time position by 4.6–5.4% points. Nevertheless, the effect on childbirth rates seems to be limited, particularly for university-educated women.

Secondly, an 80% probability of finding full-time work after career interruption is applied, instead of the estimated probability of 12–18% in Table 4. This increased probability could be increased through priority hiring of mid-career mothers in public sectors, for example. According to the table, the childbirth rate rises from 7.1% to 14.0% for university-educated women, but decreases slightly for others. An improvement in full-time opportunities may attract less-educated women to the extent that it reduces childbirths.

These policies are intended to encourage women to undertake temporary career interruption with infants and then return to full-time work. Another possibility is to reduce the considerable burden incurred to care for infants, particularly babies of age zero. The final simulation is made by adding 1.0 to estimated coefficients on the youngest child age zero for each job state; that is, -12.289 is changed to -11.289 for β_{13} in the case of university educated mothers working full time. According to the table, this change increases childbirth rates from 10.6% to 14.4% for high-school-educated women, from 10.4% to 13.8% for junior-college-educated women, and from 7.1% to 10.6% for university-educated women.

According to the simulation result, effects of policies to support temporary career interruption across childbirth appear to be limited and varied across educational groups. Instead, social support to mothers with infants may be more effective as a countermeasure to Japan's social dilemma of low childbirth occurring concomitant with the need for increased social and economic

Table 8: Support to Working Mothers

	High school		Junior college		University	
Proportion of those give birth						
	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%)
Proportion of those continue full-time work						
	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%)
Proportion of those take childcare leave						
	all	(work)	all	(work)	all	(work)
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%)

Childless married women working full time at age 29 at the previous state.
(column) (full-time) shows proportion to those who continue to work full-time.
(birth) shows proportion to those give birth birth.
(work) shows proportion to those continue to work full time across childbirth.
(row) "x% benefit" indicates the benefit level during childcare leave.
"Support to age 0" case assumes a cost reduction for a baby of age zero.
"80% placement" case assumes an 80% probability of finding a full-time work.

equality for women.

These simulation results do not imply that earnings compensation during childcare leave is little demanded. First of all, an increasing number of working mothers choose to remain employed in full-time positions utilizing childcare leave. Mothers on childcare leave gain utility from benefits that are offered even though they may not change their choices regardless of those benefit levels. Secondly, an extension of a childcare leave period can be an alternative policy instead of mid-career hiring, particularly for university-educated women. Finally, an improved financial benefit may induce more husbands to take childcare leave, the analysis of such a mechanism is beyond the scope of this paper.

6 Concluding Remarks

This study examined a life-cycle joint decision problem on family formation and labor force participation for women of childbearing age in Japan, applying an estimable dynamic model of discrete choice. Estimation and simulation results suggest that the disadvantages of marriage (such as housekeeping duties) outweigh the benefits of marriage (such as economies of scale of cohabitation, social advantages, or happiness). Scale economies seem to apply in cases of having children because women are better-off with the second or third child, but not necessarily with the first child. Various costs incurred while raising infants appear to be considerably high, thereby preventing childbirths. Cost reducing policies that target the care of infants would be an effective countermeasure against the combined trends in Japan toward fewer children and greater social and economic equality for women.

The model proposed herein seems to be over-simplified because estimation of discrete dynamic decision models require a numerical approximation that must limit explanatory factors in order to reduce computational burden. Some neglected features may include effects of career interruption and family formation on earnings of women, heterogeneous preferences, or family background such as the help of a resident older adult, matching problems of marriage, and so forth. Reduced-form estimation of static models might be advantageous to treat those issues. Notwithstanding, these structural estimation results capture important features in women's irreversible life-cycle decisions, allowing various simulations that draw policy implications.

Appendix: Specification of transition rates

Marital status

Age Group	Divorced or Widowed Rate (%)	Married Rate (%)
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%

Rates related to marital state 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 state are obtained from the 1995 Population Census of Japan.

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