# Why Women Work the Way They Do in Japan: Roles of Fiscal Policies *

Sagiri Kitao†
Minamo Mikoshiba‡

February 18, 2022

**Abstract**

Women work less often and earn significantly less than men in Japan. We use panel data to investigate employment and earnings dynamics of single and married women over the life-cycle and build a structural model to study roles of fiscal policies in accounting for their behavior. We show that eliminating spousal deductions, social insurance tax exemptions and survivors' pension benefits for low-income spouses would significantly raise labor supply of women and their earnings. More women would choose regular jobs rather than contingent jobs, accumulate more human capital and enjoy higher income growth. The government would earn higher net revenues and there is a welfare gain when additional taxes are transferred back.

**Keywords:** Female labor force participation, life-cycle, human capital accumulation, spousal deductions and exemptions, survivors' benefits, two-tiered employment system, Japan.
**JEL Classification:** D15, H2, H31, J22, J24

*Kitao acknowledges financial support provided by the Japan Science and Technology Agency for this research (19H01465). This study is conducted as a part of the Project "Macroeconomic and social security policies under demographic aging: dynamics of firms, individuals and inequality" undertaken at the Research Institute of Economy, Trade and Industry (RIETI).

†Research Institute of Economy, Trade and Industry (RIETI), University of Tokyo, Email: sagiri.kitao@gmail.com

‡University of Tokyo, Email: minamo.mikoshiba@gmail.com

# 1 Introduction

Japan ranks 120th among 156 countries in the Global Gender Gap Report in 2021. The gap has been almost fully closed in areas of education and health, but large disparity remains in economic participation and political empowerment. Women's labor force participation rate is lower than that of men, but the gap is comparable to that of other countries. Their average earnings, however, are significantly lower and a large fraction of women work on irregular or contingent jobs.[1]

Why do women work the way they do? This paper uses panel data and examines labor market experience of women born in the 1960s over their life-cycle. We build a structural life-cycle model to account for their behavior and investigate roles of fiscal policies in shaping the pattern of their employment and earnings.

When men and women enter the labor market, there is no major difference in the pattern of employment types or earnings between them. Panel analysis, however, reveals that their fates diverge thereafter. An important feature of the Japanese labor market is its two-tiered employment system, which consists of regular and contingent employment. Regular jobs are more stable and pay much more than contingent jobs on average. Contingent jobs are typically on a fixed-term contract and include part-time and temporary workers.[2] A large number of women exit labor force at marriage and child-bearing ages, and most of them return to work, if they ever do, as a contingent worker, even if they were on a regular job prior to the exit. Average earnings of contingent workers are not only lower than that of regular workers but also very flat over the life-cycle. The profile shows little potential for income growth with experience, and contributes to a large gender gap in earnings.

Earnings levels also affect how women contribute to the social insurance system, which provides public pension, health and long-term care insurance benefits to all citizens. Insurance premiums individuals pay to the government depend on marital status and earnings. Dependent spouses are exempted from payment of all premiums provided that they do not earn more than a threshold amount of 1.3 million yen.

Dependent spouses with low income are also eligible for survivors' pension benefits after the death of a main earner. Moreover, individuals, in most cases husbands, also receive spousal deductions from income taxes if their spouses do not earn more than a

[1] According to the Global Gender Gap Report of 2021 (https://www.weforum.org/reports/global-gender-gap-report-2021), women's average earnings are 44% lower than those of men. Average participation rate of women aged 15-64 is 73% and it is 87% for men. Women's average participation rate among OECD countries is 61% in 2019.

[2] Contingent jobs are also more susceptible to layoffs. Firms typically respond to business cycle fluctuations by adjusting the number of contingent workers. See, for example, Yokoyama et al. (2021) and Kikuchi et al. (2021) for episodes of labor market adjustments during the financial crisis and the COVID-19 crisis, respectively. Regular jobs are often considered as life-time employment and associated with a seniority-based wage system.

cutoff level. Not surprisingly, empirical studies identify that many women adjust their labor supply so their earnings do not exceed these cutoffs.[3]

We build a structural model populated by heterogeneous agents and evaluate how these fiscal policies affect women's labor supply, focusing on roles of three policies: spousal deductions, insurance premium exemptions, and survivors' pension benefits. We let single and married women at different stages of life-cycle choose participation, as well as types of employment, regular or contingent. They evaluate consequences of their work decisions on income and consumption of a household, and taxes they owe, not only in the current period but for the rest of their life. They also consider how earnings of her own and her spouse affect pension benefits after retirement. Women accumulate human capital on the job and growth of earnings depends not only on their age, education levels, and current employment but also on employment decisions they make over the life-cycle.

Our structural model is calibrated using the Japan Panel Survey of Consumers (JPSC) data. We follow a cohort of women born in the 1960s and parametrize the model to account for their employment patterns. Our experiments demonstrate how these women would have behaved under alternative policies.

Main results are summarized as follows. Removal of the three policies raises participation rates and earnings of women, but effects vary across policies both quantitatively and qualitatively. Average participation rates of women aged 25 to 64 rise by 6.5, 6.6 and 1.3 percentage points, if we remove spousal income tax deductions, social insurance premium exemptions, and survivors' benefits, respectively. Average earnings of women increase by 7.0%, 16.3%, and 4.1%, respectively.

Removal the first two policies causes a rise in participation rates by a similar magnitude, but effects on average earnings are very different. Without spousal deductions, a large number of women choose to participate but they continue to keep earnings at a lower level so they can avoid payment of social insurance premiums, which amounts to about 15% of earnings.[4] Therefore, a rise in participation rates entirely comes from an increase in the number of low-income contingent workers, which results in a smaller change in earnings than when exemptions from payment of social insurance premiums are removed. The latter causes a shift from both contingent jobs and not-in-labor-force to regular jobs, which generates a large increase in average earnings as women accumulate more human capital on regular employment. Although policy changes raise tax burden on women under all policy experiments, higher earnings of more productive women raise average consumption and improve welfare, when additional net revenues are transferred back to them.

We also show that if we remove the three policies altogether, women's participation

[3]See, for example, Yokoyama (2018), Abe and Oishi (2009) and Akabayashi (2006).

[4]It is the sum of employee portions of premiums for public pension (9.15%), health insurance (5%) and long-term care insurance (0.9%) as of 2021. Rates vary over time as explained in section 4.

rates rise by 12.6 percentage points and they earn 27.7% more on average. They also pay 19.5% more to the government in taxes and premiums on their earnings. Average consumption of women rise by 2.9% and they enjoy the welfare gain of 1.5% in consumption equivalence. Our results suggest that there is large room to improve women's participation and earnings by removing fiscal policies that stand as obstacles of women's work incentives. Moreover, the government could raise more tax revenues without generating a welfare loss.

This paper contributes to two lines of literature. First, it is a contribution to growing literature that builds a structural model of families to study effects of fiscal policies on labor supply of women. Second, it builds on literature that investigates macroeconomic issues and redistributive policies in an aging economy, namely Japan. It is a country that faces the most severe gender gap among developed countries and the most rapid and massive demographic aging and labor shortage.

It has become a consensus in the first line of literature that it is important to consider household structures in analyzing individual members' life-cycle behavior, as well as movement of macro economy and roles of fiscal policies. Many papers build structural life-cycle models to investigate determinants of women's labor supply and earnings. Attanasio et al. (2008) analyze participation and saving of married women and emphasize roles of childcare costs. Eckstein and Lifshitz (2011) examine contribution of various factors including education and gender wage gap in accounting for historical changes in female labor force participation. Fernandez (2013) study roles of culture and social norms, and Greenwood et al. (2016) investigate effects of technological changes.[5]

Recent papers that focus on effects of policies using a model with a household structure include Borella et al. (2021), Guner et al. (2012) and Bick and Fuchs-Schundeln (2017) on effects of joint income taxation, Voena (2015) on roles of divorce laws, and Nishiyama (2019) and Kaygusuz (2015) on social security's spousal and survivors benefits.[6] Gao (2020) studies effects of a change in social security eligibility age in China and Blundell et al. (2016) investigate effects of welfare programs on women's employment and human capital in the U.K.

Our quantitative model is closest to that of Borella et al. (2021), who study effects of joint taxation and social security's survivors' benefits in a unified framework. Both papers build a full life-cycle model in which individuals marry, have children and accumulate human capital as well as physical capital and go through phases of work and

[5]See also Doepke and Tertilt (2016) for a comprehensive review of the literature, Jones et al. (2015) on gender wage gap, Fernandez and Wong (2014) on marriage market and divorce probabilities, and Eckstein et al. (2019) on wage and employment gap in a model with endogenous education, marriage and fertility decisions.

[6]Gayle and Shephard (2019) and Kleven et al. (2009) study optimal income tax of couples. De Nardi, Fella, and Paz-Pardo (2020) study effects of income support programs in the U.K. under alternative specifications of a wage process.

retirement. In our model, we also include fixed skill heterogeneity and estimate human capital accumulation processes for women of different education levels. Our model is also tailored to the two-tiered employment system in Japan, by distinguishing between regular and contingent jobs and women's choices between employment types. Stock of human capital differs by an individual's experience on regular and contingent jobs and we show that policies have important effects on not only participation decision but also job choices of women over the life-cycle, which are critical in accounting for stagnant income growth of women in Japan.

There are recent papers that study effects of fiscal issues in Japan and emphasize importance of a change in its labor force driven by rapidly aging demographics and declining fertility rates.[7] Most of the papers in the literature abstract from a household structure and do not distinguish between men and women, or between singles and married couples.

There are a small number of papers that explicitly model a family in a structural life-cycle model and emphasize importance of women's labor supply. İmrohoroğlu et al. (2016) consider various policy options to reduce government deficits and argue that a rise in female labor force participation is one of quantitatively important factors to achieve fiscal sustainability. Fukai et al. (2021) build a model of single and married individuals and study roles of health insurance and welfare programs. Kitao and Mikoshiba (2020) use a general equilibrium life-cycle model to show that Japan's fiscal burden will be mitigated not simply by more participation of women, but also by closing a gender gap in wages and employment types. These papers assume that labor supply and earnings are exogenous. This paper makes a contribution to the literature by modeling decisions of single and married women about labor force participation, employment types and human capital accumulation, in addition to consumption and savings. We also show that it is critical to distinguish between employment types and consider marital status heterogeneity in explaining life-cycle patterns of female labor force participation.

Our structural model enables us to evaluate effects of various fiscal policies and quantify how women's labor supply and life-time earnings would respond. By including these additional dimensions of heterogeneity among women, we are able to quantify effects of subtle details of policies, which we find crucially influence women's labor supply and skill accumulation decisions. We focus on behavior of a particular cohort and do not explicitly consider issues of demographic aging and fiscal sustainability in the future, but our results suggest how alternative policies could potentially mitigate a severe labor shortage and fiscal challenges that Japan will face over the coming decades. This investigation is left for future research.

We also note that there is large empirical literature that studies effects of fiscal policies on female labor supply in Japan and our study is complimentary to papers that focus on roles of spousal deductions and social insurance policies on dependent spouses. For

[7] See, for example, Braun and Joines (2015) and Kitao (2015).

example, Akabayashi (2006) and Bessho and Hayashi (2014) investigate effects of spousal deductions on labor supply of married women. Yokoyama (2018) and Sakata and McKenzie (2005) examine effects of a change in spousal deduction policy in 2004.[8] Yamada (2011) estimates a structural life-cycle model and studies effects of income tax reforms in the 1990s.

In the context of the literature focused on Japanese women, Yamaguchi (2019) is perhaps closest to ours, who builds a structural life-cycle model to study roles of parental leave policies on female labor supply. We both endogenize women's decisions of participation and employment types and allow them to accumulate human capital over the life-cycle. Our paper, however, focuses on income taxation and social security policies and Yamaguchi (2019) examines parental leave policies for married women. Therefore rather than focusing on women of working-ages, we use a full life-cycle model of women who transition across marital statuses and from working to retirement phases. As such, our model includes both single men and women and married couples, and working-age individuals and retirees. We also let households choose not only labor supply and employment types but also consumption and saving over the life-cycle and allow for channels through which households' financial security after retirement influences behavior of working-age individuals.

The rest of the paper is organized as follows. In section 2, we describe our data source and discuss labor market experience of women over the life-cycle. In section 3, we present our quantitative life-cycle model and section 4 describes parametrization of the model. Section 5 presents numerical results and section 6 concludes.

# 2 Employment, Earnings and Fiscal Institutions

## 2.1 Labor Market Experience of Women

The main data source of our analysis is the Japan Panel Survey of Consumers (JPSC). The JPSC is a panel survey of Japanese women and their household members. The survey starts in 1993 with 1,500 women aged between 24 and 34 and more samples are added every five years thereafter. We mainly focus on data of the survey's cohort A, its first cohort of women born in 1959-1969, whose information is available up to 2018 when they are aged 49 to 59, yielding 19,500 yearly observations.[9]

[8] Yokoyama (2018) also studies how the policy change affects labor supply of women of different income levels. In addition to the papers cited above, there are a number of empirical papers written in Japanese that examine effects of deductions and social insurance policies on women's labor supply. Just to name a few, see, for example, Yokoyama and Kodama (2016), Mori and Urakawa (2009), Abe and Ohtake (1995), and Higuchi (1995).

[9] See online appendix for more details of the data source. Consistently with the model presented in the next section, we focus on single and married samples of women and do not include divorced singles.

The survey collects comprehensive information about labor market experience of women as well as some information about their family members and follows samples over time. In addition to basic information such as earnings, work hours and educational background, the survey also asks employment type, social insurance category, employment history before they joined the survey, and presence and age of dependent children.

Individuals are employed as either a regular worker or a contingent worker. The distinction between the two employment types, as discussed below, is important in analyzing the Japanese labor market. The exact definition can vary depending on the context or even by different surveys conducted by the government. In general, however, regular employees typically work full-time and they are hired directly by employers and expected to flexibly engage in different tasks assigned to them. They are also covered by social insurance programs at work and employers make partial contributions on behalf of employees.

Contingent workers may share some of these characteristics of regular workers but not all. They include part-time workers, fixed-term workers, dispatched workers sent from an agency, contract or entrusted employees. Not all of them are offered social insurance coverage at work and earnings are typically much lower than those of regular workers.[10]

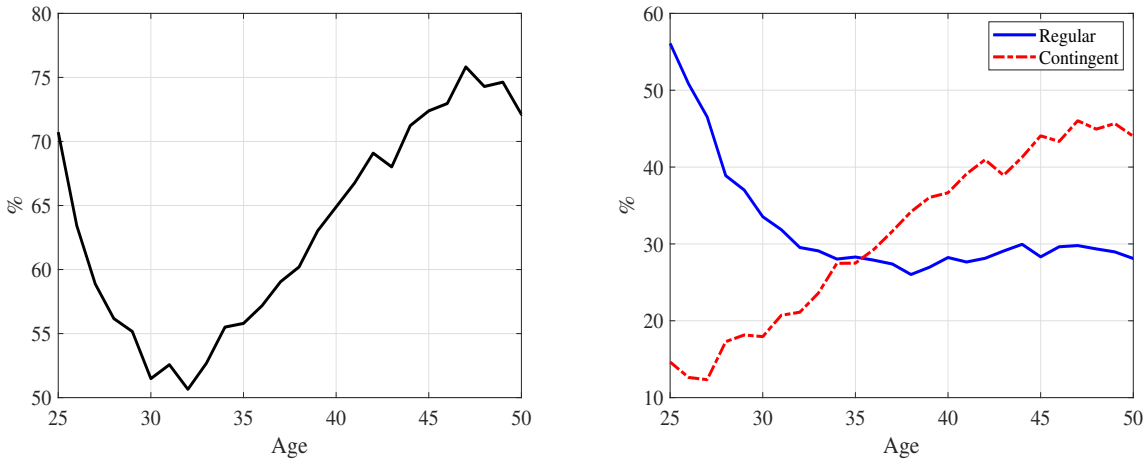
In what follows, we group women into three employment status: regular, contingent and not-in-labor-force (NILF), based on a JPSC's survey response to a question that asks a job type of a working individual. Regular employees include those who answered that they are regular workers (*seishain*), and contingent employees are those who answered otherwise, including part-time workers, and temporary or contract employees.[11] We classify women as high-skilled if they have a college degree and low-skilled otherwise.

Figure 1a shows labor force participation rates of women over the life-cycle.[12] Participation rates decline sharply from above 70% at age 25 to around 50% in their early 30s. The rates recover gradually thereafter to reach 75% in their late 40s and stays at that level. Figure 1b shows decomposition of participation rates into regular and contingent employment. The majority of women start a career as regular workers but the share declines sharply from about 55% at age 25 to less than 30% in their early 30s and, unlike the overall participation rates, does not recover thereafter. The share of contingent workers increases monotonically from around 10% to above 50% and drives the recovery of average participation rates after their 30s.

[10] See, for example, Asao (2011) for more detailed description of employment types and the employment system in Japan.

[11] See online appendix for more details about categorization based on the JPSC data. We exclude self-employed workers and those who work at home.

[12] Women in our sample cohort are born in 1959-1969 and aged 49-59 in 2018, the final year of the survey used in this paper. The number of observations decline after age 50, and we focus on employment of women aged below 50.



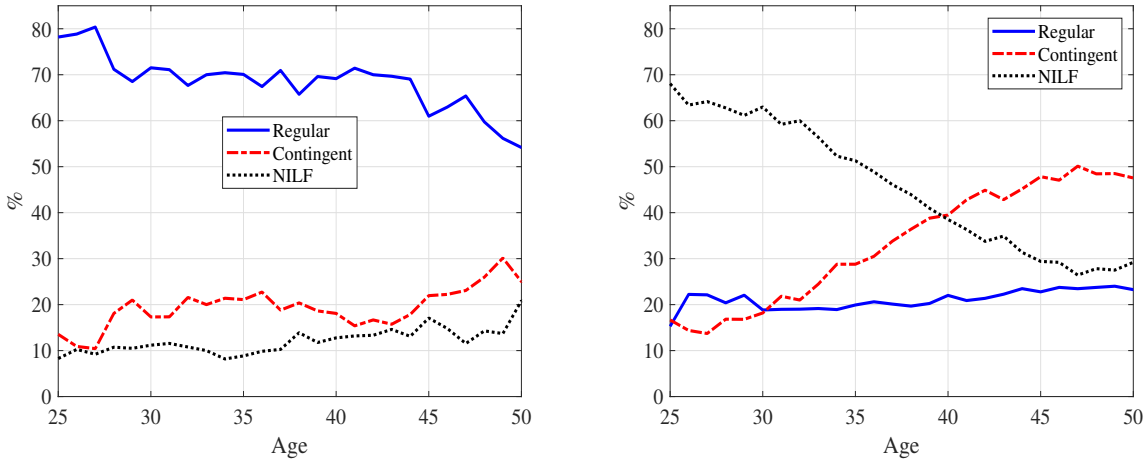

(a) Total (Regular+Contingent)

(b) By Employment Type

Figure 1: Women's Labor Force Participation Rates: JPSC Data

Another important dimension of heterogeneity in accounting for life-cycle patterns of women's labor supply is marital status. Among our JPSC samples, the majority of women get married in their 20s and the share of married women rises from 35% at age 25 to above 85% by their mid-30s. Except among those aged 20s and early 30s, labor supply behavior of married women drives the overall pattern of female labor force participation.

Figure 2 shows the distribution of employment types by marital status. The decline in regular employment and overall participation rates in their late 20s and 30s is driven by the difference in employment patterns between single and married women. Married women behave very differently from single women. The share of regular workers is stable among both single and married women at different levels, and a decline in the share of regular workers among all women is driven by changes in employment types that occur at the same time as the timing of marriage. The recovery in overall participation rates in their late 30s and 40s is explained by married women's returns to the labor market as contingent workers.




(a) Single (b) Married

Figure 2: Women's Participation Rates by Marital Status: JPSC Data

Figure 3 shows life-cycle profiles of women's earnings by skill level and employment type. Regular workers earn more than contingent workers for both low and high skill groups. The profile is flat for contingent workers and does not exhibit growth as seen among regular workers. Differences in women's earnings between employment types are larger than differences between skill levels.

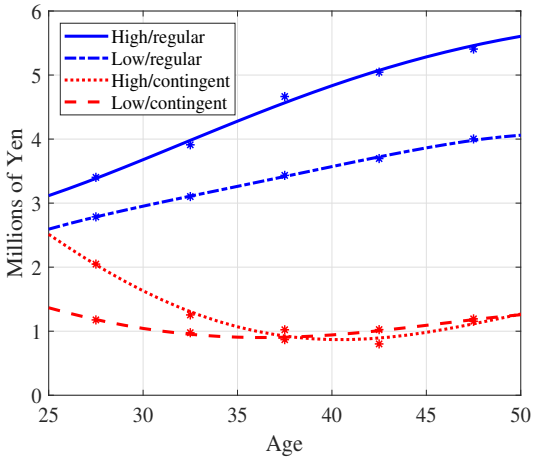



Figure 3: Women's Earnings by Skill and Employment Type: JPSC Data

## 2.2 Social Insurance and Tax Policies in Japan

In this section we summarize main features of the social insurance and tax systems in Japan, which we incorporate in the model and investigate in sections 3 to 5.

**Social Insurance System:** Public pension and health and long-term insurance programs constitute main three pillars of the social insurance system in Japan. Every

Japanese citizen is enrolled in all three programs, receives benefits and contributes to the system according to regulations of each program.

Health and long-term care insurances provide common benefits to everyone and cover medical and long-term care expenditures at age-specific copayment rates. Public pension system consists of two parts: "basic pension," which provides common lump-sum pension benefits for all individuals and "employees' pension," which depends on contributions made through employment and is added on top of basic pension benefits.

There are three categories of insurance coverage that determine required contributions to the system. Category-II insured are those who are enrolled in the employees' social insurance.[13] Category-III insured are dependent spouses of Category-II insured persons. Annual earnings must not exceed 1.3 million yen to be Category-III insured. All others are Category-I insured, which include self-employed persons, students or those not in labor force and employed individuals who are neither Category-II or Category-III insured.

Category-II insured individuals pay premiums for pension, health and long-term care insurance at a fixed rate of their earnings up to an earnings cap. Employers pay half of the contribution and employees pay the other half. As of 2021, pension premium rate is 18.3% and premium rates for health and long-term care insurance are 10.0% and 1.8%, respectively, which are shared equally by an employer and an employee.[14]

Category-I insured individuals pay a fixed premium for public pension program, and contributions to health and long-term care insurance at fixed rates of their earnings, comparable to those paid by Category-II insured individuals. Category-III insured make no contribution to any of the three insurance programs.

Pension benefits after retirement consist of basic pension benefits that are common for all individuals, and employees' pension benefits that depend on the amount of contributions an individual makes as a Category-II insured worker. When a Category-II insured spouse dies, his or her surviving spouse can be entitled to 75% of the employees' pensions of the deceased, through the survivors' pension system.[15]

**Labor Income Tax and Spousal Deductions:** Labor income taxes in Japan are progressive and consist of national and local taxes. Earnings are non-taxable up to 1.03 million yen and thereafter marginal tax rates rise from 5% to 45%. Moreover, individuals can receive income tax deductions for a dependent spouse. The maximum deduction

[13]Firms with more than five regular employees must offer social insurance and contribute half of insurance premiums for eligible employees. Individuals who work more than 30 hours in a firm that offers social insurance at work

[14]These rates vary over time and also slightly differ across employee insurance groups. The rates we use for health and long-term care insurance are those of the Japan Health Insurance Association (JHIA), the largest employees' insurance group in Japan.

[15]More precisely, a survivor's benefits are the higher of the survivor's own employees' pension benefits and 75% of the benefits of the deceased.

amount varies over time and it was 380,000 yen until 1987, 760,000 yen between 1987 and 2003 and back to 380,000 in 2004 and thereafter.[16] As of 2021, a full amount can be deducted if earnings of a spouse do not exceed 1.5 million yen and the deduction amount declines with the spouse's earnings and reaches zero if a spouse earns more than 2.01 million yen.

In summary of this section, we point out that there are multiple cutoff levels of earnings, at which effective marginal taxes on labor income are extremely high, giving married women strong disincentives to work and earn beyond a threshold amount. At the margin, a married woman and her household gain significantly more by keeping earnings below the threshold: below 1.3 million yen to satisfy eligibility as Category-III insured and save payments of social insurance premiums, below 1.03 million to avoid income taxation and below 1.5 million yen to receive full spousal deductions.[17] Empirical studies such as Yokoyama (2018) and Abe and Oishi (2009) demonstrate that many women intentionally control their labor supply to avoid hitting these "walls." In the next section, we present our structural model that we use to evaluate roles of these policies on labor supply and earnings of women.

# 3 Model

We build a quantitative life-cycle model populated by single men and women and married couples. Our focus is on behavior of women, who optimally choose participation and employment types and accumulate human capital as they go through stages of life-cycle, including marriage, child-birth, retirement, and death of her spouse and her own. It is a partial equilibrium model and individuals take as given paths of factor prices and various policies.

## 3.1 Demographics

Individuals enter the economy at age $j = 1$, and live up to a maximum age of $J$. $j^R$ denotes a retirement age, when all individuals leave the labor force and start receiving social security benefits. $g = \{m, f\}$ denotes a gender. We assume that individuals start facing mortality risks once they reach a retirement age and $\mu_{j,g}$ represents conditional probability that an individual of age $j$ and gender $g$ survives until next period.

[16] Note that spousal deduction can also be lower or none if an individual's own earnings exceed a cutoff, though the cutoff is typically well above average earnings and there are not many individuals who lose deductions by earning more than the threshold. As of 2021, a maximum of 380,000 yen can be deducted provided that an individual's own earnings do not exceed 9 million yen and the deduction amount declines to zero in steps as earnings rise.

[17] The amount of standard and "special" spousal deductions and cutoff levels have changed over time. The details, which we incorporate in our quantitative analysis, are provided in online appendix.

Marital status is denoted as $q = \{S, M\}$, single and married, respectively. At age $j = 1$, individuals enter the model with an initial marital status and a single individual of age $j$, gender $g$ and skill $s$ becomes married with probability $\xi_{j,g,s}$. Upon marriage, an individual of gender $g$ and skill $s$ is matched with a spouse of skill $s'$ with probability $\pi_g(s, s')$, which takes into account marital sorting.

For simplicity, we assume that an individual is married to a spouse of the same age and abstract from divorce and remarriage after separation by death. Married individuals are separated from their spouse only by death.

An indicator variable $i_k \in \{0, 1\}$ denotes presence of a small child in a married household and it affects women's cost of participation as discussed below. The state evolves stochastically and $\pi^k_{j,s}(i_k, i'_k)$ denotes a probability that a state of a couple of age $j$ and a wife's skill $s$ transits from $i_k$ to $i'_k$ in the next period. $\pi^{k0}_{j,s}(i_k)$ denotes a probability of $i_k$ in the first year of marriage.

## 3.2 Endowment

Each individual is endowed with skill $s = \{L, H\}$, which is fixed throughout the life-cycle. We assume that men supply labor inelastically and work on a regular job. Men's earnings are denoted as $y_m$, which differ by age and education and evolve deterministically over the life-cycle.

Employment status of a woman is denoted as $e = \{R, C, N\}$, where $R$ and $C$ represent employment on regular and contingent jobs, respectively, and $N$ denotes a state of not-in-labor-force (NILF). Earnings of a female worker are denoted as

$$y_f = h \cdot i_e, \tag{1}$$

where $h$ denotes a worker's human capital and $i_e$ is an indicator, which takes a value 1 if $e = R$ or $C$ and 0 if $e = N$.

Human capital evolves with an individual's work experience, and also depends on current and previous employment status, and their skill levels, represented as

$$h = f^h(s, e, e_{-1}, \mathbf{x}). \tag{2}$$

$e$ and $e_{-1}$ denote current and previous employment, respectively, and $\mathbf{x} = \{x_R, x_C, x_N\}$ is a vector of work experience, which consists of a number of years of employment at a regular job, $x_R$, a contingent job, $x_C$, and no employment, $x_N$.

## 3.3 Preferences

Households derive utility from individual or family consumption $c$ and leisure $l_g$ for $g = \{m, f\}$. Utility of a single individual is given as

$$u^S(c, l_g) = \frac{\left[(c/\eta)^\omega l_g^{1-\omega}\right]^{1-\sigma}}{1-\sigma},$$

and utility of a married couple is given as

$$u^M(c, l_m, l_f) = \frac{\left[(c/\eta)^\omega l_m^{1-\omega}\right]^{1-\sigma}}{1-\sigma} + \frac{\left[(c/\eta)^\omega l_f^{1-\omega}\right]^{1-\sigma}}{1-\sigma},$$

where $l_m$ and $l_f$ denote leisure of a husband and a wife, respectively. $\eta$ represents consumption equivalence and varies by the family size.

Leisure time of a woman is given as follows.

$$l_f = L - \phi_{q,e} - \chi_{e_{-1},e} - \nu_k \tag{3}$$

$L$ represents total disposable time for leisure. $\phi_{q,e}$ denotes participation disutilty of a woman of marital status $q$ and employment type $e$, evaluated in terms of lost leisure time. $\chi_{e_{-1},e}$ represents cost of switching employment status from $e_{-1}$ in the previous period to $e$ in the current period. The last term $\nu_k$ represents additional participation cost when there is a small dependent child in a household, i.e. $i_k = 1$. Leisure time for men is given as a fixed parameter $l_m = \bar{l}_m$ and also for retirees as $\bar{l}_r$.

## 3.4 Government

The government collects taxes on consumption, capital income and labor income. It runs the social insurance system that consists of public pension, health long-term care insurance, and welfare transfers. All policy parameters can be time-variant as explained in section 4, but in this section we describe policies without time subscripts to simplify notations.[18]

**Taxes:** The government levies taxes on consumption and capital income at proportional rates, $\tau^c$ and $\tau^a$, respectively. Net-of-tax gross return on capital is denoted as $R = 1 + (1 - \tau^a)r$, where $r$ is an interest rate.

Tax on labor income is progressive and given as a function of earnings, $\tau^l(y_g)$ for singles and $\tau^l(y_m, y_f)$ for couples. Taxes are determined based on an individual's earnings, rather than combined household earnings, but an individual may receive spousal deductions if earnings of his or her dependent spouse does not exceed a threshold. Therefore we express labor income tax of a married couple as a function of earnings of two members.

**Public Pension, Health and Long-term Care Insurance Programs:** The government operates three social insurance programs: public pension, health insurance and long-term care insurance programs. All individuals are covered by the three programs and

[18] In the computation, we use parameters that define policies including tax rates as in the data, and do not consider a budget balance of the government in the baseline model or under policy experiments. We also, however, consider scenarios of transferring back additional net revenues by making a lump-sum rebate and compute welfare effects with and without tax adjustments. See section 5 for more details.

receive benefits. They contribute to the system differently, depending on each individual's earnings and insurance category, denoted as $\zeta = \{I, II, III\}$. Category-II insured are those who are covered through employers. An individual who is a dependent spouse of a Category-II insured worker is Category-III insured, provided that his or her own earnings do not exceed a threshold level. Category-III insured are not required to make any payment. All others are Category-I insured. In section 4, we explain more details about insurance premiums that individuals of different category must pay.

We use distribution of insurance categories for each employment type and gender and compute a premium payment for the three social insurance programs as $\tau^{si}(y_g, e)$, a function of earnings $y_g$ and employment type $e$.

Pension benefits consist of two parts: basic pension that is common across all individuals, and employment-based part that depends on past employment and earnings history, according to the formula

$$p_g = p_b + \kappa \cdot \overline{p}_g. \tag{4}$$

$p_b$ denotes basic pension benefits. The second term is employment-based part and depends on average past labor income $\overline{p}_g$ and a replacement rate $\kappa$. Only the contributions made as a Category-II insured count for $\overline{p}_g$ and it is updated recursively based on the value in the previous period, and employment type and earnings in the current period as

$$\overline{p}'_g = f(\overline{p}_g, e, y_g). \tag{5}$$

Note that $\overline{p}_g$ is determined endogenously, depending on the employment choice of a woman over the life-cycle. For men, it is determined in the same way, but exogenously as an average of their life-time earnings for each skill type, since we assume men always work as a regular worker.

The government operates universal health insurance and long-term care insurance programs. We denote age-dependent copay rates of for medical and long-term expenditures as $\lambda^m_j$ and $\lambda^l_j$, respectively. Total out-of-pocket expenditures $o_{j,g}$ are given as

$$o_{j,g} = \lambda^m_j med_{j,g} + \lambda^l_j ltc_{j,g},$$

where $med_{j,g}$ and $ltc_{j,g}$ represent gross medical and long-term care expenditures of an individual of age $j$ and gender $g$.

We express total labor income taxes and social insurance premiums as $T^S(y_g)$ for single men and women and $T^M(y_m, y_f)$ for married couples.

$$\begin{aligned} T^S(y_g) &= \tau^l(y_g) + \tau^{si}(y_g, e) \\ T^M(y_m, y_f) &= \tau^l(y_m, y_f) + \sum_{g=\{m,f\}} \tau^{si}(y_g, e) \end{aligned}$$

**Welfare Transfers:** The government also provides a transfer $tr$ to a household to guarantee a minimum consumption level of $\underline{c}_q$, which varies by marital status $q$. The transfer amount is given as (6) and it is zero if disposable assets exceed $\underline{c}_q$ plus consumption taxes.

$$tr = \max\{0, (1+\tau^c)\underline{c}_q - \underline{a}_q\} \tag{6}$$

$\underline{a}_q$ denotes disposable assets of single and married households defined as follows.

$$\begin{aligned} \underline{a}_S &= Ra + y_g + p_g - o_{j,g} - T^S(y_g) \\ \underline{a}_M &= Ra + \sum_g (y_g + p_g - o_{j,g}) - T^M(y_m, y_f) \end{aligned}$$

.

## 3.5 Households' Problem

We consider a problem of households in two blocks: a "young" group of working-age individuals and a group of "retirees." Young individuals are either single or married and they make women's labor supply decisions as well as consumption and saving choices. Retirees are at and above a retirement age and they receive pension benefits, face survival risks, and choose consumption and savings. Married individuals may become single if their spouse dies.

We define value functions of six groups of individuals: young single men and women, $S^m$ and $S^f$, young married couples, $M$, retired single men and women, $\widetilde{S}^m$ and $\widetilde{S}^f$, and retired married couples, $\widetilde{M}$.

**Young Single Women:** A state vector of a young single woman is given as $(j, s_f, a, \mathbf{x}, e_{-1}, \overline{p}_f)$, where $j$ denotes age, $s_f$ skill, $a$ asset, $\mathbf{x}$ a vector that represents work experience, $e_{-1}$ previous employment status, and $\overline{p}_f$ average past earnings that determine pension benefits.[19]

$$\begin{aligned} S^f(j, s_f, a, \mathbf{x}, e_{-1}, \overline{p}_f) = \max_{c,a',e} \Big\{ & u^S(c/\eta, l_f) + \beta \left[ (1 - \xi_{j,f,s_f}) S^f(j+1, s_f, a', \mathbf{x}', e, \overline{p}'_f) + \right. \\ & \left. \xi_{j,f,s_f} EM(j+1, s_m, s_f, a' + \tilde{a}', \mathbf{x}', e, \overline{p}'_f, i'_k) \right] \Big\} \end{aligned}$$

subject to

$$\begin{aligned} (1+\tau^c)c + a' + o_{j,f} &= Ra + y_f - T^S(y_f) + tr \\ a' &\geq 0 \end{aligned}$$

[19]The problems of single women and men one year before retirement are defined similarly, except that their value function of the next period is that of retirees.

Earnings $y_f$ are determined as in equations (1) and (2) and leisure is given as (3). $\overline{p}_f$ is updated recursively according to the law of motion (5). $\tilde{a}'$ denotes assets of a husband that a single woman is matched with if she is married in the next period. We assume that individual knows the average assets held by their potential spouses, based on the average asset of single men by age and skill level. The expectation operator is with respect to skill and asset of a future husband as well as a presence of a child, $i'_k$.

**Young Single Men:** A state vector of a young single man is given as $(j, s_m, a)$, which represent age, skill and asset, respectively. The expectation is with respect to states of a potential spouse.[20] We assume that working-age men supply labor inelastically.

$$\begin{aligned} S^m(j, s_m, a) &= \max_{c,a'} \left\{ u^S(c/\eta, l_m) + \beta \left[ (1 - \xi_{j,m,s_m}) S^m(j+1, s_m, a') + \right. \right. \\ &\quad \left. \left. \beta \xi_{j,m,s_m} EM(j+1, s_m, s_f, a' + \tilde{a}', \mathbf{x}', e, \overline{p}'_f, i'_k) \right] \right\} \end{aligned}$$

subject to

$$\begin{aligned} (1+\tau^c)c + a' + o_{j,g} &= Ra + y_m - T^S(y_m) + tr \\ a' &\geq 0 \end{aligned}$$

**Young Married Couples:** A state vector of a young couple is given as $(j, s_m, s_f, a, \mathbf{x}, e_{-1}, p_f, i_k)$. $i_k$ is an indicator function which takes a value of 1 if there is a small child in the household and 0 otherwise.

$$M(j, s_m, s_f, a, \mathbf{x}, e_{-1}, \overline{p}_f, i_k) = \max_{c,a',e} \left\{ u^M(c/\eta, l_m, l_f) + \beta EM(j+1, s_m, s_f, a', \mathbf{x}', e, \overline{p}'_f, i'_k) \right\}$$

subject to

$$\begin{aligned} (1+\tau^c)c + a' + \sum_g o_{j,g} &= Ra + \sum_g y_g - T^M(y_m, y_f) + tr \\ a' &\geq 0 \end{aligned}$$

**Retired Single Men and Women:** A state vector of a retired single individual of gender $g = \{m, f\}$ is given as $(j, a, \overline{p}_g)$ and their problem is given as follows.

$$\widetilde{S}^g(j, a, \overline{p}_g) = \max_{c,a'} \left\{ u^S(c/\eta, l_g) + \beta \mu_{j,g} \widetilde{S}^g(j+1, a', \overline{p}_g) \right\}$$

[20] We assume that men know average assets of women by skill and age and use them in the expectation. For other states, we let men assume that they marry a woman who has been on a regular job, for simplicity. This simplifying assumption does not affect our quantitative results in any significant way but greatly simplifies the computation since we do not have to carry the distribution of women along the computation to compute the expectation.

subject to

$$\begin{aligned}(1+\tau^c)c + a' + o_{j,g} &= Ra + p_g + tr \\ a' &\geq 0\end{aligned}$$

Note that $l_g$ equals $\bar{l}_r$, a fixed parameter that represents exogenous disposable time of a retiree. Pension benefits $p_g$ are determined as a function of $\overline{p}_g$, according to equation (4).

**Retired Married Couples:** A state vector of a retired married couple is given as $(j, a, \overline{p}_m, \overline{p}_f)$

$$\begin{aligned}\widetilde{M}(j,a,\overline{p}_m,\overline{p}_f) = \max_{c,a'} \Big\{ & u^M(c/\eta, l_m, l_f) + \beta \Big[\mu_{j,m}\mu_{j,f}\widetilde{M}(j+1,a',\overline{p}_m,\overline{p}_f) + \\ & \mu_{j,m}(1-\mu_{j,f})\widetilde{S}^m(j+1,a',\overline{p}'_m) + \mu_{j,f}(1-\mu_{j,m})\widetilde{S}^f(j+1,a',\overline{p}'_f)\Big]\Big\}\end{aligned}$$

subject to

$$\begin{aligned}(1+\tau^c)c + a' + \sum_g o_{j,g} &= Ra + \sum_g p_g + tr \\ a' &\geq 0\end{aligned}$$

Note that when a spouse dies, his/her survivor may receive additional benefits, i.e. $\overline{p}'_g$ may not be the same as $\overline{p}_g$.

# 4 Calibration

The model period is annual. We calibrate the model to the Japanese data and our main data source is the JPSC panel data. As explained in section 2, we focus on data of Cohort A of the JPSC, women born between 1959-1969, and their life-cycle behavior. We call them as the cohort of the 1960s and map ages of the cohort to calendar years by taking 1964, the average birth year of the cohort as their birth year. The cohort turns 25 years old (model age $j = 1$) in 1989, retire at 65 (model age $j^R = 41$) in 2029 and live up to 95 (model age $J = 71$) in 2059. Some policies such as consumption tax rates, progressive labor income tax functions, and social insurance premiums are time-varying and we let policy parameters vary over the life-cycle of the cohort accordingly. Our model is a partial equilibrium model and interest rate $r$ is exogenous and set to 2%. Table 2 summarizes calibration of the parameters.

## 4.1 Demographics and Marriage Dynamics

For the calibration of survival rates $\mu_{j,g}$, we use the life table of the National Institute of Population and Social Security Research (IPSS).

Marriage probabilities $\xi_{j,g,s}$ of women by age and skill are based on the share of single women in each age-education group who get married in the next period, according to the JPSC data. For men, since JPSC has only information about husbands of female samples, we use the Census data to compute marriage probability based on the number of single and married men of the 1960 cohort, independently of skill levels.

$\pi_g(s, s')$, the probability that an individual of gender $g$ and skill $s$ is matched with a spouse of skill $s'$, represents the degree of assortative mating. We use the JPSC data to compute skill distribution of couples at age 50 to calibrate the probabilities. A low-skilled woman marry a husband of the same skill with probability 67.4% and a high-skilled woman marry a husband of the same skill with probability 78.7%. For men, probabilities of marrying a woman of the same skill are 95.8% and 75.0% for the low and high-skilled, respectively.

Transition probabilities of having a small child, $\pi^k_{j,s}(i_k, i'_k)$, and probabilities of having a child in the initial year of marriage, $\pi^{k0}_{j,s}(i_k)$, are computed based on the number of married couples with and without a dependent child aged 0-5 in the JPSC data.

## 4.2 Human Capital

Earnings of women depend on skill, employment type in the current and previous periods, and work experience and they are expressed as $h = f^h(s, e, e_{-1}, \mathbf{x})$, where $\mathbf{x} = \{x_R, x_C, x_N\}$. We use the JPSC data to estimate the process, following the method of Yamaguchi (2019).[21]

For women of each employment type $e = \{R, C\}$, we estimate the following function for log earnings $h_{it}$ of an individual $i$ at time $t$, which represents human capital in our model. We use information about each individual's current employment and past employment history. We also include unemployment rate $U_t$ at time $t$ to account for macroeconomic conditions that may vary and affect overall earnings levels.

$$h_{it} = \beta_s + \beta_{e_1} x_{e,it} + \beta_{e_2} x^2_{e,it} + \beta_{k_1} x_{k\neq e,it} + \beta_{n_1} x_{N,it} + \beta_{k_{-1}} i_{e_{-1}\neq e,it} + \beta_{N_{-1}} i_{e_{-1}=N,it} + \beta_U U_t + \varepsilon_{it} \tag{7}$$

$\beta_s$ is a skill-specific intercept and effects of experience in regular and contingent employment are approximated by a polynomial in the number of work years in each employment. $x_{e,it}$ represents the number of years that an individual $i$ has worked on employment type $e$ so far as of time $t$. $i_{e_{-1}\neq e,it}$ is an indicator which takes a value of 1 when the individual's previous employment type is $e$. These terms for previous employment capture an adjustment cost on human capital when an individual switches employment types.

[21] Yamaguchi (2019) is focused on effects of parental leave policies and we do not include terms that he used in his estimation related to them. Our model has heterogeneity in skills and we include an intercept for them.

Table 1 summarizes estimation results. A positive intercept for high skill represents a skill premium, which is larger on a regular job than on a contingent job. An additional year of experience increases earnings, though the effect diminishes over time, as indicated by a negative coefficient on squared years of experience. A switch from a contingent job or non-employment to a regular job has a negative impact on earnings of a regular worker, relative to individuals who continue to work on a regular job. A switch, however, from a regular job to a contingent job has a positive effect. We use these estimated functions in the computation of earnings in the model.

Table 1: Estimated Log Earnings Functions of Regular and Contingent Workers

| | Regular | | Contingent | |
|---|---|---|---|---|
| | Estimate | S.E. | Estimate | S.E. |
| Intercept, all | 5.3502 | 0.0404 | 4.4129 | 0.0678 |
| Intercept, high $H$ | 0.2755 | 0.0159 | 0.1052 | 0.0333 |
| Reg. experience $x_R$ | 0.0333 | 0.0036 | 0.0174 | 0.0020 |
| Sq. of $x_R/100$ | -0.0348 | 0.0096 | – | – |
| Cont. experience $x_C$ | -0.0054 | 0.0020 | 0.0592 | 0.0050 |
| Sq. of $x_C/100$ | – | – | -0.1369 | 0.0187 |
| NILF $x_N$ | -0.0322 | 0.0023 | -0.0343 | 0.0020 |
| Lagged reg. | – | | 0.6694 | 0.0496 |
| Lagged cont. | -0.5493 | 0.0318 | – | – |
| Lagged NILF | -0.3633 | 0.0607 | 0.0251 | 0.0444 |
| Unemp. rate | 0.0220 | 0.0093 | -0.0402 | 0.0125 |

Men's earnings $y_m$ vary by age and skill deterministically and they are estimated using men's earnings data of the JPSC.[22] We assume that men always work as regular workers: 98% of husbands of married women in our JPSC samples work and 95% of employed men work as regular workers.

## 4.3 Preferences

Equivalence scales $\eta$ for households are based on OECD's modified equivalence scale, which assigns 1.0 for the first adult, and adds 0.5 for the second adult and 0.3 for each additional child. We use the JPSC data to compute an average number of dependent children aged 18 and below for a married couple at each age and use them in the computation of equivalence scales for married households. We set risk aversion parameter $\sigma$ at 3.0 and a weight parameter $\omega$ at 0.5. Subjective discount factor $\beta$ is set to 0.98.

[22]See online appendix for the estimated profiles.

Total disposable time of an individual is normalized to 1.0. Parameters related to disutility from work are calibrated to approximate life-cycle profiles of regular and contingent employment rates of women. The set of parameters include participation cost by employment type and marital status, $\phi_{q,e}$, additional participation cost when there is a small child of age 0-5, $\nu_k$, and cost of switching employment types, $\psi_{e_{-1},e}$. We assume that there are switching costs for "upward" moves: a switch from non-employment to either a regular or contingent job, and a switch from a contingent to regular job. In total, eight parameters are calibrated and we do so to minimize the sum of distances between the data and the model in the employment rates of regular and contingent workers at each age between 25 and 49.[23] Values of the parameters are summarized in Table 2 and the fit of the model with employment data is presented in section 5.1.

## 4.4 Government

**Taxes:** Consumption tax rate is zero until 1988, raised to 3% in 1989, 5% in 1997, 8% in 2014 and 10% in 2020.[24] Capital income tax rate is set to 35%, which is in the range of estimates for effective tax rate on capital income as in Hansen and İmrohoroğlu (2013), for example.

Labor income tax is progressive and marginal tax rates rise in earnings in steps. We include basic and salary income deductions available to all employed workers, and spousal deductions for eligible workers. Spousal deductions are provided only if earnings of a spouse are below a threshold level. The upper limit of earnings and deduction amount vary over time. Until 2003, the maximum annual deduction amount is 760,000 yen and in 2004, it is reduced to 380,000 yen. As of 2021, the maximum amount can be deducted from an individual's taxable income provided that his or her spouse earns less than 1.5 million yen. The deduction phases out with earnings above the cutoff and reaches zero if earnings exceed 2.01 million yen.

Basic deductions are in a fixed amount and salary income deductions increase in earnings. Every employee can receive a minimum deductions of 1.03 million yen, which consists of basic deductions and minimum salary income deductions. In other words, there is no tax obligation for earnings below 1.03 million yen. These cutoffs for exemptions and spousal deductions are so-called "103 and 150 walls," respectively, above which earnings are subject to labor income taxes and an individual starts to lose spousal deduction.

Labor income taxes consist of national and local taxes. Tax rates and progressivity vary over time and as of 2021, marginal tax rates are between 5% and 45% at the national

[23] We use samples of women born in 1950-69 and data collected in 1993-2018. We chose the target employment of those aged 25-49 since by 2018 the youngest of the cohort reach 49 and the number of samples declines above that age.

[24] More precisely, the tax rate was raised to 3% in April 1989, 5% in April 1997, 8% in April 2014 and 10% October 2019.

level, and local tax rate is proportional at 10%.[25]

**Public Pension, Health and Long-Term Care Insurance:** As mentioned in section 2, premiums for public pension, health and long-term care insurance depend on insurance categories of individuals. Category-II insured are workers who are covered by social insurance at work and Category-III insured are dependent spouses of Category-II workers, subject to an earnings limit. Category-I insured are the rest of individuals, including those not in labor force without a Category-II spouse.

We assume that all regular workers are Category-II insured, all single non-employed individuals are Category-I insured and all married non-employed are Category-III insured. For contingent workers, we use the JPSC data to find distribution of insurance categories by marital status. The share of Category-II insured is 52% among single contingent workers and 34% among married contingent workers. We use these fractions to compute average premium payment of each contingent worker of different marital status.

As shown in equation (4), pension benefits are determined as a sum of basic pension $p_b$ and a part that depends on the average past labor income earned as a Category-II worker, $\overline{p}_g$. We set $p_b$ at 780,900 yen and $\kappa$ at 0.219 based on the pension benefit schedule in 2021.[26]

For men, $\overline{p}_m$ is computed as average earnings for each skill type. For women, $\overline{p}_f$ is updated recursively as in (5). Part of a female worker's earnings $y_f$ is counted as contribution to employment-based pensions, based on a fraction of women in each employment type who work as Category-II insured.

Once an individual is retired, $\overline{p}_g$ remains constant as long as marital status remains the same. When a spouse dies, an individual's pension benefits may be adjusted upwards if he or she is eligible to receive a survivor's benefits. Suppose that average past earnings that determine an income-dependent part of benefits are given as $\overline{p}_m$ and $\overline{p}_f$, for a husband and a wife, respectively, and that a husband dies and a wife survives. Then the wife's $\overline{p}_f$ in the next period will be given as follows.

$$\begin{array}{lll} \overline{p}'_f &= \overline{p}_f & \text{if } \overline{p}_m < \overline{p}_f \\ \overline{p}'_f &= \frac{1}{2}(\overline{p}_m + \overline{p}_f) & \text{if } \overline{p}_f < \overline{p}_m < 2\overline{p}_f \\ \overline{p}'_f &= \frac{3}{4}\overline{p}_m & \text{if } 2\overline{p}_f < \overline{p}_m \end{array} \tag{8}$$

For example, if a husband of a never-worked wife dies, then she will be entitled to 75% of her husband's employment-based pension benefits for the remainder of her life.

Gross medical expenditures and long-term care expenditures by gender and age are taken from publicly available data of the Ministry of Labour, Health and Welfare (MLHW).

[25] See online appendix for more details about the time path of progressive labor income taxes, spousal deductions, and basic and salary income deductions, which we incorporate in our computation.

[26] Note that the 1960 cohort will reach 65 in 2029 and they have not started receiving pension benefits.

Copay rates of health insurance vary by age and they are 30% up to 69 years old, 20% at age 70-74 and 10% at age 75 and above. Copay rate of long-term care expenditures is 10%.

Premiums of the public pension system depend on each individual's insurance category. Category-I insured pay a fixed amount each month and Category-II insured contributes a fixed fraction of earnings. The premium amount and rate vary over time and in 2021, Category-I premium is 16,610 yen per month and Category-II pays 9.15% of their earnings.[27] Category-III insured are exempted from premium payment. For health long-term care insurance, Category-I insured pay either a fixed premiums if an individual does not earn any, or a fixed percentage of earnings. Category-II insured also pay a fixed fraction of earnings as premiums. See online appendix for more details of the premium amount and proportional rates over time, which we use in the computation.

**Welfare Program:** Consumption floor $\underline{a}_q$ is set to 870,000 yen for singles and 1,320,000 yen for married couples, based on the minimum standard of living for one and two-member households.

[27] Total premium of Category-II is 18.3% of earnings, which is shared equally by an employer and an employee.

Table 2: Parameters of the Model

| Parameter | Description | Value/Source |
|---|---|---|
| *Demographics* | | |
| $j^R$ | Retirement age | 41 (65 years old) |
| $J$ | Maximum age | 71 (95 years old) |
| $\mu_{j,g}$ | Survival probability | IPSS life table |
| $\pi^k_{j,s}(i_k, i'_k)$ | Transition prob. of a small child | JPSC data |
| $\pi^{k0}_{j,s}(i_k)$ | Prob. of a small child (initial) | JPSC data |
| *Marital Status* | | |
| $\xi_{j,g,s}$ | Prob. of marriage | JPSC data (women) |
| | | Census data (men) |
| $\pi_g(s, s')$ | Degree of assortative mating | JPSC data |
| *Endowment* | | |
| $f^h(s, e, e_{-1}, \mathbf{x})$ | Women's human capital | JPSC data |
| $y_m$ | Men's human capital | JPSC data |
| *Preference* | | |
| $\beta$ | Subjective discount factor | 0.98 |
| $\sigma$ | Risk aversion parameter | 3.0 |
| $\omega$ | Leisure/consumption weight | 0.5 |
| $\eta$ | Equivalence scale | OECD |
| $\phi_{q,e}$ | Participation cost | 0.31($\phi_{S,R}$), 0.00($\phi_{S,C}$) |
| | | 0.20($\phi_{M,R}$), 0.15($\phi_{M,C}$) |
| $\nu_k$ | Participation cost (a small child) | 0.27 |
| $\psi_{e_{-1},e}$ | Switching cost | 0.30($\psi_{N,R}$),0.18($\psi_{N,C}$),0.34($\psi_{C,R}$) |
| *Health and Medical & Long-term Care Expenditures* | | |
| $med_{j,g}$ | Gross medical expenditures | MLHW data |
| $ltc_{j,g}$ | Gross long-term care expenditures | MLHW data |
| *Government* | | |
| $\lambda^m_j$ | Health insurance copay | 30,20,10% (varies by age) |
| $\lambda^l_j$ | Long-term care insurance copay | 10% |
| $\kappa$ | Public pension formula | 0.219 |
| $p_b$ | Basic pension | 780,900 yen |
| $\underline{c}$ | Consumption floor | 870,000 yen (singles) |
| | | 1,320,000 yen (married) |
| $\tau^l(y_g)$ | Labor income tax | Progressive (see text) |
| $\tau^c$ | Consumption tax rate | 3-10% |
| $\tau^a$ | Capital income tax rate | 35% |
| $r$ | Interest rate | 2% |

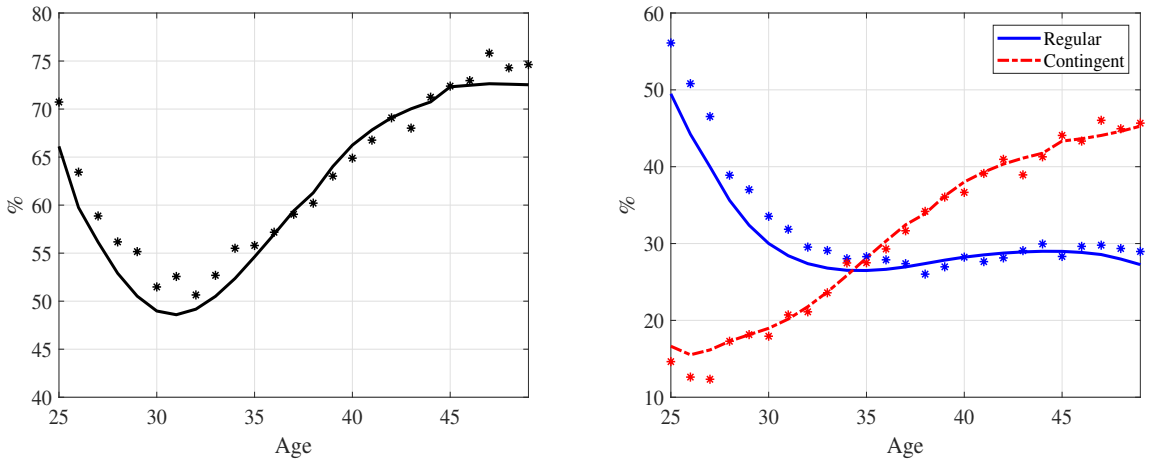
# 5 Numerical Analysis

We present our numerical results in this section. We first discuss outcome of the baseline model, focusing on women's labor force participation rates, employment choices and earnings over the life-cycle. We then simulate policy experiments and present how different fiscal policies affect employment decisions and earnings of women, as well as how they affect tax revenues and welfare.

## 5.1 Employment and Earnings in the Baseline Model

Figure 4 shows women's participation rates in our model and compares the profiles with the JPSC data, which are shown in dots. As shown in Figure 4a, the model replicates the overall participation pattern, in which an increasing number of women leave the labor force in their 20s to their early 30s, and many of them gradually come back to work thereafter. This overall pattern of employment is explained by a distinctive change in the composition of women's employment types, as shown in Figure 4b, which exhibits a sharp decline in the share of regular workers, which never recovers after their early 30s, and a monotonic increase in the share of contingent workers and the pattern in the data is replicated in the model.

Note that as explained in section 4.3, we calibrate a set of parameters that represent costs of participation and of switching employment types to approximate participation rates of women. The model approximates the age profiles of employment types fairly well, with a parsimonious set of age-independent parameters.



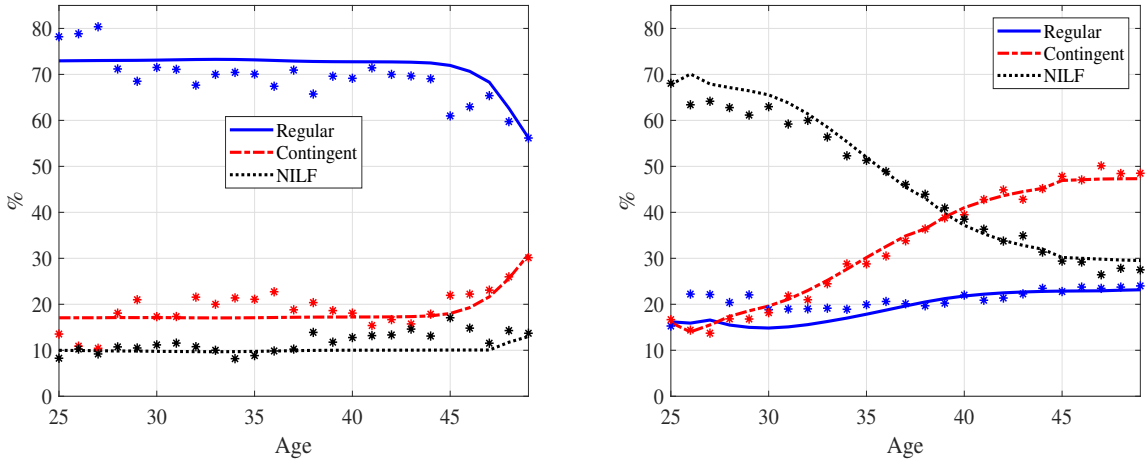

(a) Total (Regular+Contingent)

(b) By Employment Type

Figure 4: Women's Labor Force Participation Rates: Model (solid and dashed lines) and JPSC Data (circle dots)

Figure 5 shows employment profiles by martial status. The profile of single women, as

shown in the left panel, do not show any major change until their mid-40s. In particular, there is no decline in the share of regular workers as we saw in Figure 4b. Among married women, as shown in Figure 5b, the share of regular workers stays low at around 20%, and again, it does not change much. The share of contingent workers increases from around 15% to 50%, while the share of not-in-labor-force declines from around 70% to 30%. The overall pattern of women's employment is driven by a large number of women switching employment types as they become married, and their subsequent returns to employment as contingent workers.




(a) Single (b) Married

Figure 5: Women's Employment by Marital Status: Model (solid and dashed lines) and JPSC Data (circle dots)

Figure 6 shows women's annual earnings by skill and employment type in the baseline model. The pattern is in line with the data, as shown in Figure 3 based on the JPSC data. Skills are harder to accumulate on a contingent job and the life-cycle profiles are much flatter than those of regular workers. Both the composition of employment types and earnings differences between regular and contingent workers contribute to a large earnings gap between men and women.

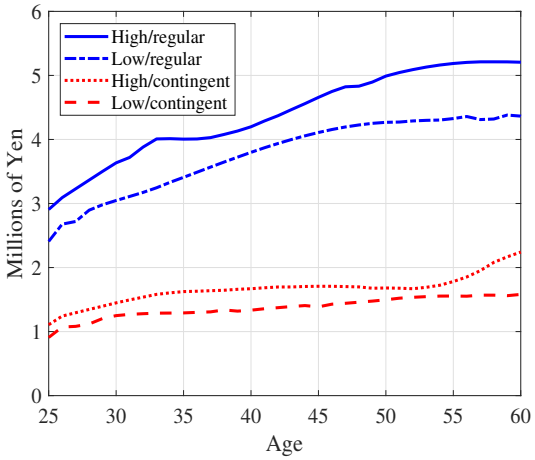



Figure 6: Women's Earnings by Skill and Employment Type: Baseline Model

## 5.2 Roles of Three Fiscal Policies

In this section we simulate our model under alternative assumptions about tax and social insurance policy to understand how each element of fiscal policies affects women's labor supply and their earnings.

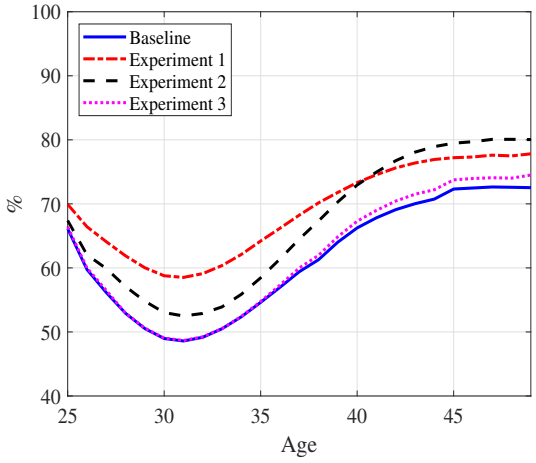
We focus on three policies. The first is income tax deductions for a dependent spouse, which allows an individual to claim a fixed deduction from gross earnings if a spouse does not earn more than a threshold level. The second is an exemption of social insurance premiums for a Category-II dependent spouse, provided that he or she does not earn more than 1.3 million yen. Lastly we study effects of survivors' pension benefits that provide a surviving individual with up to 75% of the employees' pension benefits that his or her deceased spouse was entitled to, as shown in equation (8). We simulate the model under three scenarios, in which we remove each of the three policies one by one. In the last and fourth experiment, all three policies are removed. Details of the four experiments are summarized as follows.

| | |
|---|---|
| Exp 1 | No spousal deductions |
| Exp 2 | No exemption of social insurance premiums for Category-III insured |
| Exp 3 | No survivors' benefits |
| Exp 4 | Experiments 1-3 combined |

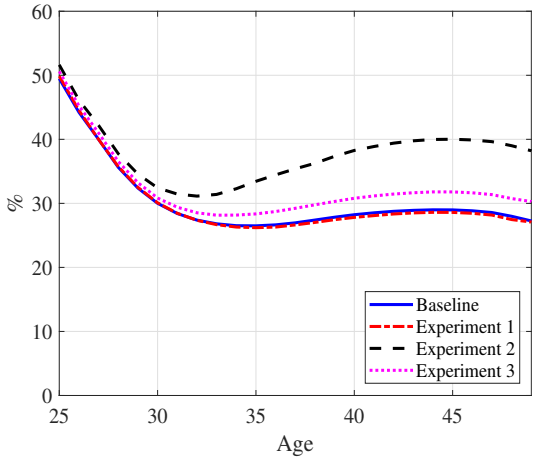
Table 3 shows average participation rates of women in the baseline model and under the four experiments. Figure 7 shows overall participation rates by age and the breakdown by employment type.

Table 3: Average Participation Rates under Alternative Policies (%): All Women Aged 25-64

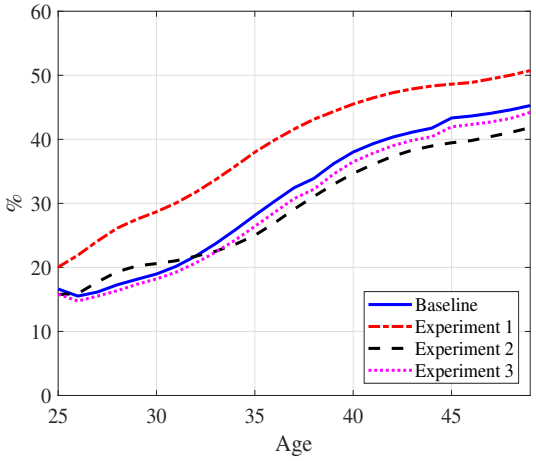
| | Baseline | Exp 1 | Exp 2 | Exp 3 | Exp 4 |
|---|---|---|---|---|---|
| Employed | 64.6 | 71.1 | 71.2 | 65.9 | 77.1 |
| - Regular | 26.8 | 26.6 | 35.6 | 29.2 | 40.2 |
| - Contingent | 37.9 | 44.5 | 35.6 | 36.7 | 36.9 |
| NILF | 35.4 | 28.9 | 28.8 | 34.1 | 22.9 |




(a) Total (Regular+Contingent)




(b) Regular




(c) Contingent

Figure 7: Women's Participation Rates Under Baseline and Three Experiments

Removal of the policies increases labor force participation of women, though effects

vary both quantitatively and qualitatively across experiments. In Experiment 1, as shown in the second column of Table 3, elimination of spousal deductions removes disincentives to participate in the labor market since it no longer implies a loss of deductions from a husband's earnings. Deductions effectively work as a major obstacle for entry since the effective tax rate on her earnings would be extremely high.[28] Removal of deductions increases the average participation rate by 6.5 percentage points, from 64.6% to 71.1%. Many of them, however, still want to keep earnings low and do not choose regular jobs so that they continue to enjoy exemptions from social insurance taxes. On top of labor income taxes, earnings are subject to social insurance premiums at rate 15% once earnings exceed 1.3 million yen. An increase in participation rates come entirely from a shift from NILF to contingent jobs, whose share rises from 37.9% to 44.5%, while the share of regular workers barely changes.

In Experiment 2, exemptions from social insurance taxes are removed and the average participation rate increases by 6.6 percentage points, by a similar magnitude as in Experiment 1. The change, however, occurs via a very different channel. A rise comes from a shift from both NILF and contingent jobs to regular jobs and the share of regular workers increases by 8.8 percentage points, as shown in Table 3. Since women are no longer exempted from social insurance taxes, and both non-working and low-income wives would have to contribute, married women have stronger incentives to participate and if so, earn more by taking on a regular job.

This change in the composition of working women leads to higher average earnings of women, as shown in Figure 8. Average earnings of all women, including both non-working and working women, increase by 7.0% in Experiment 1, but by 16.3% in Experiment 2 on average, as summarized in Table 4. More women accumulate human capital on a regular job and their earnings reach a much higher level over the career. In Experiment 2, average earnings of women aged 25-49 are 12.9% higher than in the baseline economy and women aged 50-64 earn 21.4% more. This increase is concentrated among married women, who would lose the exemption by keeping low earnings as shown in the middle panel of Table 4. There is a limited change in earnings of single women. Both low and high-skilled women are more likely to be engaged in regular jobs and earnings of low and high-skilled women increase by 16.9% and 14.0%, respectively.

[28] Maximum deductions vary over time and they are 760,000 yen until 2003, or until they are 39 years old, and they lose the entire deductions if earnings exceed 1.4 million yen. Her husband would have to pay labor income taxes at a marginal rate of 30% (assuming 20% national and 10% local taxes) plus social insurance premiums of approximately 14%, implying 44% effective tax on a wife's earnings of 1.4 million, not even taking into account taxes on her own earnings.

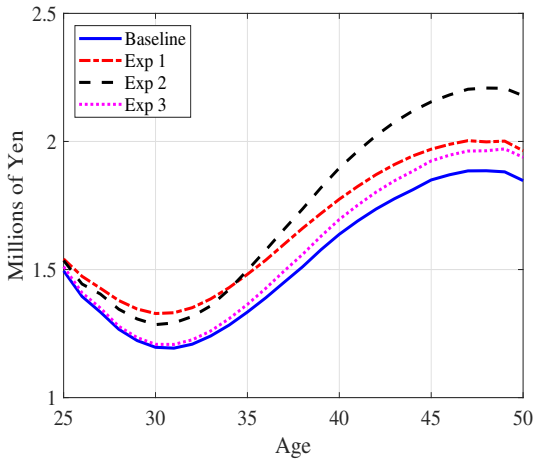



Figure 8: Women's Earnings under Alternative Policies

Table 4: Average Earnings under Alternative Policies (%-Changes Relative to Baseline)

| | Exp 1 | Exp 2 | Exp 3 | Exp 4 |
|---|---|---|---|---|
| All women | +7.0 | +16.3 | +4.1 | +27.7 |
| By age group | | | | |
| Age 25-49 | +8.3 | +12.9 | +2.9 | +23.1 |
| Age 50-64 | +5.1 | +21.4 | +6.0 | +34.5 |
| By marital status | | | | |
| Single | +1.4 | +1.3 | +1.2 | +2.9 |
| Married | +9.3 | +22.4 | +5.3 | +37.8 |
| By skill | | | | |
| Low | +7.0 | +16.9 | +3.6 | +28.1 |
| High | +7.0 | +14.0 | +6.2 | +26.1 |

Table 5 shows further decomposition of changes in employment rates. In both Experiments 1 and 2, a rise in participation mainly comes from an increase in the number of working married women, and both low and high-skilled women respond to a policy change.

Table 5: Average Participation Rates by Marital Status, Age Group and Skill under Alternative Policies (%): Women Aged 25-64

| | Baseline | Exp 1 | Exp 2 | Exp 3 | Exp 4 |
|---|---|---|---|---|---|
| By marital status | | | | | |
| Single: Employed | 85.5 | 87.6 | 86.3 | 86.3 | 88.5 |
| - Regular | 51.0 | 51.2 | 52.1 | 52.0 | 52.5 |
| - Contingent | 34.6 | 36.4 | 34.2 | 34.3 | 36.0 |
| Married: Employed | 58.4 | 65.9 | 66.1 | 59.7 | 72.6 |
| - Regular | 20.0 | 19.8 | 30.0 | 22.6 | 35.2 |
| - Contingent | 38.4 | 46.1 | 36.1 | 37.2 | 37.4 |
| By age group | | | | | |
| Age 25-49: Employed | 61.5 | 69.0 | 66.9 | 62.2 | 72.8 |
| - Regular | 30.5 | 30.3 | 37.6 | 32.4 | 41.5 |
| - Contingent | 31.1 | 38.8 | 29.3 | 29.8 | 31.3 |
| Age 50-64: Employed | 69.8 | 74.5 | 78.4 | 72.0 | 84.2 |
| - Regular | 20.6 | 20.4 | 32.1 | 23.7 | 38.0 |
| - Contingent | 49.2 | 54.0 | 46.3 | 48.3 | 46.2 |
| By skill | | | | | |
| Low | 64.6 | 71.1 | 70.9 | 65.5 | 76.3 |
| High | 64.9 | 71.2 | 73.5 | 69.0 | 82.5 |

In Experiment 3, we remove survivors' benefits. Average participation rates increase, though the change is smaller than in the first two experiments. Women face lower expected income after retirement after their husband passes away. A rise in participation comes from an increase in the number of regular workers, who, as Category-II insured, pay pension premiums and increase employment part of pension benefits.

When we combine the three experiments, average participation rate rises by 12.5 percentage points and the share of regular workers exceeds that of contingent workers. The increase is concentrated among married women as shown in Table 5, whose participation rates increase by 14.2 percentage points from 58.4% to 72.6%. Participation rates of single women also increase by 3 percentage points. Although single women are not directly impacted by policy changes, they also work more often since they anticipate different policy treatments once they are married in the future.

As a result of higher participation rates and faster accumulation of human capital on a regular job, women's average earnings rise by 27.7% in Experiment 4. Married women's earnings would rise sharply by 37.8% relative to the baseline economy.

**Consumption and Taxes:** Table 6 shows changes in consumption under alternative policies, expressed as percentage deviations from the baseline model. Note that in the baseline policy simulations we are not considering how additional tax revenues due to policy changes are used in the economy. Table 7 shows changes in the amount of taxes and social insurance premiums paid by single women and married couples under the four scenarios. Not surprisingly, average tax payment increases in all scenarios.

Although tax liabilities of women increase, average consumption increases for all groups in Experiments 1 and 2. Women participate, accumulate more human capital and earn more with their higher productivity. Positive effects from higher income dominate negative effects from higher tax burden.

In Experiment 3, a large decline in pension benefits occurs to widowed women with a removal of survivors' benefits. More women participate as regular workers and their own pension benefits increase, but their earnings are still much lower than men and the policy change reduces benefits they receive after death of a spouse and consumption is lower than in the baseline model. As shown in Table 8, pension benefits of single women are much lower than in the baseline.

In Experiment 4, where all three policies are removed, average consumption is 2.9% higher than in the baseline, though consumption of single old women is 5.9% lower. Positive effects of removing deductions and exemptions are not enough to offset a loss from a removal of survivors' pension benefits.

Table 6: Consumption under Alternative Policies (%-Changes Relative to Baseline)

| | Exp 1 | Exp 2 | Exp 3 | Exp 4 |
|---|---|---|---|---|
| All | +0.8 | +1.9 | −0.2 | +2.9 |
| By Age Group | | | | |
| Age 25-64 | +1.1 | +2.4 | +0.5 | +4.2 |
| Age 65-95 | +0.4 | +1.3 | −1.2 | +1.2 |
| By Skill (age 25-64) | | | | |
| Low | +1.1 | +1.3 | +0.4 | +2.7 |
| High | +1.3 | +2.6 | +1.1 | +5.4 |
| By Marital Status and Age | | | | |
| Single (25-64) | +0.5 | +1.0 | +0.9 | +1.6 |
| Single (65-95) | +0.3 | +0.8 | −8.0 | −5.9 |
| Married (25-64) | +1.2 | +2.5 | +0.4 | +4.4 |
| Married (65-95) | +0.4 | +1.6 | +2.5 | +5.0 |

*Note:* Average consumption levels are computed as an average of consumption at each age over relevant ages.

Table 7: Tax and Social Insurance Premium Paid by Women Aged 25-64 (%-Changes Relative to Baseline)

| | Exp 1 | Exp 2 | Exp 3 | Exp 4 |
|---|---|---|---|---|
| All | +4.8 | +13.9 | +1.4 | +19.5 |
| By Skill | | | | |
| Low | +4.8 | +14.9 | +1.2 | +20.5 |
| High | +4.8 | +9.1 | +2.6 | +14.4 |
| By Marital Status | | | | |
| Single | +0.5 | +1.1 | +0.9 | +1.6 |
| Married | +5.4 | +15.1 | +1.4 | +21.3 |

Table 8: Pension Benefits (%-Changes Relative to Baseline)

| | Exp 1 | Exp 2 | Exp 3 | Exp 4 |
|---|---|---|---|---|
| All | +0.5 | +4.3 | −10.3 | −3.6 |
| By Marital Status | | | | |
| Single | +0.2 | +1.4 | −19.3 | −15.6 |
| Married | +0.8 | +6.9 | +1.8 | +10.7 |

**Welfare Effects with and without Tax Rebate:** Table 9 shows welfare effects of the four scenarios. Effects are measured as consumption equivalence variation, which represents a percentage change in consumption across all possible states in the baseline economy so that an individual would be indifferent between the baseline economy and an alternative economy under each experiment.

The top panel "Without Tax Rebates" shows consumption equivalence based on our simulations presented above, where women pay more taxes and premiums due to a policy change, and additional revenues are not paid back to individuals. The lower panel labeled "With Tax Rebates" shows results when we assume that additional taxes collected from single women and married couples are paid back to them as a lump-sum transfer.

Removing tax deductions, premium exemptions, or survivors' benefits all implies additional burden and lowers welfare even if more women earn much higher income. The welfare loss is the highest under Experiment 2. The average loss is 2.2% in consumption equivalence and low-skilled women lose by more than high-skilled women. A larger fraction of low-skilled women work on a contingent job in the baseline economy, enjoying the

exemptions from insurance premiums, and are hit harder by the removal.

If, however, additional revenues are transferred back, all experiments generate a welfare gain, ranging between 0.2% to 1.2% in consumption equivalence, in the three experiments. When policy changes occur at the same time in Experiment 4, the welfare gain is 1.5% in consumption equivalence on average. These positive effects could be considered as a lower bound for the welfare gain. If, for example, distortionary taxes are reduced to balance the government budget, policy could generate a larger welfare gain.

Table 9: Welfare Effects of Alternative Policies (% in Consumption Equivalence)

| | Exp 1 | Exp 2 | Exp 3 | Exp 4 |
|---|---|---|---|---|
| Without Tax Rebates | | | | |
| All | −1.0 | −2.2 | −0.7 | −3.7 |
| Low | −1.0 | −2.3 | −0.7 | −3.9 |
| High | −0.9 | −1.2 | −0.6 | −2.4 |
| With Tax Rebates | | | | |
| All | +0.2 | +0.7 | +1.2 | +1.5 |
| Low | +0.2 | +0.6 | +1.2 | +1.4 |
| High | +0.3 | +1.7 | +1.3 | +2.9 |

# 6 Conclusion

Women lags behind men in economic participation and their earnings are significantly lower. A large fraction of female workers are engaged in non-regular contingent jobs and their income grows little with experience. This paper builds a quantitative life-cycle model to account for labor supply and earnings of women and to evaluate roles of fiscal policies.

We focus on three policies: spousal income tax deductions, exemptions from payment of social insurance premiums, and survivors' pension benefits. We find that removing the three policies raises participation rates of women by 6.5, 6.6 and 1.3 percentage points, respectively, or by 12.6 percentage points when all three policies are removed. There is also a large shift in the distribution of employment types. Removal of spousal deductions induces more women to participate but it comes entirely from a rise in the number of lower-income contingent workers. Regular jobs are not chosen because they prefer to keep their earnings low enough to be eligible for exemptions from payment of social insurance premiums. Removing premium exemptions raises participation rates by a similar magnitude, but the share of regular workers rises significantly. Women accumulate more human capital on a regular job and average earnings increase by 16.3%, while the

change is smaller at 7.1% when spousal deductions are removed. Although women would pay more to the government in taxes and social insurance premiums under the policy experiments, consumption is not necessarily lower since they earn more. Welfare effects are positive in the order of 0.2 to 1.2% in consumption equivalence when additional tax revenues are transferred back to them.

The Japanese government says they are working hard to encourage participation of women. We have shown that removing policies that prevent incentives for work and skill accumulation of women would raise participation and income of women by a significant amount. Such changes would not only help narrow the country's notoriously large gender gap in economic participation but also improve welfare of women. Removing these obstacles will also contribute to mitigating problems of labor shortages expected over the coming decades and severe fiscal tensions due to demographic aging.

# References


Abe, Y. and F. Ohtake (1995). Tax and social security system and part-time workers' labor supply behavior. *The Quarterly of Social Security Research (Shakaihosho Kenkyu) 31*(2), 120–134. (in Japanese).

Abe, Y. and A. S. Oishi (2009). The 1.03 million yen ceiling and earnings inequality among married women in Japan. *Economics Bulletin 29*(2), 1521–1530.

Akabayashi, H. (2006). The labor supply of married women and spousal tax deductions in Japan—a structural estimation. *Review of Economics of the Household 4*(4), 349–378.

Asao, Y. (2011). Overview of non-regular employment in Japan. *JILPT Report 10*, 1–42. Non-regular Employment - Issues and Challenges Common to the Major Developed Countries.

Attanasio, O. P., H. Low, and V. Sánchez-Marcos (2008). Explaining changes in female labour supply in a life-cycle model. *American Economic Review 98*(4), 1517–1552.

Bessho, B. and M. Hayashi (2014). Intensive margins, extensive margins, and spousal allowances in the japanese system of personal income taxes: A discrete choice analysis. *Journal of the Japanese and International Economies 34*, 162–178.

Bick, A. and N. Fuchs-Schundeln (2017). Taxation and labour supply of married couples across countries: A macroeconomic analysis. *Review of Economic Studies 85*(3), 1543–1576–292.

Blundell, R., M. C. Dias, C. Meghir, and J. Shaw (2016). Female labor supply, human capital, and welfare reform. *Econometrica 84*(5), 1705–1753.

Borella, M., M. De Nardi, and F. Yang (2021). Are marriage-related taxes and social security benefits holding back female labor supply? NBER working paper No. 26097.

Braun, A. R. and D. H. Joines (2015). The implications of a graying Japan for government policy. *Journal of Economic Dynamics and Control 57*, 1–23.

De Nardi, M., G. Fella, and G. Paz-Pardo (2020). Wage risk and government and spousal insurance. NBER working paper No. 28294.

Doepke, M. and M. Tertilt (2016). Families in macroeconomics. In J. B. Taylor and H. Uhlig (Eds.), *Handbook of Macroeconomics*, Volume 2B, pp. 1789–1891. Amsterdam: Elsevier. Chapter 23.

Eckstein, Z., M. Keane, and O. Lifshitz (2019). Career and family decisions: Cohorts born 1935–1975. *Econometrica 87*(1), 217–253.

Eckstein, Z. and O. Lifshitz (2011). Dynamic female labor supply. *Econometrica 79*(6), 1675–1726.

Fernandez, R. (2013). Cultural change as learning: The evolution of female labor force participation over a century. *American Economic Review 103*(1), 472–500.

Fernandez, R. and J. C. Wong (2014). Divorce risk, wages, and working wives: A quantitative life-cycle analysis of female labour force participation. *Economic Journal 124*(576), 319–358.

Fukai, T., H. Ichimura, S. Kitao, and M. Mikoshiba (2021). Medical expenditures over the life-cycle: Persistent risks and insurance. Working Paper.

Gao, H. (2020). Social security and female labor supply in china. Working paper, University of Minnesota.

Gayle, G.-L. and A. Shephard (2019). Optimal taxation, marriage, home production, and family labor supply. *Econometrica 87*(1), 291–326.

Greenwood, J., N. Guner, G. Kocharkov, and C. Santos (2016). Technology and the changing family: A unified theory of marriage, divorce, educational attainment and married female labor-force participation. *American Economic Journal: Macroeconomics 8*(1), 1–41.

Guner, N., R. Kaygusuz, and G. Ventura (2012). Taxation and household labour supply. *Review of Economic Studies 79*(3), 1113–1149.

Hansen, G. and S. İmrohoroğlu (2013). Fiscal reform and government debt in Japan: A neoclassical perspective. NBER Working Paper No. 19431.

Higuchi, Y. (1995). The economic consequences of policies to protect full-time housewives. In T. Hatta and N. Yashiro (Eds.), *An Economic Analysis of Policies to Protect the Weak*, pp. 185–219. Tokyo: Nihon Keizai Shinbunsha. (in Japanese).

İmrohoroğlu, S., S. Kitao, and T. Yamada (2016). Achieving fiscal balance in Japan. *International Economic Review 57*(1), 117–154.

Jones, L. E., R. E. Manuelli, and E. R. McGrattan (2015). Why are married women working so much? *Journal of Demographic Economics 71*(1), 75 – 114.

Kaygusuz, R. (2015). Social security and two-earner households. *Journal of Economic Dynamics and Control 59*, 163–178.

Kikuchi, S., S. Kitao, and M. Mikoshiba (2021). Who suffers from the covid-19 shocks? labor market heterogeneity and welfare consequences in Japan. *Journal of the Japanese and International Economies 59*. Article 101117.

Kitao, S. (2015). Fiscal cost of demographic transition in Japan. *Journal of Economic Dynamics and Control 54*, 37–58.

Kitao, S. and M. Mikoshiba (2020). Females, the elderly and also males: Demographic aging and macroeconomy in Japan. *Journal of the Japanese and International Economies 56*. Article 101064.

Kleven, H., C. Kreiner, and E. Saez (2009). The optimal income taxation of couples. *Econometrica 77*(2), 537–560.

Mori, T. and K. Urakawa (2009). Panel data analysis of the impact of the abolition of a special add-on spousal deduction on labor supply. *Konan Economic Papers 49*(2-4), 11–35. (in Japanese).

Nishiyama, S. (2019). The joint labor supply decision of married couples and the U.S. Social Security pension system. *Review of Economic Dynamics 31*, 277–304.

Sakata, K. and C. R. McKenzie (2005). The impact of tax reform in 2004 on the female labour supply in Japan. *MODSIM 2005 International Congress on Modelling and Simulation*.

Voena, A. (2015). Yours, mine, and ours: Do divorce laws affect the intertemporal behavior of married couples? *American Economic Review 105*(8), 2295–2332.

Yamada, K. (2011). Labor supply responses to the 1990s japanese tax reforms. *Labour Economics 18*, 539–546.

Yamaguchi, S. (2019). Effects of parental leave policies on female career and fertility choices. *Quantitative Economics 10*(3), 1195–1232.

Yokoyama, I. (2018). How the tax reform on the special exemption for spouse affected the work-hour distribution. *Journal of The Japanese and International Economies 49*, 69–84.

Yokoyama, I., K. Higa, and D. Kawaguchi (2021). Adjustments of regular and non-regular workers to exogenous shocks: Evidence from exchange-rate fluctuation. *Industrial and Labor Relations Review 74*(2), 470–510.

Yokoyama, I. and N. Kodama (2016). Women's labor and tax: The analysis of the current situation using data. *Financial Review 2*(127), 49–76. Special Issue on Tax Reform: Evidence-Based Policy Recommendation (in Japanese).