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A Dynamic Model of Childbearing and Labor Force Participation of Married Women: Empirical Evidence from Korea and Japan

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Abstract

This paper aims to empirically investigate childbearing and labor force participation of married women in Korea and Japan. A dynamic discrete choice model is estimated, using panel surveys in South Korea and Japan. Findings from the model suggest (1) that having first and second children is beneficial, but having third or more child is less beneficial using Japanese data but costly using Korean data, (2) that infants age zero are considerably costly, (3) that having at least one boy is beneficial in case of Korea, (4) that high-earnings jobs are less-costly or beneficial while low-earnings jobs are more costly other than earnings, and (5) that probability of finding full-time position for married women after career interruption is estimated as 6-15.

Keywords: dynamic programming, female labor supply, fertility

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1 Introduction

During the last two decades, both the South Korean (Korean, henceforth) and Japanese societies have witnessed steady progress of women's participation to the labor force market. At the same time, both societies have experienced delayed marriages and fewer children which urge the aging of the society.

Both Korea and Japan have faced a decline in fertility far below the population replacement rate. In Japan, total fertility rate was 2.13 in 1970, still around 1.75 in the early 1980s, then steadily declined to as low as 1.29 in 2003. Also in Korea, the total fertility rate dropped across the replacement rate in the mid-80s, and dropped to 1.17 in 2002. These rates are one of the lowest rates among advanced countries.

In both countries, most newborn babies are from married mothers; in the case of Japan, for example, 98.8% of newborn babies are from married mothers (Vital Statistics of Japan). The recent rise in marriage ages are considered to reduce the number of children, because delayed first childbirths possibly lead to giving up or failing to have next babies. In addition, it is suspected that an increasing number of couples in the recent Japan choose not to have children.

Both societies have gradually accepted that women take part in market work and seek their own career across marriage and child-rearing. Japan legislated the law of equal employment opportunities between men and women in 1986, and also did Korea in 1988; aftermath, increasing job opportunities have been open to women. However, mothers with young children still seem to face difficulties in managing market work and family duties at the same time, as observed in other developed economies. One common feature between Japan and Korea is that female labor force participation rates are lower than other typical developed countries in almost all age groups; in particular, these rates for those ages late twenties and thirties, when many women are taking care of young children, are much lower than other countries. In Korea and Japan, married women tend to be devoted to do housework and childcare when ages twenties and early thirties, and then gradually start to participate in labor market from late thirties, while never-married women generally participate in market work irrespective of

ages.

A number of empirical studies has shown that the female labor supply is closely related to the family's situations as regards earnings of the husband and the existence of children (Killingsworth and Heckman, 1986). However, these choices may not be completely independent, and also the timing of the choice in a life-cycle may be considered. Recently, a growing literature has applied estimable stochastic dynamic models of discrete choice for women's life-cycle choice problems (Wolpin, 1984; Hotz and Miller, 1988; Eckstein and Wolpin, 1989a, 1989b; Ahn, 1995; Hsylop, 1999; Francesconi, 2002).

This paper aims to empirically investigate behavior of childbirth and labor force participation of married women in Korea and Japan, using microdata of household surveys of both countries. In order for investigating determinants of these behavior, a dynamic decision model of childbirth and labor force participation of fertile-aged married women is applied. The model involves utility gains and losses from market work and children by birth order as perceived costs and benefits from children and labor force participation.

Estimation result suggests that having first and second children is beneficial, but having third or more child is less beneficial using Japanese data but costly using Korean data, that infants age zero are considerably costly, that having at least one boy is beneficial in case of Korea, that higher-earnings jobs are less-costly or beneficial while lower-earnings jobs are more costly other than earnings, and that probability of finding full-time position for married women after career interruption is estimated as 6-15.

The rest of this paper is organized as follows. Section 2 discusses an empirical framework of dynamic model of the joint decision problem for fertile-aged women regarding childbearing and labor force participation. Section 3 explains data sources, sample characteristics, and assumptions of the analysis. Section 4 presents the estimation result, and Section 5 discusses policy implications from simulation. Section 6 gives concluding remarks.

2 A Life-cycle Model of Childbirth and Labor Force Participation

2.1 Life-time Optimization Problem

In considering life-cycle choice of childbirth and labor force participation of wife should be a joint choice. In addition, such choices may not be easily reversed; parents must take care of children until they come of age once after childbirth; also, full-time housewives face difficulties to find full-time positions once after they withdraw from labor market.

A dynamic framework presented here integrates a married woman's (the couple's or the household's) decision as regards childbearing and labor force participation of the wife in a life-cycle perspective[1].

It is assumed that a married woman behaves in a manner to maximize the present value of utility over a known finite horizon T by choosing whether or not to have a new baby, and whether or not to participate in the labor market. She expects that the couple live together without uncertainty until the last economic period T. The objective is to maximize

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

where E denotes the expectations operator, δ is a discount factor, $u()$ is an instantaneous utility function, c_t is consumption, a_t is a vector reflecting children, j_t is her job status, subscript t is period, and β is a set of parameters. The budget constraint for the household is given by

$$c_t = j_t + y_t,$$

where j_t is earnings of the wife, and y_t is earnings of the husband. It is assumed that earnings of the husband evolves according to transitional probabilities, rather than the husband's choice. Also, it is assumed that no savings and loans are passed on to later periods of time. Although this assumption appears rather restrictive[2], earnings are treated as a proxy of

[1] Marriage behavior may be considered another life-cycle choice for women. However, I focus on behavior of married women here. One reason is that majority of women are expected to get married particularly in Korea. Another reason is the data limitation because a considerable number of single family members drop from the Korean data (described later) across marriage. The analysis including marriage choice has been made in Ueda (2004) in case of Japan.

[2] 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.

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

The definition of states and choices are summarized in Table 1. Job states are characterized by earnings rank of the husband y_t and job status including earnings rank of the wife j_t. The earnings of the husband are discretized as earnings rank $\{1, 2, ..., N_h\}$ and assumed to evolve with probability. Unemployed husbands fall into the lowest rank. The job state of the wife takes the value of 0 for housewives (including both full-time homemakers and unemployed), and discretized into $\{1, 2, ..., N_w\}$ when working; earnings rank also evolves with probability. In the case of Japan, the lowest rank $\{j_t = 1\}$ is classified as "part-time work"[3], and $\{j_t = 2, ..., N_w + 1\}$ is classified as "full-time work", and those on the childcare leave[4] (for full-time workers) are additionally considered with the earnings rank right before taking the leave.

The composition of children a_t 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, and 2 without infants ages 0-1). Also, an existence of boys in children is considered in the case of Korea, because it is considered that the boys are still welcome in Korea (for example, Ahn, 1995). With an existence of boys b_t (0 for without boys, and 1 for with boys), $\{n_t, b_t\}$ takes 7 cases; no children, 1-3 children including at least one boy, and 1-3 girls[5]. The number of children n_t is assumed to increase by one 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 and 1 in order to control for 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

[3] In the case of Japan, "part-time" workers often chooses much shorter working hours (e.g., 4-6 hours) a day and working days (e.g., 2-4days) a week, particularly for married women, instead of taking much lower hourly wages compared to full-time workers. In the case of Korea, such a way of working did not seem to prevail.

[4] The childcare leave in Japan was legitimated in 1992 for regularly employed mothers after the maternity leave until the baby becomes age one. Earnings of the mother are considered as 25% of the earnings at the previous period, from the employment insurance. Such paid leave in Korea was also legitimated in 2001, but not in questionnaire in the KHPS.

[5] It is better to consider 0-3 boys and 0-3 girls, but this specification requires 16 states for the number of children, which increases the computational burden.

Table 1: State and Choice

	Korea	Japan
State		
No. of children (n_t)	{0, 1, 2, 3 (3 or more)}	{0, 1, 2, 3 (3 or more)}
Existence of boys (b_t)	{0 (not exist), 1 (exist)}	-
Age of youngest child (q_t)	{0, 1, 2 (others)}	{0, 1, 2 (others)}
Earnings rank of husband (y_t)	{1 $\sim$ 7 }	{1 $\sim$ 7 }
Job status of wife(j_t)	{0 (not working),	{0 (not working),
		1 (part-time),
(by earnings rank)	1$\sim$5 }	2$\sim$6 (full-time),
		7$\sim$11 (childcare leave)}
Choice		
Childbearing (db_t)	{0 (not planning),	{0 (not planning),
	1 (planning)}	1 (planning)}
Job (dj_t) (when not working)	{1 (not to work),	{1 (not to work),
	2 (to work part-time),	2 (to work part-time),
	3 (to seek full-time work)}	3 (to seek full-time work)}
Job (dj_t) (when working)	{1 (to quit),	{1 (to quit),
	2 (to continue working),	2 (to work part-time),
	3 (to quit with birth)}	3 (to work full-time),
		4 (to quit with birth),
		5 (childcare leave)}

children.

Choices are considered for childbearing and a change in the job status. The childbearing choice is made on whether or not to plan to have a new baby: db_t = 0 (not planning to have an additional child), or 1 (planning for an additional child); it is assumed that a married woman successfully has a new baby in the next period with a given probability of P_b, with choosing db_t = 1. Unexpected childbirths are not considered here, considering availability to access to contraception and abortion in both countries.

In the case of Korea, the job choice at the end of period t is defined as: dj_t = 1 (to quit job), 2 (to continue working), or 3 (to quit job only when an additional baby is born with the joint decision of db_t = 1; to continue working otherwise) for working wives, and dj_t = 1 (not to work), 2 (to choose part-time work), or 3 (to seek full-time employment position) for housewives. Wives newly participating labor market are assumed to fall into earnings rank with different probability depending on choosing full-time work or part-time work. In addition, it is considered that getting full-time position can be successful only with a probability

of π, while housewives are able to seek job other than full-time employment whenever they hope for, due to the limited full-time job opportunities for married women mostly with children after career interruption. Thus, "continuously not working" case includes both choosing not to work and also unemployed.

In the case of Japan, the job choice for housewives are the same as Korea. The job choice for working wives are: $dj_t = 1$ (to quit job), 2 (to transfer to part-time work), 3 (to continue full-time work), 4 (to quit job if an additional baby is born; to continue full-time work otherwise), and 5 (to take the childcare leave if an additional baby is born; to continue full-time work otherwise).

Thus, the decision is defined as $d_t = \{dj_t, db_t\}$. Some of the states and choices occurs in some particular combinations rather than independently.

Now the process is characterized by the state: $s_t = \{j_t, y_t, n_t, q_t, b_t\}$ from the set of state S, and the decision $d_t = \{dj_t, db_t\}$ from the set of decision $D(s_t)$ depending 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:

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

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

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

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. 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

The utility function is parameterized as

$$u(s_t;\beta) = \ln(j_t + y_t) + \beta' \cdot h(s_t) + \varepsilon_t(d_t) \tag{4}$$

where $h(s_t)$ is a vector of dummy variables converted from state s_t, and $\varepsilon_t(d_t)$ is an unobservable state variable that may depend on choice variables. The first component captures the benefit from consumption. The second component consists of additional utility gains and losses from raising children and labor force participation:

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

where $I()$ is the indicator function which assumes a value of 1 if its argument is true, and a value of 0 otherwise. In case of Japan, considering earnings from part-time employment mostly fall into the lowest earnings rank, the second component is assumed to be

$$\begin{aligned}\beta' \cdot h(s_t) \quad = \quad & \beta_1 \cdot I(n_t \geq 1) + \beta_2 \cdot I(n_t \geq 2) + \beta_3 \cdot I(n_t = 3) + \beta_4 \cdot I(q_t = 0) + \beta_5 \cdot I(q_t = 1) \\ & + \beta_6 \cdot I(j_t = 1) + \beta_7 \cdot I(2 \leq j_t \leq 6).\end{aligned}$$

With regard to children, β_1, β_2, and β_3 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. Positive values imply that benefits surpass costs of raising the child, and vice versa. β_4 and β_5 indicate additional utility gains and losses from infants ages zero and one; if their total values 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. In the case of Korea, β_8 on the existence of boys is added for measuring the additional costs and benefits from having boys.

With regard to labor force participation of the wife, β_6 and β_7 indicate utility gains and losses from lower-earnings job[6] (or part-time work in the case of Japan) and from higher-earnings job, respectively, including perceived costs (such as reduction in time spent on leisure and housework as bearing responsibility of housework and childcare) and benefits (such as satisfaction gleaned from social position) other than the effect of earnings itself in the first component: $\ln(j_t + y_t)$.

Now the sample likelihood function is written as

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

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; τ_n is the last decision age or the sample age at the survey before τ.

The transition from the current state and decision to the next state evolves with probability indicates as p. First, the job status evolves with π and P_b in addition to the earnings-rank probability transition matrix.

Probability P to choose d_t is assumed to take the multinomial logit formula with assuming the disturbance $\varepsilon_t(d_t)$ in the utility function (4) to be independently and identically distributed with the type I extreme-value distribution[7].

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

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[8].

[6] In the case of Japan, part-time employment is paid much lower but working hours are much shorter and flexibly chosen than full-time employment; married women often chose part-time employment to utilize tax exemptions and other dependent privileges. Such part-time employment has not prevailed in Korea.

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

[8] The estimation is carried out with the simulated annealing optimization program by Goffe (1996). Needless

3 Data

3.1 Data Sources

Sample of married women in Korea is obtained from 1993-1998 rounds of the Korea Household Panel Survey (KHPS) conducted by the Daewoo Research Institute. The KHPS in 1993 covers 4,547 households and 10,460 household members at age 18 or older. The number of the original household declined to 2,468 in 1998 with an average annual drop-off rate of 14%. When a household member left the original household, the Institute tried to involve new households where these members belong.

Sample in Japan is obtained from 1994-1999 rounds of the Japanese Panel Surveys of Consumption (JPSC). The JPSC started as a panel survey on 1,500 women ages 24-34 in 1993 ("cohort-A"), and added 500 women ages 24-27 in 1997 ("cohort-B"). Annual drop-off rates were 3.8-5.7% in cohort-A. The Institute of Household Economy (1995) explains that the sample generally represents characteristics of women at the same ages in Japan.

Both surveys cover almost entire countries, and involve characteristics of each household members as well as characteristics of households, including age, education, marital status, and job status and working conditions such as earnings.

The observations of state transition from time t to $t+1$ are retrieved from five transitional periods (1993-94, 94-95, ..., 97-98) in the KHPS 1993-98, and from four transitional periods (1994-95, 95-96, ..., 97-98) in the JPSC 1994-99 because annual earnings must be retrieved from the next round[9]. Observations are further grouped according to the educational level, because childbearing and labor supply behavior may be different across educational level. "Secondary-educated" group includes senior high school graduates or less educated; "tertiary-educated" group includes junior-college, university, and tertiary-educated. The final samples consist of 4613 (903) observations in the case of secondary (tertiary) educated in Korea, and 1722 (1596) observations in the case of secondary (tertiary) educated in Japan. Married women with husbands at school, in mandatory military service, or being full-time homemaker

to say, all remained errors are the author's.

[9] The 1993 round of JPSC is not used, becasue the round lacks the choice of "childcare leave" in the question of the job status.

are excluded.

3.2 Sample Characteristics

Table 2 presents sample characteristics. Average ages are about 31. Ages in KHPS range from 20 to 40, and ages in JPSC range from 24 to 39. 93-95% (83-92%) of married women have at least one child in KHPS (JPSC); secondary-educated women have children more often than tertiary-educated women. Observation from JPSC have three or more children more often than observations from KHPS. More than two out of three married women have boys in KHPS. In the samples, 27-46% (26-28%) of married women are with infants age zero or one, and 8-12% (10-13%) gave birth in the transitional period in KHPS (JPSC).

It should be noticed that almost four out of five married women are not working in KHPS, while nearly half of married women participate labor force market in JPSC. Tertiary-educated women are engaged in higher-earnings work more than secondary-educated women. When a housewife get employed, she is employed with lower-earnings more often than with higher-earnings job.

3.3 Terminal Conditions, Earnings Rank, and Other Assumptions

The selected first decision age is 20, the last decision age τ is 39, and the last economic age T is 59. The decision period is chosen in order to focus on fertility decision under restriction of the number of discretized states due to the curse of dimensionality and data limitation of JPSC. The last economic period is chosen, considering that a typical retirement age is 60 in Japan, while retirement ages vary from mid-50s to mid-60s in Korea.

From 40 to the last age of economic life, several assumptions are imposed to calculate the value function. It is assumed that a woman will not have additional babies at the age of 41 or older. In analyzing fertility choice, this limit of upper age is not very restrictive, because the ratio of newborn babies from mothers over age 40 is pretty small in both countries[10], although it is still possible for women to give birth in the forties.

The earnings ranks of the wife are discretized as 5 ranks ($j_t = 1, ..., 5$) with the threshold:

[10] 98.9% of newborn babies are from mothers aged 39 or younger in the case of Japan (The 1995 Vital Statistics of Japan).

Table 2: Sample Characteristics

	Korea		Japan	
	Secondary Educated	Tertiary Educated	Secondary Educated	Tertiary Educated
Sample	4613	903	1722	1596
Average age (t)	31.6	30.6	31.4	32.0
(s.d.)	(4.3)	(3.7)	(3.6)	(3.3)
Number of chilldren (t)				
0	5.2%	7.1%	8.1%	17.0%
1	20.6%	30.7%	23.8%	28.4%
2	63.2%	58.4%	49.1%	39.0%
3 or more	11.0%	3.9%	19.0%	15.6%
Existence of boys (t)	73.2%	68.2%	-	-
Existence of infants (t)				
age zero	16.7%	27.0%	11.9%	14.2%
age one	10.8%	18.7%	13.8%	14.2%
Childbirth (t+1)	7.5%	11.6%	9.7%	12.7%
Job status (t)				
Not working (N)	82.2%	78.4%	54.0%	52.9%
Lower-earnings (L)	13.5%	9.0%	32.5%	24.0%
Higher-earnings (H)	4.3%	12.6%	13.5%	23.1%
Job transition				
(N) → (N)	73.2%	70.0%	46.1%	46.0%
(N) → (L)	7.8%	5.9%	7.4%	6.5%
(N) → (H)	1.2%	2.5%	0.6%	0.5%
(L) → (N)	3.8%	3.3%	4.4%	4.3%
(L) → (L)	8.5%	4.1%	26.7%	19.0%
(L) → (H)	1.1%	1.6%	1.5%	0.8%
(H) → (N)	0.8%	1.1%	0.9%	1.7%
(H) → (L)	0.9%	1.9%	0.9%	1.4%
(H) → (H)	2.6%	9.6%	11.7%	19.9%

500 (130), 1000 (200), 1500 (300), and 2000 (450) in terms of million won (yen) in a year in the case of KHPS (JPSC). Average earnings are assumed to be: 250 (85), 750 (165), 1250 (250), 1750 (375), and 2500 (500) million won (yen), respectively. Husband's earnings are discretized in 7 ranks ($y_t = 1, ..., 7$) with thresholds: 500 (250), 1000 (350), 1500 (450), 2000 (550), 3000 (650), and 4000 (850) million won (yen); and average earnings are assumed to be: 250 (200), 750 (300), 1250 (400), 1750 (500), 2500 (600), 3500 (750), 5000 (1000) million won (yen) in the case of KHPS (JPSC), respectively[11].

[11] In the case of Korea, earnings are discounted by CPI (source: International Financial Statistics). In the case of Japan, they are not, because inflation rates were negligible in the surveyed years.

The transitional probabilities of earnings rank are calculated from empirical distribution of earnings as in Appendix. Matrices of transitional probabilities from t and $t+1$ are prepared for working continuously. For newly participate in labor market, transitional probabilities are considered different between the choice of part-time work and full-time work in the case of KHPS; in the case of JPSC, job status becomes 1 with choosing part-time work, and 2-6 when successfully getting full-time position. After the decision period, transitional probabilities of the job status in the case of KHPS are also in Appendix; the same earnings transition matrix us used for full-time workers (due to the data limitation) and 40% of labor force participation for others in the case of JPSC.

Regarding the job choice, self-employment is included in full-time job in the case of Korea; part-time jobs include temporary employment, family workers, and primary industry workers. In the case of Japan, full-time job is considered as regular employment, and part-time jobs include self-employment (considering earnings profile that is similar to part-time employment), family workers, and all others.

A couple of parameters are selected as a best guess, due to data limitations and identification problems. The discount factor (δ) is set to 0.90 in the estimation; other selections such as 0.85 or 0.95 are not affect implications of the result. Also, the birth rate when the couple hopes for new baby is assumed to be 0.4[12].

4 Estimation Results

Table 3 reports the estimation result, using the utility function with simple dummy variables to estimate costs and benefits of children and labor force participation.

As regards costs and benefits of children, estimates of the first and second child are significantly positive for both educational groups in both countries, and there does not seem to be clear difference between the net benefit of the first child and that of the second child. As regards the third (and subsequent) child, estimates are significantly negative in the case of Korea, while significantly positive in the case of Japan. In the case of Korea, the existence

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

Table 3: Estimation Result of Life-Cycle Model (1)

Country	KOREA		JAPAN	
Education	Secondary	Tertiary	Secondary	Tertiary
First child	0.159 ***	0.580 ***	1.441 ***	1.185 ***
	(0.015)	(0.189)	(0.313)	(0.345)
Second child	0.404 ***	0.530 ***	1.824 ***	1.412 ***
	(0.007)	(0.014)	(0.266)	(0.254)
Third child	-0.647 ***	-0.821 ***	1.028 ***	0.421 **
	(0.005)	(0.027)	(0.188)	(0.191)
Infant age zero	-4.569 ***	-4.598 **	-15.193 ***	-10.725 ***
	(0.732)	(2.261)	(2.238)	(1.937)
Infant age one	-2.401 ***	-0.913	2.204	2.892 *
	(0.477)	(1.479)	(1.870)	(1.579)
Existence of boys	0.691 ***	0.538 ***	-	-
	(0.007)	(0.017)		
Lower-earnings Job	-2.072 ***	-2.745 ***	-0.316 ***	-0.478 ***
	(0.287)	(0.851)	(0.114)	(0.119)
Higher-earnings Job	-0.302 ***	-0.176	0.738 ***	0.497 ***
	(0.064)	(0.294)	(0.100)	(0.096)
Probability of	0.059 ***	0.149 ***	0.085 ***	0.056 ***
placement	(0.008)	(0.024)	(0.014)	(0.012)
log-likelihood	-10939.5	-2306.9	-3812.1	-3557.1
Sample	4613	903	1722	1596

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

of boys is estimates as significantly positive, and estimated effects are larger for less educated women than tertiary-educated women.

The estimate of an existence of the youngest child age zero indicates costs of nursing newborns. In both countries, considerably big negative effects are estimated with statistical significances. This result indicates that nursing newborns demand so much time and care. An estimate of the youngest child age one indicates incentives on spacing of childbirth as well as costs of nursing young infants. This effects is estimated negatively in the case of Korea (but insignificant in the case of tertiary-educated women), and positive in the case of Japan. That is, with planning subsequent childbirth, one-year spacing of childbirth is preferable in the case of Japan, while successive childbirth is preferable in the case of secondary-educated women in Korea.

As regards labor force participation, values of lower-earnings job other than earnings are

estimated negative in all cases; estimates of better-earnings job are significantly negative but are much smaller than those of lower-earnings job in the case of secondary-educated women in Korea, negative but not significant in the case of tertiary-educated women in Korea, and significantly positive in the case of Japan. This difference may imply that high-profile career with higher-earnings attracts Japanese women more than Korean women, and tertiary-educated women than secondary-educated women in Korea, possibly because of perceived benefits for wives (such as social advancement or improvement of the wife's position in the family). The probability to find full-time position is estimated as 15% for tertiary-educated wives in Korea, and as low as 6% for secondary-educated wives in Korea.

Table 4 reports the estimation result employing a utility function with crossed variables of three types of job status (not working, lower-earnings job, and higher-earnings job) and the number of children. The referenced case is no job without children; the effect of lower-earnings job with two children, for example, is divided into "lower-earnings job with first child" and "second child when lower-earnings job".

The results are generally similar to the result presented by Table 3. Effects on the first and second child are estimated as positive, but those of the third one is estimated as negative; effects of lower-earnings job are negative, while negative effects of higher-earnings job are smaller and not statistically significant in Korea and positive in Japan; effects of existence of boys are estimated significantly positive; nursing a baby age zero is costly, but nursing costs of an infant age zero vary across educational levels and countries.

Table 5 supplements Table 4 by summarizing estimates of children (with or without boys) according to the job status. The table indicates several interesting characteristics on fertility and the job status.

First, it is costly for married women to participate labor market, although it brings financial benefits, in Korea. This costs are estimated larger for tertiary-educated women than secondary-educated women ,and larger for lower-earnings work than higher-earnings job. Wives in Korea seem to pay some costs, such as social pressure against working mothers. In the case of Japan, on the other, it is rather beneficial for married women to participate

Table 4: Estimation Result of Life-Cycle Model (2)

Country	KOREA		JAPAN	
Education level	Secondary	Tertiary	Secondary	Tertiary
No job				
First child	0.291	0.913	1.870 ***	1.430 ***
	(0.956)	(2.782)	(0.456)	(0.482)
Second child	0.327	0.630	1.548 ***	1.322 ***
	(0.734)	(2.358)	(0.374)	(0.330)
Third child	-0.640	-1.358	1.136 ***	0.366
	(0.626)	(2.069)	(0.289)	(0.293)
Low-earnings Job				
No child	-2.331 ***	-3.264 *	0.055	-0.269
	(0.535)	(1.955)	(0.506)	(0.394)
First child	-2.572 ***	-2.496 **	1.109 **	0.520
	(0.392)	(1.165)	(0.469)	(0.512)
Second child	1.338 ***	1.393	2.079 ***	1.820 ***
	(0.354)	(1.114)	(0.421)	(0.431)
Third child	-1.174 ***	-2.363 ***	1.133 ***	0.565 *
	(0.259)	(0.716)	(0.332)	(0.331)
High-earnings Job				
No child	-0.061	-0.581	0.004	0.081
	(0.114)	(0.443)	(0.515)	(0.454)
First child	0.014	0.704	0.836	1.083 **
	(0.194)	(0.570)	(0.540)	(0.471)
Second child	0.226	0.622	3.970 ***	2.482 ***
	(0.163)	(0.496)	(0.675)	(0.609)
Third child	-0.345 **	0.392	0.746 **	0.226
	(0.137)	(0.383)	(0.338)	(0.373)
Common				
Infant age zero	-4.650 ***	-5.743 ***	-15.288 ***	-11.060 ***
	(0.176)	(0.557)	(2.783)	(2.040)
Infant age one	-2.233 ***	-0.629	2.189	3.132 *
	(0.140)	(0.484)	(2.318)	(1.700)
Existence of boys	0.661 ***	0.180 ***	-	-
	(0.007)	(0.018)		
Probability of	0.060 ***	0.151 ***	0.099 ***	0.055 ***
placement	(0.008)	(0.024)	(0.016)	(0.012)
log-likelihood	-10921.4	-2301.8	-3786.3	-3538.2
Sample	4613	903	1722	1596

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

Table 5: Estimated values from market work and children

		KOREA				JAPAN	
	Children	Secondary		Tertiary		Secondary	Tertiary
No Job	0	0.000		0.000		0.000	0.000
	1	0.291	(0.951)	0.913	(1.093)	1.870	1.430
	2	0.618	(1.279)	1.543	(1.723)	3.418	2.752
	3	-0.022	(0.638)	0.185	(0.365)	4.554	3.118
Lower-earnings Job	0	-2.331		-3.264		0.055	-0.269
	1	-2.572	(-1.911)	-2.496	(-2.317)	1.109	0.520
	2	-1.234	(-0.574)	-1.103	(-0.923)	3.189	2.340
	3	-2.408	(-1.748)	-3.466	(-3.286)	4.321	2.906
Higher-earnings Job	0	-0.061		-0.581		0.004	0.081
	1	0.014	(0.675)	0.704	(0.884)	0.836	1.083
	2	0.240	(0.900)	1.326	(1.506)	4.806	3.565
	3	-0.105	(0.555)	1.719	(1.898)	5.552	3.791

In the case of Korea, values are without boys; values with boys are in parentheses.

labor market, except for part-time work for tertiary-educated women. This result implies that married women in Korea face some difficulties in pursuing their career, while those in Japan benefit more than pay costs from pursuing their career.

Secondly, as regards having children, wives in Japan are better-off with having additional child; in particular, they are better-off with having the second child, irrespective of the job status. Also, wives in Korea are better-off with having the second child, but not necessarily having the first and third children.

Finally, with the same number of children, wives are better-off when not working in most cases in Korea; wives with one child are better-off when not working, but wive with two or more children are better-off when working full-time in Japan.

5 Policy Implications from Simulation

This section presents simulations that could draw policy implications for married women's labor force participation and childbearing behavior. The expected one-period-ahead transition, which conditioned the previous state, is simulated, rather than the long-run transition. Thereby, errors are reduced. Before proceeding, performance of the forecast is shown in figures 1 and 2, which compare predicted and actual average numbers of children, and per-

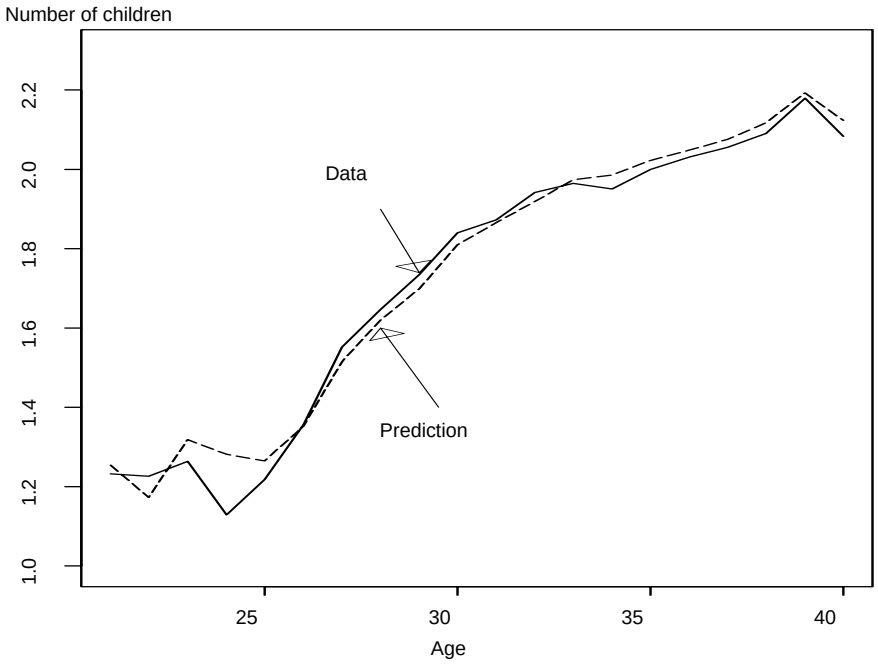

Figure 1: Predicted and Actual Numbers of Children

centages of those working, using the estimate of the secondary-educated sample in Table 3 as an example. The forecast of the number of children seems to predict the actual data fairly well, while the forecast of the job status does not predict the actual data as much as the childbearing behavior. The similar tendencies are observed using tertiary-educated estimates or the estimates using the JPSC.

The first simulation concerns effects of a reduction in the considerable costs to take care of babies age zero for both countries. Although this is only one-period costs, this negative effect cancels almost ten-year positive effects of having the first or second child. The costs may be reduced by offering financial and other support to mothers such as: family allowance for infants, inexpensive day care centers, or medical consultation and counseling to help nursing.

The second simulation concerns a positive effect of having a boy in the case of Korea. The elderly son has been expected to take care of his parents in Korea as was in Japan. However, it is possible that elderly parents do not expect to depend on the elderly son in the near future in Korea as in the current Japan, influenced by an offer of pension system and

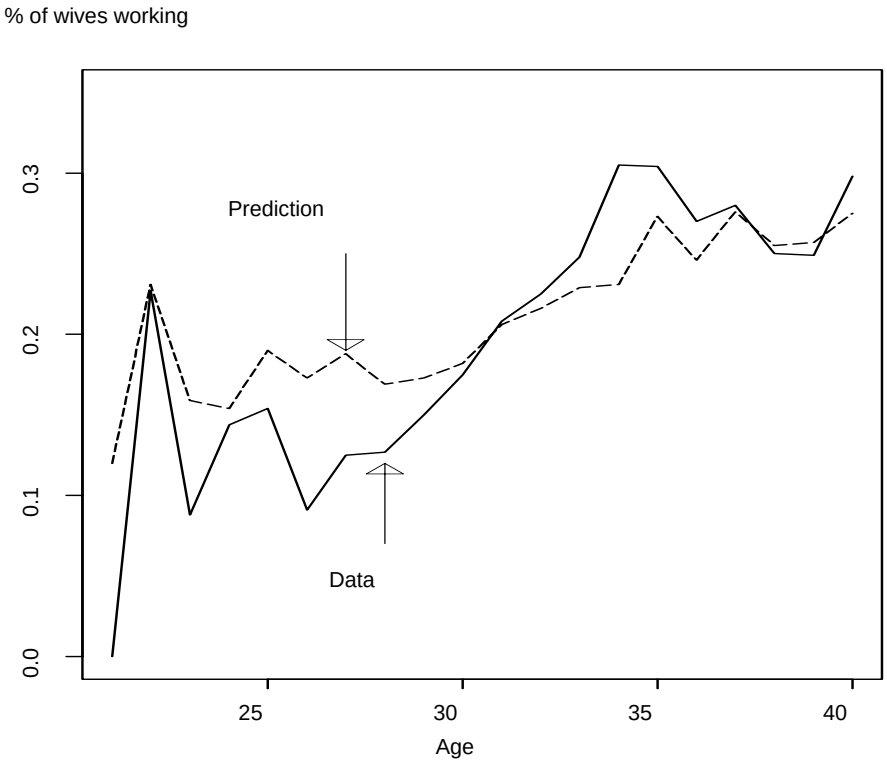

Figure 2: Predicted and Actual Working Rates

a change in social attitude. It is also predicted from estimates in which tertiary-educated women receive smaller benefits from having boys.

Table 6 presents predicted childbirth rates[13] and rates of not working, conditioned either childless wives working full time with earnings rank 4 (the second highest rank out of 5 ranks) or childless housewives, with husbands in the earnings rank 5 (the third highest rank out of 7 ranks) at the previous period. The first simulation assumes that the negative estimates on the existence of a baby age zero are reduced by 10%. The second simulation assumes that the positive effect of having a boy would be zero.

In the first simulation, a reduction in costs to nurse babies would be excepted to encourage childbirth. The simulation result illustrates that more wives plan to have a child, irrespective of job statuses, educational levels, and countries, although the effect seems to be larger in Japan than in Korea. Only 10% reduction in the nursing costs raise 0.8%-2.8% childbirth rates.

[13] Childbirth rates seem to be higher for Japanese than Korean. However, it should be noted that late- and never-married behavior proceeds more in Japan than in Korea, and childbirths from unmarried mothers are very limited in both countries.

Table 6: Simulation Result

Birth rate (Rate of not working)

	KOREA		JAPAN	
	Secondary	Tertiary	Secondary	Tertiary
	Working wives			
Current Condition	10.1% (18.2%)	18.2% (13.3%)	25.5% (4.9%)	28.8% (7.0%)
90% costs on baby age zero	10.9% (19.0%)	19.1% (13.8%)	28.3% (4.9%)	30.4% (6.9%)
No advantages on boys	4.0% (29.5%)	13.6% (14.5%)	-	-
	Housewives			
Current Condition	18.6% (34.9%)	22.5% (46.3%)	20.6% (32.5%)	24.1% (35.9%)
90% costs on baby age zero	19.6% (34.4%)	23.4% (45.9%)	23.9% (32.3%)	26.2% (35.8%)
No advantages on boys	21.7% (25.1%)	21.1% (39.9%)	-	-

Childless wives at the previous period.

It is expected that a reduction in benefits from having children may discourage childbirth and encourage labor force participation. However, the simulation result using Korean data seems to be somewhat puzzling. Childbirth rates clearly drop in the case of working wives, but the rate even rises for secondary-educated housewives. It is also puzzling that more working wives withdraw from market work, while more housewives choose to work than the case assuming the current condition.

6 Concluding Remarks

This paper has investigated behavior of childbirth and labor force participation of married women in Korea and Japan, using microdata of the both countries. A life-cycle model of childbirth and labor force participation of married women are examined using a dynamic discrete-choice model, in order to shed light on perceived benefits and costs on having children and labor supply of married women.

According to the life-cycle model, market work is still costly for married women in Korea; this might imply that married women face difficulties in conducting market work and housework including childcare at once, or under pressures to stay at home by their family or society. However, higher-earnings job is less costly than lower-earnings job, much less costly for tertiary-educated wives than others, and even beneficial for Japanese wives.

One concerning result of the Korean case on the fewer-children issue is that estimated

costs and benefits of the third or more child is mostly negative, which leads further fewer-children when an importance to have boys becomes less. An attention must be paid to the case of Japan, because recent fewer-children in Japan is affected by both an increasing delayed- or even never-marriage, as well as a decline in the number of children of married women. Although marriage choice is not integrated in the life-cycle mode here due to the data limitation of KHPS here, it is desired to integrate marriage behavior in considering the fewer-children issue.

Appendix: Transitional Probability Matrices

Earnings transition of husband (KHPS)

	1	2	3	4	5	6	7
1	0.526	0.216	0.112	0.079	0.047	0.013	0.008
2	0.187	0.387	0.283	0.078	0.053	0.008	0.004
3	0.060	0.103	0.469	0.239	0.100	0.019	0.011
4	0.029	0.039	0.206	0.435	0.245	0.034	0.012
5	0.023	0.022	0.090	0.256	0.472	0.097	0.041
6	0.014	0.025	0.065	0.125	0.387	0.270	0.114
7	0.029	0.010	0.049	0.093	0.216	0.216	0.387

Earnings transition of wife (KHPS)

	1	2	3	4	5
0, dj_t = 1	0.799	0.150	0.022	0.022	0.006
0, dj_t = 2	0.151	0.428	0.158	0.137	0.127
1	0.516	0.288	0.103	0.048	0.045
2	0.127	0.425	0.311	0.080	0.057
3	0.018	0.090	0.505	0.259	0.127
4	0.011	0.036	0.224	0.454	0.276
5	0.007	0.018	0.088	0.218	0.668

Earnings transition of wife age 40- (KHPS)

	0	1	2	3	4	5
0	0.860	0.068	0.039	0.017	0.008	0.009
1	0.163	0.466	0.230	0.075	0.037	0.031
2	0.078	0.154	0.497	0.187	0.044	0.039
3	0.063	0.061	0.173	0.397	0.190	0.116
4	0.026	0.017	0.059	0.190	0.405	0.303
5	0.025	0.016	0.028	0.078	0.208	0.645

Earnings transition of husband (JPSC)

	1	2	3	4	5	6	7
1	0.504	0.344	0.112	0.008	0.000	0.016	0.016
2	0.078	0.464	0.327	0.083	0.024	0.016	0.008
3	0.021	0.133	0.560	0.216	0.048	0.011	0.011
4	0.007	0.030	0.138	0.542	0.215	0.059	0.009
5	0.004	0.014	0.047	0.142	0.535	0.238	0.020
6	0.005	0.007	0.016	0.053	0.109	0.683	0.127
7	0.011	0.011	0.011	0.022	0.045	0.153	0.747

Earnings transition of wife (JPSC)

	2	3	4	5	6
0, dj_t = 2	0.722	0.167	0.000	0.111	0.000
1, dj_t = 2	0.433	0.270	0.243	0.054	0.000
2,7	0.676	0.118	0.088	0.059	0.059
3,8	0.091	0.576	0.303	0.030	0.000
4,9	0.046	0.109	0.609	0.218	0.018
5,10	0.047	0.006	0.112	0.665	0.170
6,11	0.009	0.009	0.027	0.063	0.892

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