Encouraging Labor Participation of Married Female in Japan: The Roles of Tax System and Child-care Subsidy

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Abstract

Population aging results in the problem of labor shortage. Encouraging female labor force participation seems to be a possible solution. In the literature, the current low female labor force participation in Japan is attributed to two reasons. First, the spousal and tax deduction policies in Japanese tax system provide disincentives to married women's labor decisions. Second, similar to other countries, child-care plays a crucial role in determining married women's labor participation. This paper employs a standard neo-classical model with heterogenous households, which are differentiated by spouse's education level and preference on leisure, to examine the aforementioned issues. Based on the 2004 tax reform in Japan, we quantitatively conduct experiments of two types of policy reform: changing tax structure and providing child-care subsidy. We find that the effect of changing tax structure on encouraging married women's labor supply is larger than providing more child-care subsidies. In addition, different types of households response to policies in different ways. Therefore, it is important to understand who are the policy target in order to formulate appropriate policies.

JEL Classification:

Keywords: Female Labor Supply; Japan Tax System; Child-care Subsidy.

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1 Introduction

Japan enjoys the longest life expectancy at birth around the world. Therefore, the problem of labor shortage, which is mainly resulted by population aging, becomes a big concern in current Japan. Among various possible solutions, encouraging female labor force participation seems to be the most promising and comprehensive policy to alleviate the problem of labor shortage.

The labor force of Japanese female is indeed the potential resource. According to OECD (2008), Japan had the lowest female labor force participation rate among OECD countries.[1] Less than 50% of Japanese households are dual earners (both husband and wife work). Thus, many Japanese females are still out of the labor force. Besides, according to Japan Statistic Bureau, female labor force in 2011 was 26.3 million.[2] However, only 44.7% of all female employees were regular staffs, while 80% of all male employees were regular staffs.[3] Furthermore, 93.7% of part-time female workers have annual income less than 2 million yen and 53.5% of them has annual income less than 1 million yen. Similar income distribution applies to temporary female workers. In fact, Matsui et al. (2010) suggest that if the female labor force participation rate is equal to the rate of male, Japan would have additional 8.2 million workers in the labor force and boost the country's GDP up to 15% per year. More importantly, Japanese females are among top three of the most educated women in the world (Matsui et al. 2010). Therefore, females, especially married women, are the potential labor force for Japan in the long run. They may not only solve the problem of labor shortage but also help to produce in a more efficient way.

The empirical literature has pointed out four important determinants of the low female labor force participation in Japan. The first one is women's education level. Hirao (2001) shows that university graduates are more likely to stay in the labor force longer than high school graduates. Abe (2011) does a cohort analysis and finds that the ratio of regular employment of university graduates is much higher than that of senior high school graduates. Steinberg and Nakane (2012) estimate that a 10 percent increase in education level results in a corresponding 1.1 percentage point increase in female labor force participation rate.

The second determinant is the availability of child-care facilities. Nakamura and Ueda (1999) empirically document that not only education level of female but also the availability of child-care facilities are crucial for women to return to workforce after childbirth. Sasaki (2002) shows that a married woman has a higher probability of participating in workforce if she resides with her parents or in-laws because parents will share the child-care burden.

Third, Japanese tax and social security system contains tax disincentive to married women's work. In Japan, spousal tax exemption for primary earner is applicable if the spouse's income is lower than 1.03 million yen. As shown in Figure 1, there exists a concentration of married women's income at 1.03 million yen. Previous studies, such as Akabayashi (2006), Takahashi, Kawade, and Kato (2009), and Takahashi

[1]The female labor force participation rate in Japan was 60%, while it was 66% and 75% in the United States and Norway, respectively.

[2]The value is the sum of employed and unemployed women, excluding Iwate, Miyagi and Fukushima Prefectures, and the areas affected by the 311 earthquake and tsunami.

[3]Regular staff is full-time workers. Non-regular staff includes part-time workers, *arbeit* (temporary workers), dispatched workers from temporary labour agencies, contract employees or entrusted employees, and others. Data source: *The 2007 Employment Status Survey*.

(2010) have successfully confirmed the important role of the spousal deduction policy in married women's labor supply. Furthermore, Kawata and Naganuma (2010) and Kohara (2010) find that a wife returns to work and works longer when her husband suffers from a decline in income.

In contrast, Abe and Otake (1995) examine the work disincentive of single women and married women. They conclude that Japanese tax and social security system does not affect the working decision of a single women. In other words, marital status plays a more important role in women's labor supply behavior.

However, most previous studies on the issue of Japanese female labor force participation are from an empirical perspective. To our best knowledge, Abe (2009) is the only one that explains the impact of spousal tax deduction by a dynamic theoretical framework with a partial equilibrium analysis. Our paper, motivated by Attanasio, Low, and Sanchez-Marcos (2008), aims to employ a general equilibrium model with heterogenous married women to explore the roles of Japanese tax and social security system and child-rearing subsidy in Japanese married women's labor decisions. Our model contains the four important determinants to explain Japanese female's labor supply.

Using a standard neo-classical framework, we assume that there exists a couple and a child in one household. Since 80% of Japanese males are regular staff, we assume husband's labor supply is inelastic. Wives among households are differentiated by their education level and preference on leisure and endogenously make decisions on their working hours. However, the child has to be accompanied by adults. Thus, the child has to be sent to kindergarten or daycare center when the mother goes out to work. The government provides child-rearing subsidy on sending children to kindergartens or daycare centers. In addition, to capture the main spirit of tax deduction policies in Japan's tax and social security system, there exist four kinks in household's budget constraint. Therefore, it is possible for a household to choose at a kink when the household's lifetime utility is maximized.

The mode is calibrated to data from Japan before the 2004 tax reform as a benchmark economy. Based on the benchmark economy, we first evaluate the model performance by imposing the 2004 tax reform to our model. The result suggests that only low-income wives' working hours are encouraged by the 2004 tax reform, while others are remain unchanged. The increase in married women's labor supply due to the 2004 tax reform is limited. Our finding is consistent with the literature. Then, we take one step forward: based on the tax structure after the 2004 reform, we propose two types of policies and examine their effects on boosting married women's labor supply. The first type is tax-related policies: extending the spousal deduction, changing the tax structure, and a direct tax cut. Alternatively, married women's labor supply could be encouraged by providing more child-rearing subsidies. Our conclusions are as follows. First, tax-related policies and child-rearing subsidies are both able to encourage married women's labor participation. However, our result suggests that the effects of tax-related polices are relatively large. This may be due to the second-layer effect of a decline in a tax rate. Second, different types of wives response to policies in different ways. Therefore, it is important to understand who are the policy target in order to formulate appropriate policies.

The rest of the paper is organized as follows. Section 2 provides a brief review on the institutional background of Japan's tax, social security, and child-care systems. Section 3 presents the model economy. Parametrization, the benchmark economy, and the impact of the 2004 tax reform are discussed in Section 4. Section 5 provide policy experiments. Finally, Section 6 concludes this paper.

2 Institutional Background in Japan

This section summarizes the background information on Japanese income tax and social security system. The tax reform in 2004 is also discussed. Finally, a brief description on Japanese child-care system is provided.

2.1 Individual Income Tax

In Japan, the individual income tax is based on the self-assessment system. Taxpayers file the income tax by themselves. Various deductions could be subtracted from individual's income in the calculation process. Then, an appropriate tax rate is applied to obtain the "amount of income tax". The current income tax rate in Japan is divided into six brackets, ranging from 5% to 40%, depending on the taxable income. The two types of deductions that we focus in this paper are described as follows.

- **Basic and Employment Deduction**
  For Japanese employees, they are eligible to have a basic deduction and an employment deduction. The basic deduction is a fixed amount, 380 thousand yen, for all employees. The employment deduction depends on an employee's income level and the lowest deduction is 650 thousand yen for income between 0 and 1,625 thousand yen. These two deduction policies imply that people whose annual income is lower than 1,030 thousand yen do not have to pay the individual income tax in Japan. The schedule of the basic and employment deduction is summarized in Table 1.

- **Spousal Deduction**
  For a married couple, if the spouse's annual income is lower than 700 thousand yen, the taxpayer can enjoy a deduction of 760 thousand yen (Allowance for Spouse, 380 thousand yen, and Special Allowance for Spouse, 380 thousand yen) when filing the individual income tax. In addition, if the spouse's income is in the range of 700 thousand yen and 1,430 thousand yen, each 50 thousand yen gained of the spouse income leads to the same amount of deduction that the taxpayer can enjoy. When the spouse's income is higher than 1,430 thousand yen, the taxpayer does not enjoy the spousal deduction. The spousal deduction is not applied for the taxpayer, whose annual income is higher than 10 million yen, in contrast, the spouse has to pay the individual income tax. The left-hand side of Figure 2 illustrates the relation between spouse's income and the amount of spousal deduction that the taxpayer can enjoy before the 2004 tax reform.

2.2 Social Security System

Japanese social security system includes various social welfare programs, such as health care, public assistance, and pension system. Here, we focus on the pension system and its insurance premium policy on spouse.

- **The Structure of Pension System**
  The Japanese pension system is multi-tiered and running by both public and private sectors. The

subscribers or social security contributors are categorized into three groups. Category No.1 is farmers, students, self-employed subscribers; Category No.2 is working employees, and Category No.3 is the spouses of Category No.2.

There are three tiers in the pension system. The first tier is the Basic Pension (*Kiso Nenkin*), which is mandatory for residents 20 years old or above in Japan, including foreigners. A flat rate is applied to everyone. The basic pension aims to provide a basic income guarantee for old age. The second tier, the Employees' Pension Insurance (*Kose Nenkin Hoken*), covers Category No. 2. It is co-paid by employers and employee and is mandatory to firms that are over a certain size. These two pensions are both public and controlled by the Japanese government. In contrast, the third tier is an optional scheme. It is operated either by firms for employees or by a government insurer for self-employed workers (as a collective national pension fund).

- **Spousal Category**
  According to the rule of Japanese pension system, a taxpayer is listed in Category No. 2 and his/her spouse is listed in Category No.3. The taxpayer has to pay the social security premium which is proportional to the taxpayer's income. However, whether the spouse has to pay the social security premium or not depends on the spouse's annual income. If the spouse's annual income is lower than 1,300 thousand yen, the spouse does not have to pay the social security premium but is still covered by the second tier. When the spouse's annual income is above 1,300 thousand yen, the spouse has to pay the social security premium.

2.3 Thresholds of Spouse's Income

Under the Japanese tax and social security system, there exist four thresholds for a spouse's annual income. The four income thresholds will be incorporated in our benchmark economy. Figure 3 plots these income thresholds and the family income schedule and they are described as follows.

First, when the spouse's annual income ranges between 0 and 700 thousand yen (the first threshold, T1 dashed-line), the spouse does not have to pay the income tax as well as the social security premium. Moreover, the corresponding taxpayer enjoys a spousal deduction of 760 thousand yen out of his/her tax base. The second threshold is located at the annual income of 1,030 thousand yen. If the spouse's annual income is between 700 and 1,030 thousand yen (T2 dashed-line), the spouse does not have to pay either the income tax nor the social security premium. However, the spousal deduction that the corresponding taxpayer enjoys is decreasing as the spouse's income increase. Third, the spouse, whose annual income is higher than 1,030 thousand yen but lower than 1,300 thousand yen (T3 dashed-line), has to pay the income tax. The social security premium is still waived. The corresponding taxpayer still enjoys the spousal deduction. Fourth, if the spouse's annual income is between 1,300 thousand yen and 1,430 thousand yen (T4 dashed line), both the income tax and social security premium are applicable to the spouse. The corresponding taxpayer enjoys the last moment of the spousal deduction. Finally, when the spouse's annual income is higher than 1,430 thousand yen, both the taxpayer and his/her spouse have to pay the income tax and the social security premium. With this income level, the spousal deduction is not applicable to the taxpayer. The tax schedule is summarized in Table 2.

2.4 The 2004 Tax Reform

In 2003, in order to response to structure changes in Japanese society, Japan Prime Minister Koizumi Government had proposed a tax reform package. The proposal then was successfully passed by the Japanese Diet and officially implemented since the fiscal year of 2004 (1 April 2004). This reform has been considering as the most considerable reform policy on individual tax system.

Among the 2004 tax reform package, one important policy was to abolish a part of the spousal deduction (i.e., Special Allowance for Spouse, 380 thousand yen). The right-hand side of Figure 2 shows the amount of spousal deduction according to spouse's annual income proposed by the 2004 tax reform. Compared with the deduction before the tax reform, the flat spousal deduction decreases from 760 to 380 thousand yen if the spouse's annual income is lower than 700 thousand yen. When the spouse's annual income ranges from 700 to 1,030 thousand yen, the spousal deduction is a fixed amount (380 thousand yen), while it was decreasing in spouse's annual income before the tax reform. The structure of the spouse deduction remains unchanged if the spouse's annual income is higher than 1,030 thousand yen.

In our quantitative analysis, we first study the effect of the 2004 tax reform based on the benchmark economy. Then, we take one step further. Using the economy with the 2004 tax reform as our reference economy, we explore possible policy experiments and study the macroeconomic impacts.

2.5 Child-care System in Japan

Following an international trend in recent years around the world on investing more in pre-school education, Japan has also restructured the child-care system. The new system is under the name of "Early Childhood Education and Care" (ECEC). There are basically three types of ECEC in Japan: Kindergartens (*youchien*), Day-care Centers or Nursery Schools (*hoikujo*), and newly ECEC centers (*ninteikodomoen*, since 2006).

Kindergartens are administrated, supported, and partially funded by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). Kindergartens admit children from age 3 to 5. They are education-oriented institutions and listed in Japanese education system. A kindergarten could be either public or private; however, both of them are supported and partially funded by the government. An important disadvantage makes kindergartens less preferred from the alternatives is that they only operate 4 hours per day.

Day-care centers are the social-welfare-oriented institutions and operate under the Ministry of Health, Welfare, and Labor (MHWL). They admit children aged 0 to 5. The priority is given to children whose parents are working or families who have special difficulties in taking care of children. There are 3 types for the day-care centers based on their establishment, registration, and funding. The first type is licensed-public centers: they are established and operated by the government (public-funded and public-run). Second, licensed-private centers are those private-established and private-operated but need to follow the standards of child-care centers set by prefectures. A part of the operation cost of this type is shared by the local government (public-funded and private-run). The third type is non-licensed and completely privates operated centers. They do not have to meet the standards of public child-care centers. They are not licensed and do not receive any funding from government (private-funded and private-run). Different from kindergartens, day-care centers open for 8 hours per day.

One more alternative type of child-care services with partially public financial aid is newly authorized ECEC centers. They have been established since 2006 in order to solve the limitations of kindergartens and day-care centers. Both MEXT and MHWL are responsible for ECEC centers. ECEC centers open for all children regardless of parentsworking status. The child-care time is flexible and depends on parents' demand.

The government provides approximately 51.3% of child-care costs to kindergartens and roughly 60% of child-care costs to day-care centers. On average, the government covers 56.6% of the child-care expenditures in the ECEC system. The child-care expenditures are shared by the central government and the local government (both the prefecture and municipal administrations).[4] According to OECD (2011), in 2005, the government spending on day-care centers and kindergartens amounted to 0.2% and 0.1% of Japan's GDP, respectively.

3 The Model

A general equilibrium framework with endogenous female labor supply is employed. Our model builds upon the work of Attanasio, Low and Sanchez-Marcos (2006) with two important departures: (i) heterogeneous households and (ii) a piecewise linear and discontinuous household budget constraint which is constructed based on Japanese tax and social security system.

Time is discrete. Our model economy includes three parts: households with different education level, the production sector, and the government sector. Each household consists of a couple: a main taxpayer and his/her spouse. To focus on the disincentive to work for female, we assume the main taxpayer in a household is the husband and the spouse is the wife. [5] Husbands are identical among households. In contrast, wives are differentiated by their education levels and preferences on leisure. There exists one consumption goods in the economy. A representative firm produces the goods which can be used as either consumption or capital accumulation. The government maintains a balanced budget every period. In the following, we first describe the household's problem and the production side. Then, the government tax tools and social security system are provided. Finally, a competitive equilibrium is defined.

3.1 Household

3.1.1 Household's Problem

The economy is populated by different types of infinitely lived households. Each household refers to a couple who remain married and a child.[6] To simplify the working-leisure decision in a household, we assume all husbands are homogenous and husband's labor supply is inelastic, $\overline{H}^m$. In contrast, wives' working time are endogenously determined and differentiated by education level (indexed by i) and preference on

[4] Source: *ECEC System in Japan*, Ministry of Education, Culture, Sports, Science and Technology (MEXT), 2009; Oishi (2002); Zhou, Oishi and Ueda (2003); OECD (2011)

[5] This assumption is roughly consistent with the case of Japan, where 80% of males are regular staffs.

[6] The total fertility rate in Japanese of 2016 is 1.44. Thus, we exogenously assume that there is only one child in a household. A simple way to model the size of household (i.e., the family with different number of children) can be found in Attanasio, Low and Sanchez-Marcos (2008).

leisure (indexed by j). A wife could be high-educated (H) or normal-educated (N), $i \in \{H,N\}$, with higher preference on leisure (H) or lower preference on leisure (L), $j \in \{H,L\}$.

A household derives utility from the household's consumption and the wife's leisure time. Specifically, our setting describes that the working time of the wife reduces the time spent on her family and thus decreases the household's utility. Moreover, our setup also captures the important role of education in determinant of female labor decision. The household's periodic utility function at period t is given by:

$$U(C_t^{ij}, H_t^{ij}) = \log(C_t^{ij}) + \alpha_j \log(L - H_t^{ij}), \tag{1}$$

where C_t^{ij} denotes household consumption for a family in which the wife's type is ij, α_j represents the preference type on leisure, L is time endowment for the wife, H_t^{ij} is the raw labor supply of the wife with the type ij, $i \in \{H,N\}$, and $j \in \{H,L\}$.

The budget constraint at time t for a household with ij type is given by:

$$\begin{aligned}(1+\tau_c)C_t^{ij} + (1-\rho)H_t^{ij}P_t + K_{t+1}^{ij} = [1+(1-\tau_k)(r_t-\delta_t)]K_t^{ij} + [(1-\tau_s^{ij})w_t e^i H_t^{ij} - T_t(y_t^{ij})] \\ + [(1-\tau_s)w_t\overline{H}^m - T_t(y_t^m)] + \zeta,\end{aligned} \tag{2}$$

where w_t denotes labor wage rate, r_t is the rental rate of capital, δ_t refers to the depreciation rate of capital, and e^i represents the labor efficiency of the wife with education type i. Note that all husbands are identical, so we normalize the husband's labor efficiency to be one. Therefore, w_t refers to the husband's wage rate and e^i is the labor efficiency of an i-type wife relative to the husband. K_{t+1}^{ij} denotes the capital stocks for the household. P_t is per-hour cost of sending the child to school or day-care center when the wife is working. ρ refers to the share of government subsidy on the child-rearing cost. ζ is a lump-sum transfer, which is equally distributed by the government. In addition, τ_c denotes the tax rate on consumption goods, τ_k refers to the tax rate on capital rental income, τ_s represents the tax rate of husband's social security premium, and τ_s^{ij} is the tax rate on wife's social security premium. Based on the Japanese social security system, whether the wife pays the premium or not depends on her labor income. It takes the following structure:

$$\tau_s^{ij} = \begin{cases} 0, & w_t e^i H_t^{ij} \le \xi; \\ \tau_s, & w_t e^i H_t^{ij} > \xi, \end{cases} \tag{3}$$

where ξ is the threshold for paying the social security premium. When the wife's income is lower than ξ, she is covered by the social security system but does not have to pay the premium. In contrast, the wife has to pay the premium when her income is higher than ξ.

$T_t(y_t^n) = \tau_h y_t^n$, which is the tax schedule imposed on the taxable labor income, y_t^n, τ_h is the marginal tax rate of the taxable labor income, and $n \in \{m, NH, NL, HH, HL\}$. In Japan, social security premium is tax free and each employee enjoys the basic and employment deduction, which is a function of one's labor income, $D_t(w_t e^i H^{ij})$. Therefore, the taxable income of the wife with type ij takes the following forms:

$$y_t^{ij} = \begin{cases} 0, & w_t e^i H_t^{ij} \le \lambda; \\ \max\{[(1-\tau_s^{ij})w_t e^i H_t^{ij} - D_t(w_t e^i H_t^{ij})], 0\}, & w_t e^i H_t^{ij} > \lambda, \end{cases} \tag{4}$$

where λ is the threshold for paying the labor income tax. A wife with type ij does not have to pay the individual labor income tax when her labor income is lower than this threshold. We approximate the basic and employment deduction by a linear function, $D_t(w_t e^i H_t^{ij}) = a(w_t e^i H_t^{ij}) + b$, where a and b are parameters that we will calibrate to match the Japanese tax deduction schedule in our quantitative analysis. Finally, the taxable income of the husband is given by:

$$y_t^m = \max\{[(1-\tau_s)w_t\overline{H}^m - D_t(w_t\overline{H}^m) - S_t], 0\}, \tag{5}$$

where S_t refers to the spousal tax deduction in Japan. The amount of spousal deduction that the husband enjoys depends on his wife's labor income and is given by:

$$S_t = \begin{cases} \overline{AS} + \overline{SAS}, & 0 \le w_t e^i H_t^{ij} \le \chi_1; \\ \chi_2 - w_t e^i H_t^{ij}, & \chi_1 < w_t e^i H_t^{ij} \le \chi_2; \\ 0, & \chi_2 < w_t e^i H_t^{ij}, \end{cases} \tag{6}$$

where $\overline{AS}$ is the Allowance for Spouse, $\overline{SAS}$ is Special Allowance for Spouse, and χ_1 and χ_2 are the two thresholds for the spousal deduction. If the wife's labor income is lower than χ_1, the husband enjoys the fixed amount of spousal deduction, $\overline{AS} + \overline{SAS}$. When the wife's labor income is in the range of χ_1 and χ_2, the spousal deduction is decreasing in the wife's labor income. The husband is not able to claim the spousal deduction if his wife's labor income is higher than χ_2.

In summary, based on the tax and social security system in Japan, there exist four thresholds on the wife's labor income and $\chi_1 < \lambda < \xi < \chi_2$. The thresholds, χ_1 and χ_2, are those for spousal deductions, λ is the threshold for paying labor income tax, and ξ is the one for paying social security premium. Therefore, the ij-type household's optimization problem can be written as follows. Each household chooses consumption, capital accumulation, and the wife's labor supply to maximize the household's lifetime utility:

$$\max_{\{C_t^{ij}, H_t^{ij}, K_{t+1}^{ij}\}_{t=0}^{\infty}} \left\{ \sum_{t=0}^{\infty} \beta^t [\log(C_t^{ij}) + \alpha_j \log(L - H_t^{ij})] \right\},$$

subject to the budget constraint:

$$\begin{aligned}(1+\tau_c)C_t^{ij} + (1-\rho)H_t^{ij}P_t + K_{t+1}^{ij} = [1 + (1-\tau_k)(r_t - \delta_t)]K_t^{ij} + \phi^{ij} w_t e^i H_t^{ij} \\ + \phi^m w_t \overline{H}^m + \psi^{ij} + \zeta,\end{aligned} \tag{7}$$

where

$$\phi^m = 1 - [\tau_s + \tau_h(1 - \tau_s - a)]; \tag{8}$$

$$\phi^{ij} = \begin{cases} 1, & 0 \le w_t e^i H_t^{ij} < \chi_1; \\ 1 - \tau_h, & \chi_1 < w_t e^i H_t^{ij} \le \lambda; \\ 1 - \tau_h(2-a), & \lambda < w_t e^i H_t^{ij} \le \xi; \\ 1 - [\tau_s + \tau_h(2 - \tau_s - a)], & \xi < w_t e^i H_t^{ij} \le \chi_2; \\ 1 - [\tau_s + \tau_h(1 - \tau_s - a)], & \chi_2 < w_t e^i H_t^{ij}; \end{cases} \tag{9}$$

and

$$\psi^{ij} = \begin{cases} (b+S)\tau_h, & 0 \leq w_t e^i H_t^{ij} \leq \chi_1; \\ (b+\chi_2)\tau_h, & \chi_1 < w_t e^i H_t^{ij} \leq \lambda; \\ (2b+\chi_2)\tau_h, & \lambda < w_t e^i H_t^{ij} \leq \xi; \\ (2b+\chi_2)\tau_h, & \xi < w_t e^i H_t^{ij} \leq \chi_2; \\ 2b\tau_h, & \chi_2 < w_t e^i H_t^{ij}. \end{cases} \tag{10}$$

The household's budget constraint depends on the labor income level of the wife. Thus, it is discontinuous and piece-wise linear. It is this discontinuous tax structure in Japan's income tax and social security system that creates the disincentives for married women to work.

3.1.2 Household's Optimal Choices

The first order conditions for heterogeneous households imply the same Euler equation. Each household's inter-temporal consumption choice is determined by:

$$\frac{C_{t+1}^{ij}}{C_t^{ij}} = \beta[1 + (1-\tau_k)(r_{t+1} - \delta_{t+1})]. \tag{11}$$

In contrast, each household's intra-temporal labor-leisure arrangement depends on its after-tax income,

$$C_t^{ij} = \left[\frac{1}{(1+\tau_c)\alpha_j}\right][\phi^{ij} w_t e^i - (1-\rho)P_t](L - H_t^{ij}). \tag{12}$$

The intra-temporal condition shows the trade-off between the benefit and the cost of labor-leisure choices. It also equates the slope of the household's indifference curve to the real wage rate. Note that the after-tax return to the wife's labor supply depends on her labor efficiency and the effective tax rate on her labor income. The labor-leisure allocation also depends on the household's preference on the wife's time spent at home and government's subsidy on child-rearing cost. Therefore, the optimal choice on the wife's labor hours could be different among heterogenous households.

3.2 Production Technology

The aggregate output, Y, of the economy at time t is produced by a Cobb-Douglas technology:

$$Y_t = A K_t^{\theta} H_t^{1-\theta}, \tag{13}$$

where K_t and H_t represent the aggregate capital and aggregate effective labor, respectively. θ is the income share of capital. A denotes the total factor productivity. Capital depreciates at an exogenous rate of $\delta \in (0,1)$ in each period. All markets behave competitively. With a constant-returns-to-scale technology and a perfectly competitive environment, we assume without loss of generality that there exists a representative firm employing this technology to produce aggregate output.

Denote w_t as the real wage rate per unit of effective labor and r_t to be the net-of-depreciation real rental rate per unit of capital. Given w_t and r_t, the representative firm's maximizing profit yields the following

conditions:

$$w_t = (1-\theta)A\left(\frac{K_t}{H_t}\right)^{\theta}; \tag{14}$$

$$r_t = \theta A\left(\frac{K_t}{H_t}\right)^{\theta-1}. \tag{15}$$

3.3 The Government

The government collects consumption tax, capital income tax, labor income tax, and social security premium to finance the government general expenditure, G_t, the subsidies on child-rearing cost, Ω_t, and the lump-sum transfer. We assume the government maintains the balanced budget in each period of time. The government budget is given by:

$$G_t + \Psi_t + \Omega_t + \zeta = \tau_c C_t + \tau_k(r_t - \delta_t)K_t + (1-\phi^m)w_t\overline{H}^m + \Phi_t, \tag{16}$$

where Ψ_t is the total amount of deduction, which includes the spousal deduction and the basic and employment tax deductions. Φ is the total labor income tax and social security premium paid by working wives. Denote μ^{ij} to be the proportion of wives with the type ij to wives with education level i. The following conditions should be satisfied:

$$\mu^{HH} + \mu^{HL} = 1; \tag{17}$$

$$\mu^{NH} + \mu^{NL} = 1. \tag{18}$$

We further assume that the proportion of wives with education level i to total wives is π^i, where $\pi^H + \pi^N = 1$. Then, the total amount of deduction is given by:

$$\Psi_t = \sum_{ij}(\pi^i \mu^{ij} \psi_t^{ij}). \tag{19}$$

The total amount of labor income tax and social security premium collected from wives is given by:

$$\Phi_t = \sum_{ij}[\pi^i \mu^{ij}(1-\phi^{ij})w_t e^i H_t^{ij}]. \tag{20}$$

The subsidies on child-rearing cost is as follows:

$$\Omega_t = \rho P_t \sum_{ij}(\pi^i \mu^{ij} H_t^{ij}). \tag{21}$$

Finally, the lump-sum transfer, ζ, is equally distributed to all households.

3.4 A Competitive Equilibrium

We now define the competitive equilibrium of our economy. Given a set of the government's fiscal policies $\{G_t, \tau_c, \tau_k, \tau_s, \tau_h\}_{t=0}^{\infty}$, the government subsidy on child-rearing cost ρ, the child-rearing cost $\{P_t\}_{t=0}^{\infty}$, a set of labor efficiency for husband, high-educated wife and normal-educated wife $\{1, e^H, e^N\}$, the proportions of normal-educated wives and high-educated wives $\{\pi^N, \pi^H\}$, the proportions of high and low preference on leisure $\{\mu^H, \mu^L\}$, and a set of prices $\{w_t, r_t\}_{t=0}^{\infty}$, a competitive equilibrium in our economy is an allocation of $\{C_t^{NH}, H_t^{NH}, K_{t+1}^{NH}, C_t^{NL}, H_t^{NL}, K_{t+1}^{NL}, C_t^{HH}, H_t^{HH}, K_{t+1}^{HH}, C_t^{HL}, H_t^{HL}, K_{t+1}^{HL}, H_t, K_t, C_t, Y_t\}_{t=0}^{\infty}$, such that

- The allocation solves the households' problem described in Section 4.1;
- The allocation also solves the firm's profit maximization problem described in Section 4.2;
- The government's budget described in Section 4.3 is balanced in every period of time;
- The aggregate economy:
  - Aggregate labor follows:

$$H_t = \overline{H}^m + \pi^H e^H H_t^H + (1-\pi^H) e^N H_t^N; \tag{22}$$
$$H_t^H = \mu^{HH} H_t^{HH} + (1-\mu^{HH}) H_t^{HL}; \tag{23}$$
$$H_t^N = \mu^{NH} H_t^{NH} + (1-\mu^{NH}) H_t^{NL}; \tag{24}$$

  - Aggregate capital follows:

$$K_t = \pi^H K_t^H + (1-\pi^H) K_t^N; \tag{25}$$
$$K_t^H = \mu^{HH} K_t^{HH} + (1-\mu^{HH}) K_t^{HL}; \tag{26}$$
$$K_t^N = \mu^{NH} K_t^{NH} + (1-\mu^{NH}) K_t^{NL}; \tag{27}$$

  - Aggregate consumption follows:

$$C_t = \pi^H C_t^H + (1-\pi^H) C_t^N; \tag{28}$$
$$C_t^H = \mu^{HH} C_t^{HH} + (1-\mu^{HH}) C_t^{HL}; \tag{29}$$
$$C_t^N = \mu^{NH} C_t^{NH} + (1-\mu^{NH}) C_t^{NL}; \tag{30}$$

- Market clear condition is satisfied: $Y_t = C_t + G_t + I_t$;
- The law of motion of capital, which is traditionally written as: $K_{t+1} = (1-\delta)K_t - I_t$, follows the rule:

$$K_{t+1} = \left[(1-\delta) + (1-\frac{G_t}{Y_t}) A \left(\frac{K_t}{H_t} \right)^{\theta-1} \right] K_t - C_t. \tag{31}$$

4 Parametrization

This section first describes how we calibrate the theoretical framework in order to match the Japanese economy before the 2004 tax reform. The calibrated result is our benchmark economy. Then the 2004 tax reform is applied to the benchmark economy to evaluate the performance of our model.

4.1 Calibration

The theoretical model is calibrated to data from Japan before the 2004 tax reform. It is solved as a steady state. Table 3 summarizes the parameters and the target data moments. The details are explained as follows.

Preferences

There are three preference parameters, β, α_H, and α_L. The discount factor, β, is calibrated to match the average annual capital-output ratio in Japan of 2000, approximately 2.34, Thus, β is set to be 0.960.[7] The rest two preference parameters are related to work-leisure decisions. To capture the concentration of income distribution of Japanese married women, we use the labor supply decisions of wives in the model to calibrate α_H and α_L. We choose $\alpha_H = 0.396$ and $\alpha_L = 0.316$ such that the normal-education wife with high preference on leisure decides to work at the threshold, χ_1 and the average weekly working hours of wives is 24.4.[8]

Population Shares

Households are classified by two dimensions, the education level and preference on leisure. We define high-educated wives are those who graduated from junior college, college or university, and graduate school. Normal-educated wives include those who graduated from primary or junior school, senior high school, and vocational school. Using the data from 2010 *Basic Survey of Schools*, the shares of high-educated and normal-educated wives (π^H and π^N) are 26.5% and 73.5%, respectively.[9].

Takahashi (2010) reports the hours worked, before-tax wage, and education years of Japanese women in five budget segments. We fist define those in the first three segments to be normal-educated wives and those in the first segment to be normal-educated wives with high preference on leisure. Second, we compute the number of observations in the first segment relative to those in the first three segments to be the share of normal-educated wives with high preference on leisure to total normal-educated wives, $\mu^{NH} = 41\%$. Since preference on leisure is directly related to labor supply, the above strategy is to capture the distribution of hours worked for Japanese women. Third, we assume that preference on leisure is independent of education level, so the share of high-educated wives with high preference on leisure to total high-educated wives (μ^{HH}) is also equal to 41%.

Production

There are seven parameters in the production: A, θ, δ, L, $\bar{H}^m$, e^H, and e^N. Total factor productivity is normalized to be 1. The income share of capital (θ) is set to be 0.363, which is the standard valve for Japanese economy in the literature.[10] Following Chen et al. (2006), the annual depreciation rate of capital is set at 0.082.

The rest four parameters are related to labor. The time endowment (L) is normalized to be 105 hours. Husband's working time is set to be 46.11 hours, which is the average working hours of Japanese male during 2000-2010.[11] We normalize the labor efficiency of the husband to be one. Then the labor efficiencies of the normal-educated and high-educated wives (e^N and e^H) are calculated using the average monthly income

[7] The capital-output ratio is taken from Hayashi and Prescott (2002) and Chen et al. (2006).

[8] As Table 4 shows, the average weekly working hours of female is 35.04. However, the employment rate of female aged 20 and above is 68.75%. Thus, the adjusted working hours for female become 24.4.

[9] The survey of *Basic Survey of Schools* was reported in *The Japan Statistical Yearbook 2013*

[10] For example, Hayashi and Prescott (2002).

[11] Source: Statistics Bureau of Japan. See Table 4 for the details.

of female relative to male. Thus, $e^N = 0.607$ and $e^H = 0.788$, respectively. The details are summarized in Table 5.

Child-rearing

Two parameters are related to child-rearing. The first one is the child-rearing hourly cost, P. Using the data on the average child-care cost of different child-care arrangement, we are able to compute the hourly cost per child in kindergartens and day-care centers. The average hourly cost per child in kindergartens was roughly equal to 462 yen, while the cost was higher, 625 yen per hour per child in day-care centers.[12] In 2007, roughly 46% of children were sent to kindergartens and 54% were to day-care centers. Therefore, the weighted average hourly cost per child in Japan was roughly 550 yen. Japanese male's average monthly wage in 2007 was 328,000 yen. Average working time per week for male was 46.11 hours. Thus, Japanese male's hourly wage was 1,778 yen. Finally, the hourly child-care cost as a percentage of male's wage was 31%. We therefore choose $P = 0.321$ so that in the benchmark economy the child-rearing cost is 31% of husband's wage. The details are summarized in Table 6.

The second child-rearing parameter is the child-rearing subsidy, ρ. As discussed in Section 2, Japanese government covers 56.6% of the child-care expenditures in the ECEC system. The rest is contributed by parents. In addition, there are only 56.49% of Japanese children aged 0 to 5 actually benefited from the child-care subsidies. Thus, the actual share of government subsidy on child-rearing cost is 31.97

Taxes and Deductions

There are four tax rates. The labor income tax rate, τ_h, is set to 0.236, which is estimated by a simple linear regression shown in Figure 4. The social security premium is about 15% of total income (NIPSSR, 2011). It is equally distributed between employers and employees. Thus, we set the social security premium (τ_s) paid by the household to be 7.5%.[13] The tax rate of capital income (τ_k) is set to be 43.5%, which is equal to the average capital income tax in the studying period.[14] Consumption tax (τ_c) is set to be 5%, which is equal to the average consumption tax rate in Japan in our targeted periods.[15] The above tax information and tax data are collected from Japanese Tax Agency (NTA).

Four parameters govern the basic and employment deduction and the spousal deductions. As shown in Figure 5, we use a simple linear regression on the actual basic and employment deduction schedule to estimate the two parameters for the basic and employment deduction. The slope of the basic and employment deduction is equals 0.163. Thus, we set $a = 0.163$. The intercept of the regression is 980 thousand yen,

[12]The hourly cost per child include both the payment out of parents' packet and from government's spending. The main data year is 2007. Since our benchmark targets to the periods before the 2004 tax reform but ECEC centers started to operate since 2006, we do not consider the child-care cost in ECEC centers in our calculation.

[13]This is relatively smaller than the social security tax rate reported in the literature. The main difference is that the literature usually does not separate the contribution of employers and employees. Here, because the main purpose of this paper is to capture the impact of the tax on household's decisions, we only consider the premium paid by employees.

[14]The data of capital income tax is from Chen et al. (2006).

[15]The consumption tax was first introduced in 1989 at 3% and then adjusted to 5%. However, during the early life of the tax, some kinds of consumption were taxed at higher rates. Thus, we choose the tax rate to be 5% as an average.

which is then converted to 27.22% of male's average income. Thus, we set $b = 11.8$ in the benchmark economy. As discussed in Section 2, the spousal deductions before the 2004 tax reform consist of two parts: Allowance for Spouse and Special Allowance for Spouse. Both are fixed at 380 thousand yen. The 380 thousand yen is then converted to be a percentage of male's wage. Thus, we set $\overline{AS} = 4.575$ and $\overline{SAS} = 4.575$ in the benchmark economy.

Income Thresholds

As mentioned in Section 2, the Japanese tax system results in four thresholds for wife's income. The first threshold is at 700 thousand yen, the second one is at 1,030 thousand yen, the third one is 1,300 thousand yen, and the last 1,430 thousand yen. They are converted to be percentages of male's average income. Thus, we set $\chi_1 = 8.428$, $\lambda = 12.402$, $\xi = 15.653$, and $\chi_2 = 17.218$ in the calibration.

Government Expenditure

The general government expenditure (G) is chosen to match the ratio of government expenditure to output, 15%, in the literature. Therefore, $G = 15.356$ in the benchmark economy. The lump-sum transfer (ζ) is set such that the government balances its budget. $\zeta = -0.132$ in the benchmark economy.

4.2 The Benchmark Economy

The first column in Table 7 summarizes the calibrated results. In the benchmark economy, the average working hours of a household (a husband and a wife) is 63.06. The main contributor of the household working time is the husband (73%), while the wife only contributes 27%. Among wives, the working time of normal-educated wives is lower than the average. In contrast, the working times of both types of high-educated wives are far away from the average. For example, the working hours of high-educated women with low preference on leisure is almost as twice as the average. The order of working times among different types of wives is roughly consist with the one reported in Takahashi (2010). Besides, there are some evidences that supporting our calibrated result. In Japanese data of 2011, only 37% of normal-educated women work as regular staff, while 63% of them are non-regular staff. In contrast, high-educated women, who graduated from junior college and college or university, tend to engage in regular works (57% of them are regular workers). In the literature, Sasaki (2002) shows that employed married women are more highly educated than housewives. Hirao (2001) suggests that university graduates are more likely to stay in the labor force.

In addition, we find that normal-educated wife with low preference on leisure chooses to work at the point that her income is equal to the second income threshold (λ), which is 1,030 thousand yen in the real tax schedule. High-educated wives choose to work at the point that beyond all thresholds, regardless of their preference on leisure. Thus, our benchmark economy suggests that about 73% of Japanese wives (30% for normal-educated with low preference on leisure and 43% for normal-educated with high preference on leisure) choose to work at or below the threshold of 1,030 thousand yen. This income distribution in the benchmark economy captures the main feature of income concentration for Japanese married women in the income data.

4.3 Impacts of the 2004 Tax Reform

As discussed in Section 2, Japan introduced a tax reform in 2004 in response to the structural change of the Japanese society. It has been considering as the most considerable reform policy on tax system so far. Based on our benchmark economy, we incorporate the tax reform into the theoretical framework and study the effect of the 2004 tax reform on female's working decisions.

The spousal deductions consist of two parts: Allowance for Spouse and Special Allowance for Spouse. The 2004 reform policy aims to remove the Special Allowance for Spouse. After the tax reform, if spouse's income is lower than 1,030 thousand yen, the total amount of spousal deductions is flat and equal to 380 thousand yen. Others remain unchanged. To capture the main spirit of the 2004 tax reform, we remove the Special Allowance for Spouse $\overline{SAS}$ and the first threshold (χ_1) from the model. Therefore, in the experiment of 2004 tax reform, there exists three thresholds, λ, ξ, and χ_2 and four categories in the framework. The husband whose spouse's income is lower than λ enjoys a flat deduction, $\overline{AS}$ and the spouse's labor income tax is waived. If the spouse's income is between λ and ξ, the spousal deduction is decreasing in the spouse's income and the spouse has to pay the labor income tax but the social security premium is waived. When the spouse's income is between ξ and χ_2, the spouse has to pay both taxes and the spousal deduction is decreasing in the spouse's income. Finally, the spouse has to pay both taxes and no spousal deduction is applied if the spouse's income is larger than χ_2. Then, using the parameters in the benchmark economy, we re-solve the model with the aforementioned tax structure. To keep the labor income tax rate at the same level, the general government expenditure G is adjusted to balance the government's budget in the scenario with the 2004 tax reform. Others remain unchanged. The result is reported in the second column of Table 7. Percentage changes relative to the benchmark economy (before 2004 tax reform) are summarized in the third column of Table 7.

We find that the tax reform mainly affect the decisions of normal-educated wives with high preference on leisure. The reform policy has minor or no effects on other groups of wives since the tax reform does not change the deductions they enjoy and the taxes they are collected.[16] Before the tax reform, normal-educated wives with high preference on leisure decides to work at the threshold χ_1. Their working decision moves to λ after the tax reform. Therefore, their working time increases from 13.4 to 19.7 hours. The tax reform removes the disincentive to this group to work. However, normal-educated wives with high preference on leisure accounts for only 30% of total wives. Thus, the average working time of wives in the whole economy only slightly increases from 24.4 to 26.3 hours. The effect of the 2004 tax reform on encouraging female's labor supply is not large. Yokoyama (2018) indicates that the 2004 tax reform increased the work hours among low-income married women and created a new kink on the budget line. Our result is consistent with the findings in Yokoyama (2018).

The above quantitative analysis shows that our model is able to capture the main influence of tax policy on female's working decisions. Therefore, we take the model framework with the 2004 tax reform as a reference economy and proceed to conduct several policy experiments in the next section.

[16] Before the tax reform, normal-educated wives with low preference on leisure choose to work at the threshold λ, where the total amount of spousal deduction is exactly equal to $\overline{AS}$. Thus, they are not affected by the tax reform.

5 Policy Experiments

This section provides policy experiments to examine the impacts of various policies on Japanese wives' working behaviors as well as the aggregate economy. The main purpose of our policy experiments is to provide incentives to married women to supply more labor. Therefore, we consider two types of policies: (i) changing the tax structure in Japan and (ii) increasing government's subsidy on child-rearing cost. All policies are conducted based on and compared with the result of the 2004 tax reform. Given the level of general government expenditure in the 2004 tax reform, the labor income tax rate is adjusted to balance the government's budget in all policy experiments, expect policy 3 (described below). In Policy 3, the labor income tax rate is treated as a tool of government to encourage labor supply, so the government's budget is balanced by the consumption tax rate instead. Each policy is solved as a steady state.

5.1 Changing the Tax Structure

In this type of policy experiments, we consider three possible scenarios. The first scenario extends the flat spousal deduction to a high income threshold. In addition to the first scenario, the second one removes the thresholds for paying labor income tax and social security premium. That is, we consider the scenario that all wives have to pay both taxes, regardless of their income level. The tax structure in the third scenario is back to the one in 2004 tax reform. However, the labor income tax rate exogenously decreases to the level of scenario 2 and the consumption tax rate is adjusted to balance the government's budget. Scenario 3 enables us to compare the effect of changing tax structure to the policy that directly lowering the labor income tax rate. The details are described as follows. The results are summarized in Table 8.

Policy 1: a flat spousal deduction

In the 2004 tax reform, the flat spousal deduction ($\overline{AS}$) is applicable up to the income threshold λ. When the wife's income is higher than λ but lower than χ_2, the spousal deduction is decreasing in the wife's income. Therefore, Policy 1 considers the scenario that extending the flat spousal deduction up to the threshold χ_2 and the spousal deduction is 0 when the income is beyond χ_2. Others remain unchanged.

We find that extending the flat spousal deduction encourages the labor supply of normal-educated wives. In the 2004 tax reform, normal-educated wife work at the point that her income is equal to the threshold λ. In contrast, under the implementation of policy 1, normal-educated wife work at the point that her income is beyond λ. Normal-educated wife with low preference on leisure even moves to the threshold ξ. However, the collection of labor income tax is not enough to finance the extra spousal deduction. Thus, the labor income tax rate has to increase and it slightly discourages the labor supply of high-educated wives. On average, policy 1 increases wives' labor supply from 26.31 to 28.91 hours.[17]

[17] We also consider a scenario that providing the flat spousal deduction to all households, regardless of wives' income level and obtain the same result.

Policy 2: removing tax thresholds

Based on policy 1, we further discuss what if the thresholds of labor income tax and social security tax are both removed. In other words, in policy 2, we consider a scenario that the flat spousal deduction is applicable up to the threshold χ_2 but each wife has to pay the labor income tax and social security tax as long as her income is larger than zero. The result suggests that the labor income tax rate indeed can be decreased from 23.6% in the 2004 tax reform or from 24.8% in policy 1 to 17.9% in this scenario. The lower tax rate encourages the labor supply of wives, so that the average working time of wives increases to 32.87 hours (a 24.96% increase, compared with the 2004 tax reform). We find that removing the tax thresholds together with offering a flat spousal deduction provides a strong incentive for wives to work.[18]

Policy 3: a low labor income tax rate

To provide incentives to work, the alternatives is to directly lower the tax rate. Therefore, policy 3 consider a scenario that the government directly lowers the labor income tax rate to the level of policy 2, while the tax structure in the 2004 tax reform is maintained. In this quantitative analysis, the government's budget is then balanced by raising the consumption tax rate. Compared with policy 2, the result suggests that the effect of a direct decrease in labor income tax on labor supply is smaller than that in policy 2. The average working time of wives increases by 10.62%, which is smaller than that in policy 2 (24.96%). We further find that a direct decrease in labor income tax does not change the labor-leisure decision of normal-educated wives with high preference on leisure. Since they do not pay labor income tax (they are at the threshold λ) in the 2004 tax reform, they are not affected by the tax-cut policy and stay at the threshold λ. In contrast, because in the 2004 tax reform high-educated wives have chosen to work at the point that paying both taxes, the tax-cut policy encourages their labor supply.

5.2 Increasing Child-rearing Subsidy

Raising children at home is the main reason that married women choose to leave the labor market. To encourage married women's labor supply, many countries provide child-rearing subsidies in order to lower married women's opportunity cost of working. Here we conduct experiments on child-rearing subsidies and study its impact of wives' labor supply. Our baseline is the 2004 tax reform, where the child-rearing subsidy is 0.32. Based on the tax structure in the 2004 tax reform, we consider increasing child-rearing subsidy to 0.35, 0.45, and 0.50. The government has to rise the labor income tax rate accordingly to finance the increase in the child-rearing subsidy and to balance the government's budget. The results are reported in Table 9.

There are two important implications in the result. First of all, increasing child-rearing subsidy indeed encourages married women's labor supply .However, the cost of increasing child-rearing subsidy is the increase in labor income tax rate, which would instead discourage labor decisions. Therefore, we find that the effect of increasing child-rearing subsidy on encouraging wives' labor supply is smaller than those of tax

[18] We also consider a scenario that providing the flat spousal deduction to all households together with removing both tax thresholds. We obtain the same result.

policies. The average working time of wives increases by only 1% when the child-rearing subsidy increases from 0.32 to 0.50. Second, different types of wives react in different ways. Since the incentives provided by the spousal deduction and zero labor income tax rate are strong enough, normal-educated wives choose to stay at the income threshold λ. In other words, increasing the child-rearing subsidy does not make them work more. In contrast, in the 2004 tax reform, high-educated wives does not enjoy the spousal deduction and have to pay both taxes. Thus, increasing the child-rearing subsidy lowers their opportunity cost of working and they choose to work for more hours. But, due to the higher labor income tax rate, the increase in their working time eventually is relatively small. For example, high-educated wives with high preference on leisure increase the working time by 2.80% in the scenario with 50% child-rearing subsidy.

6 Concluding Remarks

Population aging results in labor shortage. Many countries aim at encouraging married women, who are the potential labor force. However, Japanese tax and social security systems distort (discourage) Japanese married women's labor force participation. Therefore, this paper attempts to construct a theoretical framework to quantitatively study the impact of the tax and social security system on married women's labor decisions in Japan. In the model, wives' working hours are endogenously determined. We also identify four income thresholds for wives' income to mimic the Japanese tax and social security system.

There was a tax reform in Japan of 2004. Therefore, our benchmark economy is calibrated to data from Japan before 2004 to represent the Japanese economy before the tax reform. Then, the tax reform policies are imposed to quantitatively study the effect of the 2004 tax reform. We find that the 2004 tax reform has a limited effect on wives' labor supply. Low-income wives move to and stay at the next income threshold. There is no effect on other types of wives. Our result is consistent with the findings in the literature.

Taking the result of the 2004 tax reform as our reference, we further explore possible policies to encourage married women's labor supply. Our conclusions are as follows. First, tax policies and child-rearing subsidies are both able to encourage female's labor participation. We find that the effect of tax polices are relatively large. This may be due to the second-layer effect of a decline in the tax rate. Second, different types of wives response to policies in different ways. Therefore, it is important to understand who are the policy target in order to formulate appropriate policies.

There are some limitations in the current version of this paper. They will be our extension in the near future. First, an increase in married women's working hours leads to an increase in aggregate output. However, it does not necessary improve an individual's welfare. Therefore, we will consider welfare improvement as a measure of policy effect in the next step. Furthermore, since this paper adopts the log-utility function, thus, the elasticity of labor in the model is constant and might not be consistent with Japanese female's labor elasticity. A more precise utility function would be employed in the future.

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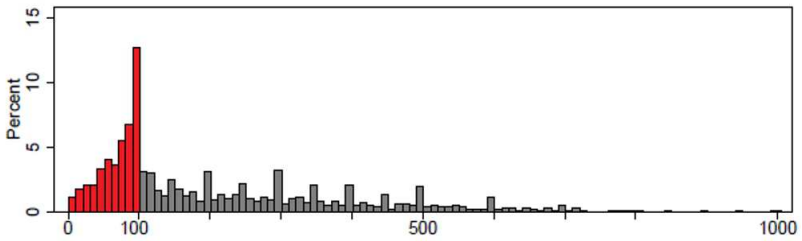
Table 1: The Basic and Employment Deduction in Japan

Individual Taxable Income *(in Thousand Yen)*	Total Employment Income Deduction	
	Employment Deduction	Basic Deduction
$0 < y <$ 1,625	650	380
1,625 $\leq y <$ 1,800	$0.40 \times y$	380
1,800 $\leq y <$ 3,600	$0.30 \times y + 180$	380
3,600 $\leq y <$ 6,600	$0.20 \times y + 540$	380
6,600 $\leq y <$ 10,000	$0.10 \times y + 1,200$	380
10,000 and above	$0.05 \times y + 1,700$	380

Source: Japanese Tax System, 2007

Figure 1: Wife's Income Distribution in Japan



Source: Takahashi, Kawade, and Kato (2009).

Figure 2: Spousal Deductions and the 2004 Tax Reform in Japan

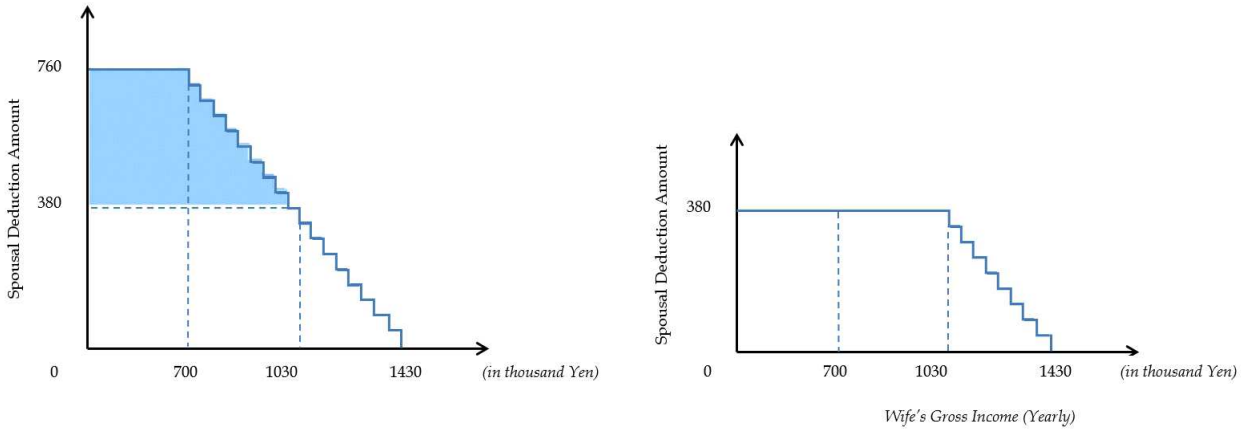


Table 2: The Tax Schedule in Japan

Income Brackets	Wife's Gross Income: Reality *(annual)*	Wife's Gross Income: Model *(weekly)*	Tax and Deduction
Bracket 1	[0.00 $\sim$ 700]	$0 \leq w_t e^i H_t^{ij} \leq \chi_1$	• No labor income tax for wife • No social security premium for wife • A flat spousal deduction for husband
Bracket 2	(700 $\sim$ 1,030]	$\chi_1 < w_t e^i H_t^{ij} \leq \lambda$	• No labor income tax for wife • No social security premium for wife • Spousal deduction for husband is decreasing in wife's income
Bracket 3	(1,030 $\sim$ 1,300]	$\lambda < w_t e^i H_t^{ij} \leq \xi$	• Wife pays labor income tax • No social security premium for wife • Spousal deduction for husband is decreasing in wife's income
Bracket 4	(1,300 $\sim$ 1,430]	$\xi < w_t e^i H_t^{ij} \leq \chi_2$	• Wife pays labor income tax • Wife pays social security premium • Spousal deduction for husband is decreasing in wife's income
Bracket 5	(1,430 $\sim$ ...)	$\chi_2 < w_t e^i H_t^{ij}$	• Wife pays labor income tax • Wife pays social security premium • No spousal deduction for husband

Table 3: Parameters

Parameters	Description	Value	Source/Target
Preferences			
β	discount factor	0.960	K/Y=2.34
α_H	high preference on leisure	0.396	type NH locates at χ_1
α_L	low preference on leisure	0.316	type HH and HL locate beyond χ_2
Population shares			
π^H	ratio of high-educated to total wives	0.265	data
π^N	ratio of normal-educated to total wives	0.735	data
μ^{HH}	ratio of high preference among high-educated	0.410	Takahashi (2010)
μ^{NH}	ratio of high preference among normal-educated	0.410	Takahashi (2010)
Production			
A	total factor productivity	1.000	normalization
θ	capital income share	0.363	Hayashi and Prescott (2002)
δ	capital depreciation rate	0.082	Chen et al. (2006)
L	time endowment	105	data
$\bar{H}^m$	husband labor supply	46.110	data
e^H	labor efficiency of high-educated wife	0.788	data
e^N	labor efficiency of normal-educated wife	0.607	data
Child-rearing			
P	child-rearing hourly cost	0.321	data
ρ	child-rearing subsidy	0.320	data
Taxes and deductions			
τ_h	labor income tax rate	0.236	estimated
τ_s	social security tax rate	0.075	data
τ_k	capital income tax rate	0.435	Chen et al. (2006)
τ_c	consumption tax rate	0.050	data
a	parameter for basic and employment deduction	0.163	estimated
b	intercept for basic and employment deduction	11.800	data
$\overline{AS}$	allowance for spouse	4.575	data
$\overline{SAS}$	special allowance for spouse	4.575	data
Thresholds			
χ_1	the first threshold for spousal deduction	8.428	data
λ	threshold for paying labor income tax	12.402	data
ξ	threshold for paying social security premium	15.653	data
χ_2	the second threshold for spousal deduction	17.218	data
Government			
G	general expenditure	15.356	G/Y=15%

Table 4: Average Weekly Working Hours

Unit: hour

Year	Both sexes	Male	Female
2000	42.70	47.30	36.10
2001	42.20	46.70	35.70
2002	42.20	46.80	35.50
2003	42.00	46.60	35.30
2004	42.00	46.70	35.40
2005	41.80	46.50	35.10
2006	41.70	46.30	35.10
2007	41.10	45.60	34.60
2008	40.70	45.30	34.40
2009	40.20	44.60	34.10
2010	40.30	44.80	34.10
Average	41.54	46.11	35.04
Adjusted by employed & age			24.40

Note: Three prefectures (Iwate, Miyagi, and Fukushima) are not included in 2010. The employment rate of female aged 20+ is about 68.75%. Source: Statistics Bureau of Japan.

Table 5: Average Monthly Income by Gender and Education

Unit: yen

Wage	Colleges	Higher Professional Schools or Junior Colleges	Senior High Schools	Average
Male	395,300	300,100	289,100	328,300
Female	274,700	242,900	199,400	227,600

Note: The average wage of the first two education levels for female is 258,800. Thus, the average wage of high-educated female relative to (average wage of) male is 0.788. The wage of normal-educated female relative to that of the average male is 0.607. Source: *Basic Survey on Wage Structure 2010*, Ministry of Health, Labour and Welfare, Japan.

Table 6: Child-rearing Cost

	Kindergartens	Day-care Centers	Aggregate
Number of children	45.83%	54.17%	100%
Public	19.8%	46.9%	34.48%
Private	80.2%	53.1%	65.52%
Hourly cost per child			
Public	438	625	539.30
Private	469	625	553.51
Average cost per child	462	625	550.30
Male's hourly wage			1,778.36
Child cost (% of male's hourly wage)			31%

Source: *ECEC System in Japan*, Ministry of Education, Culture, Sports, Science and Technology (MEXT), 2009; Oishi (2002); Zhou, Oishi and Ueda (2003); OECD (2011).

Figure 3: Tax Schedule in Japan

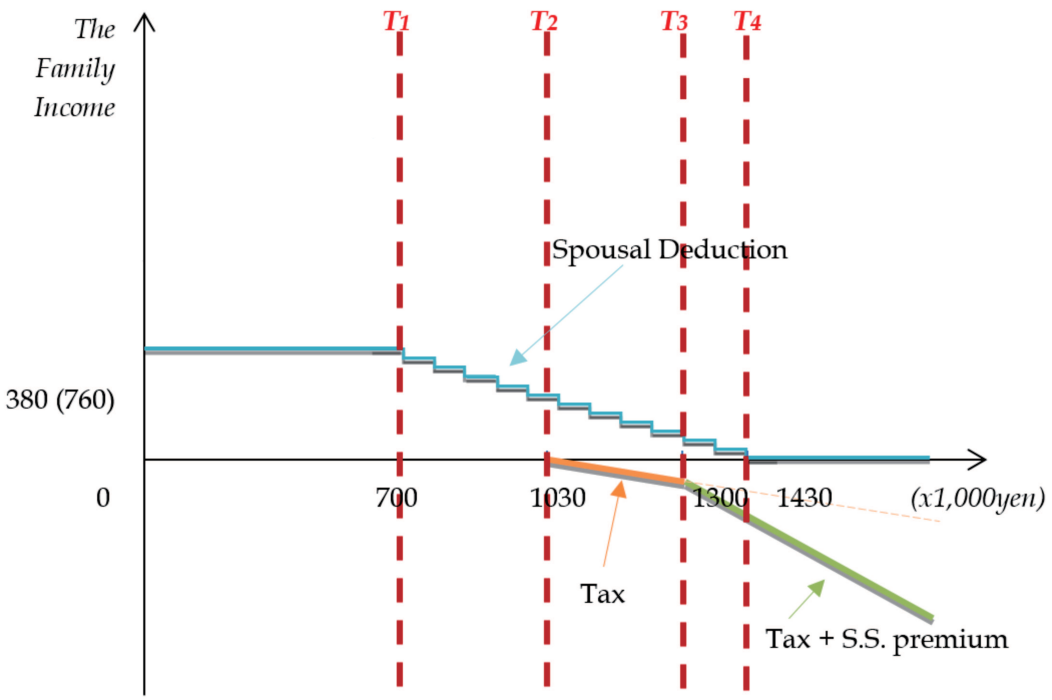


Table 7: The Benchmark and the 2004 Tax Reform

Variable	Benchmark	2004 Tax Reform	2004 Tax Reform (% change)
Aggregate			
C	56.886	57.470	1.03%
H	63.064	64.222	1.84%
H^{wife}	24.401	26.307	7.81%
K	239.566	243.965	1.84%
Y	102.375	104.254	1.84%
G	15.356	15.680	2.11%
Normal-educated women with high preference on leisure			
c^{NH}	53.045	54.913	3.52%
h^{NH}	13.420	19.746	47.14%
k^{NH}	238.347	249.153	4.53%
y^{NH}	8.428	12.402	47.14%
Normal-educated women with low preference on leisure			
c^{NL}	54.863	54.913	0.09%
h^{NL}	19.746	19.746	0.00%
k^{NL}	246.518	249.152	1.07%
y^{NL}	12.402	12.402	0.00%
High-educated women with high preference on leisure			
c^{HH}	62.101	62.101	0.00%
h^{HH}	38.793	38.793	0.00%
k^{HH}	220.816	220.816	0.00%
y^{HH}	31.623	31.623	0.00%
High-educated women with low preference on leisure			
c^{HL}	66.276	66.276	0.00%
h^{HL}	48.474	48.474	0.00%
k^{HL}	235.662	235.662	0.00%
y^{HL}	39.514	39.514	0.00%

Note: y^{ij} denotes the income of the wife with type ij, where $i \in \{N,H\}$ and $j \in \{H,L\}$. The thresholds are $\chi_1 = 8.428$, $\lambda = 12.402$, $\xi = 15.653$, and $\chi_2 = 17.218$.

Table 8: Experiments on Tax Policy

Variable	2004 Tax Reform	Policy 1	Policy 2	Policy 3
Scenarios				
$\overline{AS}$	up to λ	up to χ_2	up to χ_2	up to λ
τ_h	from λ	from λ	to all	from λ
τ_s	from ξ	from ξ	to all	from ξ
Aggregate				
τ_h	0.236	0.248	0.179	0.179
τ_c	0.050	0.050	0.050	0.060
H	64.222	65.742	68.280	66.019
K	243.965	249.737	259.380	250.791
Y	104.254	106.721	110.842	107.172
Wife's labor supply				
H^{wife}	26.307	28.913	32.874	29.102
	–	(9.91%)	(24.96%)	(10.62%)
h^{NH}	19.746	22.109	21.001	19.746
	–	(11.97%)	(6.35%)	(0.00%)
h^{NL}	19.746	24.922	33.129	24.922
	–	(26.21%)	(67.77%)	(26.21%)
h^{HH}	38.793	37.346	40.384	41.063
	–	(-3.73%)	(4.10%)	(5.85%)
h^{HL}	48.474	47.238	49.832	50.415
	–	(-2.55%)	(2.80%)	(4.01%)
Wife's income				
y^{NH}	12.402	13.886	13.190	12.402
	–	(11.97%)	(6.35%)	(0.00%)
y^{NL}	12.402	15.653	20.807	15.653
	–	(26.21%)	(67.77%)	(26.21%)
y^{HH}	31.623	30.442	32.919	33.473
	–	(-3.73%)	(4.10%)	(5.85%)
y^{HL}	39.514	38.506	40.621	41.097
	–	(-2.55%)	(2.80%)	(4.01%)

Note: y^{ij} denotes the income of the wife with type ij, where $i \in \{N,H\}$ and $j \in \{H,L\}$. Percentage changes relative to the 2004 tax reform are reported in parentheses. The thresholds are $\chi_1 = 8.428$, $\lambda = 12.402$, $\xi = 15.653$, and $\chi_2 = 17.218$.

Table 9: Experiments on Child-rearing Subsidy

Variable	2004 Tax Reform	Subsidy 1	Subsidy 2	Subsidy 3
Scenarios				
ρ	0.320	0.350	0.450	0.500
τ_h	0.236	0.251	0.301	0.326
Aggregate				
H	64.222	64.258	64.373	64.429
K	243.965	244.101	244.540	244.752
Y	104.254	104.313	104.500	104.591
Wife's labor supply				
H^{wife}	26.307	26.353	26.499	26.570
	–	(0.17%)	(0.73%)	(1.00%)
h^{NH}	19.746	19.746	19.746	19.746
	–	(0.00%)	(0.00%)	(0.00%)
h^{NL}	19.746	19.746	19.746	19.746
	–	(0.00%)	(0.00%)	(0.00%)
h^{HH}	38.793	38.982	39.587	39.880
	–	(0.49%)	(2.04%)	(2.80%)
h^{HL}	48.474	48.635	49.151	49.401
	–	(0.33%)	(1.40%)	(1.91%)
Wife's income				
y^{NH}	12.402	12.402	12.402	12.402
	–	(0.00%)	(0.00%)	(0.00%)
y^{NL}	12.402	12.402	12.402	12.402
	–	(0.00%)	(0.00%)	(0.00%)
y^{HH}	31.623	31.776	32.269	32.508
	–	(0.49%)	(2.04%)	(2.80%)
y^{HL}	39.514	39.645	40.066	40.270
	–	(0.33%)	(1.40%)	(1.91%)

Note: y^{ij} denotes the income of the wife with type ij, where $i \in \{N,H\}$ and $j \in \{H,L\}$. Percentage changes relative to the 2004 tax reform are reported in parentheses. The thresholds are $\chi_1 = 8.428$, $\lambda = 12.402$, $\xi = 15.653$, and $\chi_2 = 17.218$.

Figure 4: Estimated Labor Income Tax Rate in Japan

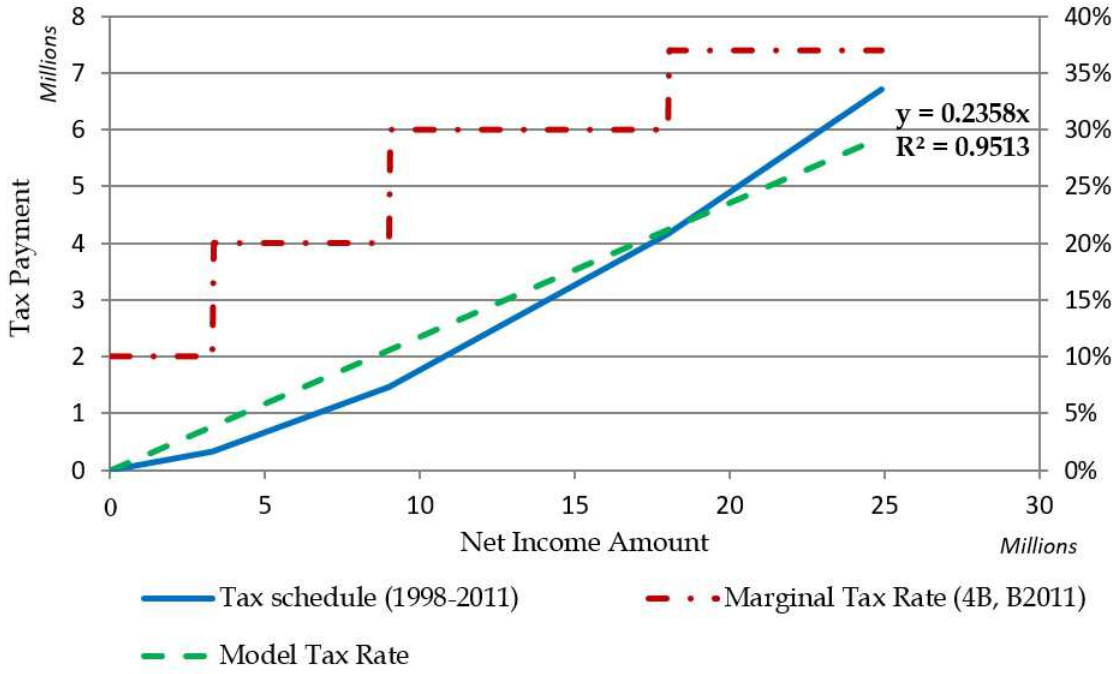


Figure 5: Basic and Employment Deduction in Japan

(in Thousand Yen)