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

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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 the roles of fiscal policies in accounting for their behavior. We show that eliminating spousal deductions, social insurance premium exemptions and survivors' pension benefits for low-income spouses would significantly raise the labor supply of women and their earnings. More women would opt for 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

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1 Introduction

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

Why do women work the way they do? This paper uses panel data and examines the 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 the 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. On average, regular jobs are more stable, and pay much more than contingent jobs. Contingent jobs are typically characterized by a fixed-term contract, which includes part-time and temporary workers.[2] A large number of women exit the labor force when they get to marriage and child-bearing ages, and if they return to work, most of them do so as contingent workers, even if they were on a regular job prior to the exit. The 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.

The level of earnings also affects how women contribute to the social insurance system, which provides public pension, health, and long-term care insurance benefits to all the citizens. The insurance premiums that individuals pay to the government depend on their marital status and earnings. Dependent spouses are exempted from the 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

[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. Participation rate of women aged 15-64 is 73%, whereas it is 87% for men. Women's average participation rate among the 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.

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 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 the roles of three policies: spousal deductions, insurance premium exemptions, and survivors' pension benefits. We let single and married women at different stages of the life-cycle choose the participation, as well as the 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 their earnings, as well as their spouses', affect pension benefits after retirement. Women accumulate human capital on the job, and the growth of earnings depends not only on their age, education levels, and current employment, but also on the employment decisions they make over their 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. The removal of the three policies raises the participation rates and earnings of women, but the effects vary across policies, both quantitatively and qualitatively. The 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. The average earnings of women increase by 7.0%, 16.3%, and 4.1%, respectively.

The removal of the first two policies causes a rise in the participation rates by a similar magnitude, but the effects on the average earnings are very different. Without spousal deductions, a large number of women choose to participate, but they continue to keep their earnings at a lower level to avoid the payment of social insurance premiums, which amount to around 15% of their earnings.[4] Therefore, a rise in the participation rates is entirely due to an increase in the number of low-income contingent workers, which results in a smaller change in earnings compared to the removal of exemptions from payment of social insurance premiums. The latter causes women to shift from contingent jobs and not-in-labor-force to regular jobs, which generates a large increase in their average earnings as they accumulate more human capital during regular employment. Although policy changes raise the tax burden on women under all policy experiments, the higher

[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.

earnings of more productive women raise the average consumption and improve welfare when additional net revenues are transferred back to them.

The paper also shows that if the three policies are removed altogether, women's participation rates rise by 12.5 percentage points, and they earn 27.7% more on average. They also pay 19.5% more to the government in taxes and social insurance premiums on their higher earnings. Average consumption of women rises by 3.0% and they enjoy a welfare gain of 2.1% in consumption equivalence. Our findings suggest that there is a large room to improve women's participation and earnings by removing the fiscal policies that stand as obstacles to incentivize work. Moreover, the government could raise more tax revenues without generating a welfare loss.

This paper contributes to two lines of literature. Firstly, it is a contribution to the growing literature that builds a structural model of families to study the effects of fiscal policies on the labor supply of women. Secondly, it builds on the literature that investigates macroeconomic issues and redistributive policies in an aging economy. Japan is a country that faces the largest gender gap among the developed countries, with the most rapidly aging demographics and severe labor shortages.

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

Recent papers that focus on the 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 the effects of joint income taxation, Voena (2015) on the role of divorce laws, and Nishiyama (2019), Kaygusuz (2015) and Sánchez-Marcos and Bethencourt (2018) on spousal and survivors benefits in the social security system.[6] Gao (2020) studies the effects of a change in the social security eligibility age in China, and Blundell et al. (2016)

[5]See also Doepke and Tertilt (2016) for a comprehensive review of the literature, Jones et al. (2015) on the gender wage gap, Fernandez and Wong (2014) on marriage market and divorce probabilities, and Eckstein et al. (2019) on the 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 the effects of income support programs in the U.K. under the alternative specifications of a wage process. Groneck and Wallenius (2021) analyze the effects of the U.S. social security system on married women's labor supply and inequality.

investigate the 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 the 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, going through phases of work and retirement. In our model, we also include fixed skill heterogeneity and estimate the 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 of employment types. The stock of human capital varies according to an individual's experience of regular and contingent jobs, and the paper shows that policies have important effects, not only on participation decisions, but also on the job choices of women over their life-cycle. The latter is critical in accounting for the stagnant income growth of women in Japan.

Our analysis can also be applied to evaluations of fiscal policies in other countries that treat earnings of low-income jobs differently from those of regular jobs, rendering the labor market stratified, perhaps unintentionally. For example, workers engaged in small jobs called the Mini-jobs in Germany, which pay no more than a threshold amount of 450 euros per month, are exempt from labor income taxes and social security contributions. Some empirical studies demonstrate that the introduction of the Mini-jobs increased labor supply at the extensive margin, but not at the intensive margin, and raised income inequality across workers.[7]

There are recent papers that build a structural model to study the effects of fiscal issues in Japan, and emphasize the importance of a change in its labor force, driven by rapidly aging demographics and declining fertility rates.[8] 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 life-cycle model, and place emphasis on the 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 the quantitatively important factors to achieve fiscal sustainability. Fukai et al. (2021) build a model of single and married individuals and study the 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

[7]See, for example, Haywood and Neumann (2021) and Tazhitdinova (2020) for studies about the effects of the Mini-job policy on the labor market outcomes. Carrillo-Tudela et al. (2021) analyze flows of employment in the German labor market and argue that although the introduction of the Mini-jobs increased participation rates, many formerly unemployed individuals accepted low-paid part-time jobs and income inequality increased.

[8]See, for example, Hansen and İmrohoroğlu (2013), Braun and Joines (2015) and Kitao (2015).

be mitigated not simply by the increased participation of women, but also by closing the gender gap in wages and employment types. All these papers assume that the labor supply and earnings are exogenous. This study makes a contribution to the literature by modeling the decisions of single and married women regarding 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 the employment types, and to consider the marital status heterogeneity in explaining the life-cycle patterns of female labor force participation.

Our structural model enables us to evaluate the 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 the effects of the subtle details of policies, which we find crucially influence women's labor supply and skill accumulation decisions. We focus on the behavior of a particular cohort, and do not explicitly consider issues of demographic aging and fiscal sustainability in the future. However, our results suggest that 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 a large body of empirical literature that studies the effects of fiscal policies on female labor supply in Japan, and our study is complimentary to papers that focus on the roles of spousal deductions and social insurance policies on dependent spouses. For example, Akabayashi (2006) and Bessho and Hayashi (2014) investigate the effects of spousal deductions on the labor supply of married women. Yokoyama (2018) and Sakata and McKenzie (2005) examine the effects of a change in the spousal deduction policy in 2004.[9] Yamada (2011) estimates a structural life-cycle model and studies the effects of income tax reforms in the 1990s.

In the context of the literature focused on Japanese women, Yamaguchi (2019), who builds a structural life-cycle model to study the role of parental leave policies on married women's labor supply and fertility, is perhaps closest to ours. We both endogenize women's decisions of participation and employment types, and allow them to accumulate human capital over the life-cycle. However, our paper focuses on effects of income taxation and social security policies. Therefore 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, 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

[9] Yokoyama (2018) also studies how the policy change affects the labor supply of women at different income levels. In addition to the papers cited above, there are a number of empirical papers written in Japanese that examine the 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).

which the financial security of the households after retirement influences the behavior of working-age individuals.[10]

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

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 the 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.[11]

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

Individuals are employed as either a regular worker or a contingent worker. The distinction between these 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 on the 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 be flexible in engaging in different tasks assigned to them. They are also covered by social insurance programs at work, and employers make partial contributions on behalf of the 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

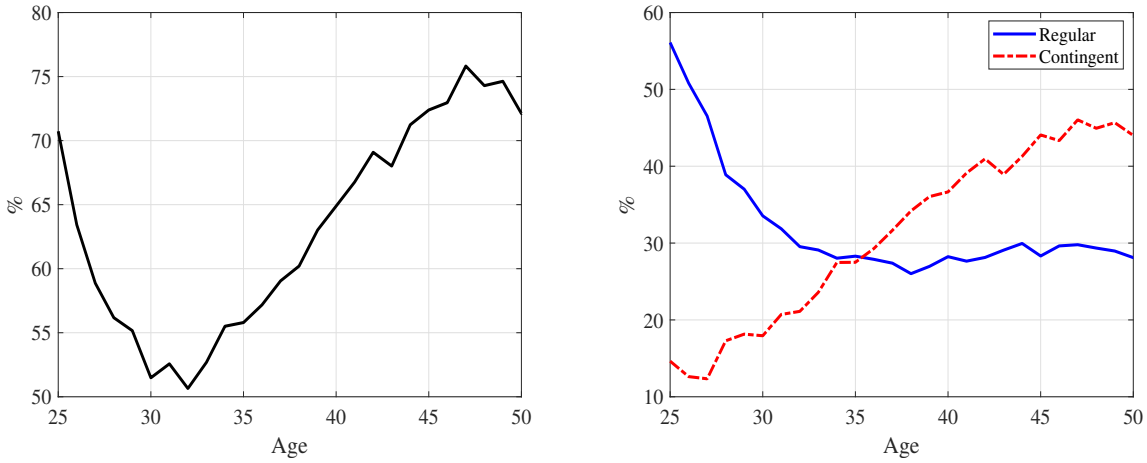
[10] Yamaguchi (2019) also models women's decisions to conceive and give birth and to take up a parental leave, which we abstract from and assume exogenous in our model.

[11] See the online appendix for more details of the data source. In the appendix, we also show that the participation rates and earnings profiles are in line with those computed from other widely used data sources such as the Employment Status Survey (ESS). Consistent with the model presented in the next section, we focus on single and married samples of women and do not include divorced singles.

from an agency, and contract or entrusted employees. Not all of them are offered social insurance coverage at work, and their earnings are typically much lower than those of regular workers.[12]

In what follows, we group women into three employment statuses: regular, contingent and not-in-labor-force (NILF), based on a JPSC's survey response to a question that asks the 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.[13] We classify women as high-skilled if they have a college degree, and low-skilled otherwise.

Figure 1a shows the labor force participation rates of women over the life-cycle.[14] 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 stay at that level. Figure 1b shows the decomposition of participation rates into regular and contingent employment. The majority of women start their 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.



(a) Total (Regular+Contingent)

(b) By Employment Type

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

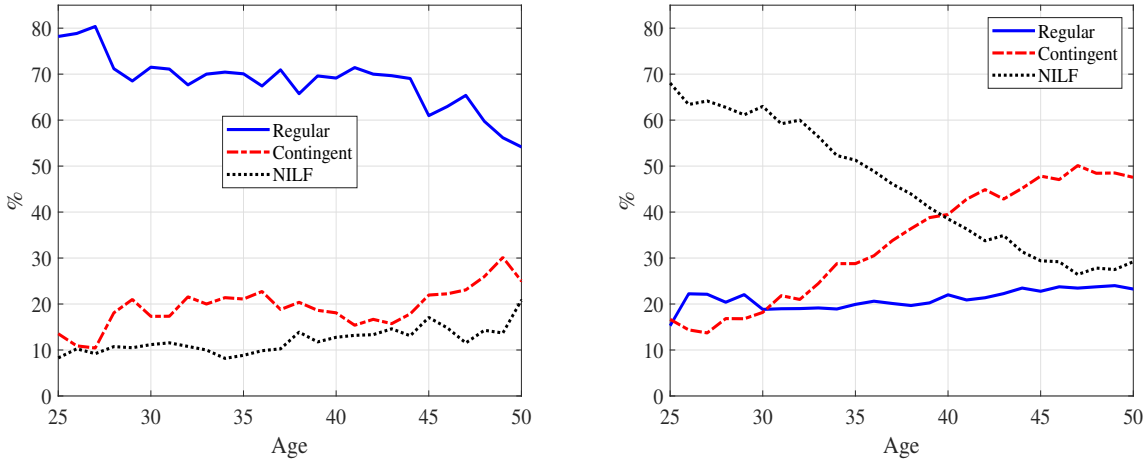
[12]See, for example, Asao (2011) for a more detailed description of the employment types, and the employment system in Japan.

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

[14]Women in our sample cohort are born in 1959-1969 and are 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 the employment of women aged below 50.

Another important dimension of heterogeneity in accounting for the life-cycle patterns of women's labor supply is marital status. According to our JPSC samples, a majority of the 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. Apart from those aged 20s and early 30s, the 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 their marriage. The recovery in the overall participation rates in their late 30s and 40s is explained by the return of the married women 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 the life-cycle profiles of women's earnings by skill level and employment type. Regular workers earn more than contingent workers in both low and high skill groups. The profile is flat for contingent workers and does not exhibit growth as seen among the regular workers. There is a larger difference between earnings of regular and contingent workers than the difference between earnings of low and high-skilled workers.

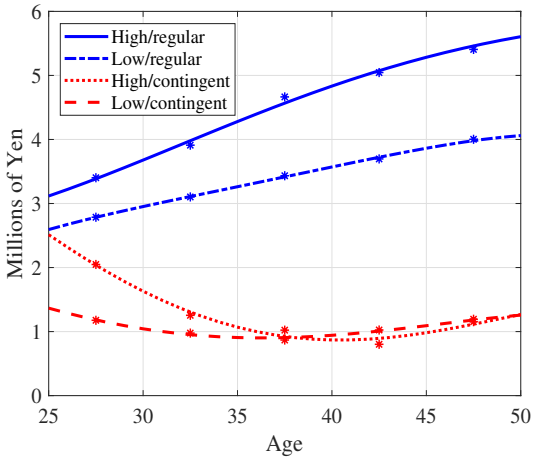


Figure 3: Women's Earnings by Skill and Employment Type: JPSC Data

2.2 Social Insurance and Tax Policies in Japan

In this section we summarize the 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 the three main pillars of the social insurance system in Japan. All Japanese citizens are enrolled in the three programs, receive their benefits, and contribute to the system according to the regulations of each program.

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

There are three categories of insurance coverage that determine the required contributions to the system. Category-II insured are those who are enrolled in the employees' social insurance.[15] Category-III insured are the dependent spouses of Category-II insured persons. Annual earnings must not exceed 1.3 million yen for someone to be Category-III insured. All others are Category-I insured, which include self-employed persons, students or those not in labor force, as well as employed individuals who are neither Category-II

[15]Firms with more than five regular employees must offer social insurance and contribute half of the insurance premiums for eligible employees, which include all regular workers and some non-regular workers. Non-regular workers who work more than 30 hours per week, or 75% of regular workers, are eligible for the coverage at work. In addition, as of 2021, non-regular workers who work between 20 and 30 hours per week in a firm with more than 500 employees, expect to work for more than a year, and earn more than 1.06 million yen annually are also eligible for coverage.

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, the pension premium rate is 18.3%, and the premium rates for health and long-term care insurance are 10.0% and 1.8%, respectively, shared equally by the employer and the employee.[16]

Category-I insured individuals pay a fixed premium for the public pension program, and contributions to health and long-term care insurance at fixed rates of their earnings, comparable to those paid by the Category-II insured individuals. Category-III insured people make no contribution to any of the three insurance programs. This exemption of social insurance contributions for dependent spouses was introduced in 1985. [17]

Pension benefits after retirement consist of two parts, 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.[18]

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 amount varies over time and was 380,000 yen until 1987, 760,000 yen between 1987 and 2003, and back to 380,000 in 2004 and thereafter.[19] As of 2021, a full amount can be deducted if the earnings of a spouse do not exceed 1.5 million yen, and the deduction amount declines with the spouse's earnings, reaching zero if a spouse earns more than 2.01 million yen.

To summarize the information in this section, there are multiple cutoff levels of earn-

[16]These rates vary over time and also slightly differ across the 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.

[17]Prior to 1985, it was an option for housewives to enroll in the public pension system but not mandatory. The introduction was intended to support full-time housewives, who are not able to enroll in the social security system with their own income. The introductions of the survivors' benefits and spousal tax deductions date back to 1948 and 1961, respectively.

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

[19]Note that the spousal deduction can also be lower or none if an individual's own earnings exceed a cutoff, though the cutoff is typically well above the 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 with a rise in earnings.

ings 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 the earnings below threshold levels: below 1.3 million yen to satisfy the eligibility of a Category-III insured person, and avoid the payments of social insurance premiums, below 1.03 million not to pay labor income taxes, and below 1.5 million yen to receive full spousal deductions.[20] 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 the structural model that we use to evaluate the role of these policies on the 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 the behavior of women, who optimally choose participation and employment types, and accumulate human capital as they go through stages of the life-cycle, including marriage, child-birth, retirement, and the death of her spouse and her own. It is a partial equilibrium model, and individuals take the paths of factor prices and various policies as a given.

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 the conditional probability that an individual of age j and gender g survives until the next period.

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 the 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 the presence of a small child in a married household, and it affects the women's cost of participation as discussed below. The state

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

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 their earnings are denoted as y_m, which differ by age and education, and evolve deterministically over the life-cycle.

The employment status of a woman is denoted as $e = \{R, C, N\}$, where R and C represent employment in regular and contingent jobs, respectively, and N is a state of not-in-labor-force (NILF). The earnings of a female worker are defined 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 the 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 $g = \{m, f\}$. The 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 the 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 the leisure of a husband and a wife, respectively. η represents consumption equivalence and varies with 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 the total disposable time for leisure. $\phi_{q,e}$ denotes the 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 the cost of switching employment status from e_{-1} in the previous period to e in the current period. The last term ν_k represents the 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 the policies without time subscripts to simplify the notations.[21]

Taxes: The government levies taxes on consumption and capital income at proportional rates, τ^c and τ^a, respectively. The 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 the combined household earnings, but an individual may receive spousal deductions if the earnings of his or her dependent spouse do not exceed a threshold. Therefore we express the labor income tax of a married couple as a function of the earnings of the 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 receive the benefits. However, they contribute to the system differently, depending on each individual's earnings and insurance category. There are three categories, denoted as $\{I, II, III\}$, and Category-II insured people are those who are covered by their 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 individuals are not required to make any payment. All others are Category-I insured. In section 4, we explain more details about the insurance

[21] 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. However, we also consider scenarios of transferring back the additional net revenues by making a lump-sum rebate, and compute welfare effects with and without tax adjustments. See section 5 for more details.

premiums that individuals of different category must pay.

We use the 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: a basic pension that is common across all individuals, and the 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 the employment-based part, and depends on the average past labor income $\overline{p}_g$ and a replacement rate κ. 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.

The government operates the universal health insurance, and the long-term care insurance programs. We denote age-dependent copay rates of for medical and long-term expenditures as λ_j^m and λ_j^l, respectively. The total out-of-pocket expenditures $o_{j,g}$ are given as

$$o_{j,g} = \lambda_j^m med_{j,g} + \lambda_j^l ltc_{j,g},$$

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 the 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 the 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 Problems of Households

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 the 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.[22]

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

subject to

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

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

[22] 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. Their value functions are not presented here to save space, but are included in the online appendix.

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 the states of a potential spouse.[23] 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.

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

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).

[23] We assume that men know the average assets of women by skill and age and use them in the expectation of values in the next period. For other states, we assume that men expect to marry a woman who has been in a regular job, for simplicity. This assumption does not affect our quantitative results in any significant way but greatly simplifies the computation since we do not have to use the information about the distribution of women across all states to compute the expectation.

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

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

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 the data of Cohort A of the JPSC, women born between 1959-1969, and their life-cycle behavior. We call them the cohort of the 1960s, and map the 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 so we let policy parameters vary over the life-cycle of the cohort accordingly. Our model is a partial equilibrium model, and the interest rate r is exogenous and set to 2%. Table 2 summarizes the 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 computed based on the share of single women in each age-education group in the JPSC data who get married in the next period. Since JPSC only has information about the husbands of female samples, we use the Census data to compute the marriage probability based on the number of single and married men of the 1960 cohort, independent 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 the skill distribution of couples at age 50 to calibrate the probabilities. A low-skilled woman marries a husband of the same skill with a probability of 67.4% and a high-skilled woman marries a husband of the same skill with a probability of 78.7%. For men, the probability of marrying a woman of the same skill level is 95.8% and 75.0% for low and high skills, respectively.

The transition probabilities of having a small child, $\pi^{k}_{j,s}(i_k, i'_k)$, and the probability 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 according to the JPSC data.[24]

4.2 Human Capital

The earnings of women depend on their skill level, employment type in the current and previous periods, and work experience, and these 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).[25]

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 the information about each individual's current employment, and also the past employment history. We also include unemployment rate U_t at time t to account for macroeconomic conditions that may vary and affect the level of the overall earnings.[26]

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

β_s is a skill-specific intercept, and the effects of experience in regular and contingent employment are approximated by a polynomial in the number of work years in each job. $x_{e,it}$ represents the number of years that an individual i has worked in an 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 the type of employment.

Table 1 summarizes the 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

[24] Costa Dias et al. (2020) show that women's participation rates declines sharply during the first five years after childbirth using the labor market data in the U.K. Bick (2016) also shows a similar pattern in Germany and other EU countries.

[25] Yamaguchi (2019) focuses on the 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 defined by education levels and we include an intercept for them.

[26] Estimated coefficients on unemployment rates are small (0.022 for regular and -0.0402 for contingent workers) and estimates of other coefficients do not change much quantitatively.

additional year of experience increases the 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 the earnings of a regular worker, relative to individuals who continue to work as regular employees. However, a shift from a regular job to a contingent job has a positive effect. We use these estimated functions to compute the earnings in the model.

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

	Regular		Contingent	
	Estimate	Std. err.	Estimate	Std. err.
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)

Men's earnings y_m vary with age and skill deterministically, and are estimated using data on men's earnings of the JPSC.[27] 98% of the husbands of married women in our JPSC samples participate in the labor market and we assume that men always work in our model.

4.3 Preferences

The equivalence scales η 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 the risk aversion parameter σ at 3.0, and a weight parameter ω at 0.5, which are in the range of values used in the literature.[28] The subjective discount factor β is set to 0.98.

[27] See the online appendix for the estimated profiles.

[28] For example, Borella et al. (2021) set the risk aversion parameter at 2.5 and De Nardi et al. (2016) set it to 2.83, as estimated in their model. Consumption weight is set to 0.5 (equal weight) in De Nardi et al. (2020), and French (2005) estimate the parameter to be in the range of 0.53-0.62. The subjective discount factor is in the range of 0.98-0.99 in these papers.

An individual's total disposable time is normalized to 1.0. The parameters related to disutility from work are calibrated to approximate life-cycle profiles of the regular and contingent employment rates of women. The set of parameters include the participation cost by employment type and marital status, $\phi_{q,e}$, the additional participation cost when there is a small child of age 0-5, ν_k, and the cost of switching employment types, $\chi_{e_{-1},e}$. 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, there are eight parameters related to the participation costs, and we calibrate them by minimizing 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.[29] The values of the parameters are summarized in Table 2 and the fit of the model with the employment data is presented in section 5.1.

4.4 Government

Taxes: The consumption tax rate is zero until 1988, raised to 3% in 1989, 5% in 1997, 8% in 2014, and 10% in 2020.[30] The capital income tax rate is set to 35%, which is in the range of estimates for effective tax rates on capital income as in Hansen and İmrohoroğlu (2013), for example.

The labor income tax is progressive, and marginal tax rates rise in earnings in steps. We include the basic and salary income deductions available to all employed workers, and spousal deductions for eligible workers. Spousal deductions are provided only if the earnings of a spouse are below the threshold level. The upper limit of earnings, and the deduction amount vary over time. Up 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 the earnings exceed 2.01 million yen.

The basic deductions are a fixed amount, and salary income deductions increase with the earnings. Every employee can receive a minimum deduction 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 out on the spousal deduction.

[29] We use the 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.

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

Labor income taxes consist of national and local taxes. Tax rates and progressivity vary over time and as of 2021, the marginal tax rates are between 5% and 45% at the national level, and the local tax rate is proportional at 10%.[31]

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 the insurance categories of individuals. Category-II insured are workers who are covered by social insurance at work, and Category-III insured people are the dependent spouses of Category-II workers, subject to an earnings limit. Category-I insured are the rest of the 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 people 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 individuals is 52% among single contingent workers, and 34% among married contingent workers. We use these fractions to compute the 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 κ at 0.219, based on the pension benefit schedule of 2021.[32]

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

Once an individual has retired, $\overline{p}_g$ remains constant as long as the 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 survivor's benefits. Supposing that the average past earnings that determine an income-dependent part of the 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, 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, she will be entitled to 75% of her husband's employment-based pension benefits for the remainder of her life.

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

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

Data for gross medical expenditures and long-term care expenditures by gender and age are taken from the publicly available data of the Ministry of Labour, Health and Welfare (MLHW). The copay rates of health insurance vary by age and they are 30% up to 69 years old, 20% at ages 70-74, and 10% at ages 75 and above. The copay rate of long-term care expenditures is 10%.

The premiums of the public pension system depend on each individual's insurance category. Category-I insured individuals pay a fixed amount each month, and the Category-II insured ones contribute a fixed fraction of their earnings. The premium amount and the rates vary over time, and in 2021, the Category-I premium is 16,610 yen per month, and Category-II individuals pay 9.15% of their earnings.[33] Category-III insured workers are exempted from the premium payment. For health and long-term care insurances, Category-I insured individuals pay either a fixed premium if an individual does not earn, or a fixed percentage of their earnings. Category-II insured individuals also pay a fixed fraction of their earnings as premiums. See the online appendix for more details regarding the premium amount and proportional rates over time, which we use in the computation.

Welfare Program: The 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.

[33]The 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		
β	Subjective discount factor	0.98
σ	Risk aversion parameter	3.0
ω	Leisure/consumption weight	0.5
η	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($\phi_{M,C}$)
ν_k	Participation cost (a small child)	0.27
$\chi_{e_{-1},e}$	Switching cost	0.30($\chi_{N,R}$),0.18($\chi_{N,C}$),0.34($\chi_{C,R}$)
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		
λ^m_j	Health insurance copay	30,20,10% (varies by age)
λ^l_j	Long-term care insurance copay	10%
κ	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)
τ^c	Consumption tax rate	3-10%
τ^a	Capital income tax rate	35%
r	Interest rate	2%

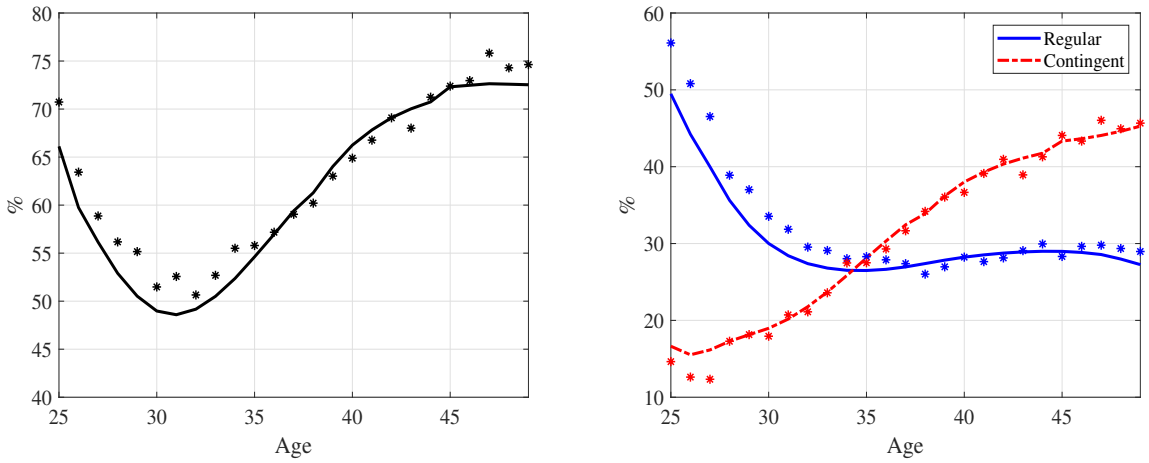
5 Numerical Analysis

We present our numerical results in this section. We first discuss the 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 the employment decisions and earnings of women, and influence the 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 as 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 return 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. This 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 the costs of participation and of switching employment types to approximate the participation rates of women. The model approximates the age profiles of employment types fairly well, with a parsimonious set of age-independent parameters.



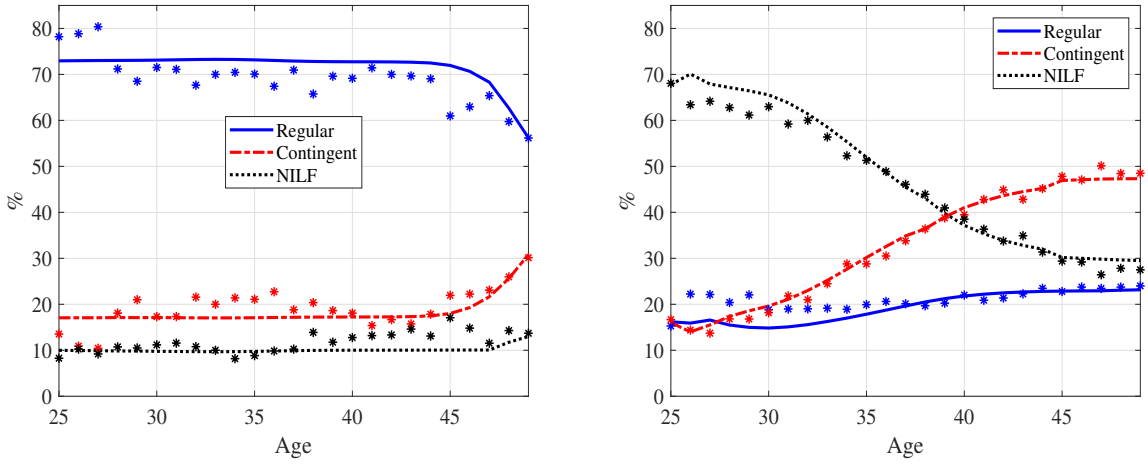
(a) Total (Regular+Contingent)

(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 marital 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 similarly, 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 get married, and their subsequent return 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 based on the JPSC, as shown in Figure 3. 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 the difference in earnings between regular and contingent workers contribute to a larger earnings gap between men and women.

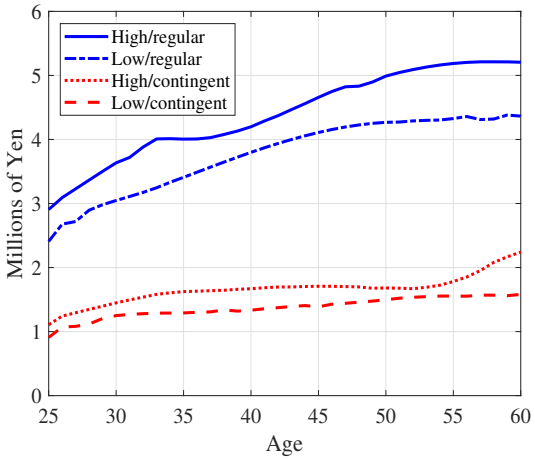


Figure 6: Women's Earnings by Skill and Employment Type: Baseline Model

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 the fiscal policies affects women's labor supply and their earnings.

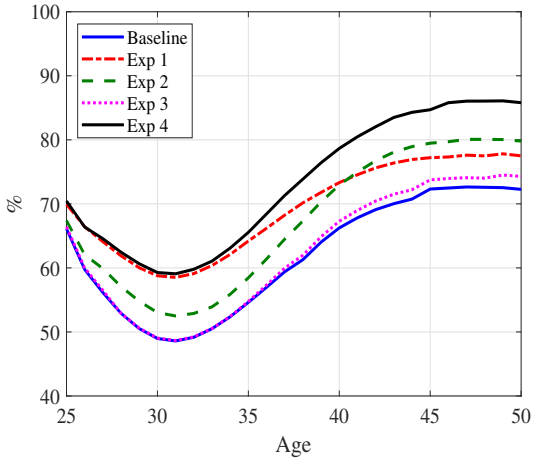
We focus on three policies. The first is income tax deductions for a dependent spouse, which allows an individual to claim a fixed deduction from gross earnings if a spouse does not earn more than a threshold level. The second is an exemption of social insurance premiums for a Category-II dependent spouse, provided that he or she does not earn more than 1.3 million yen. Finally, we study the 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. The 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

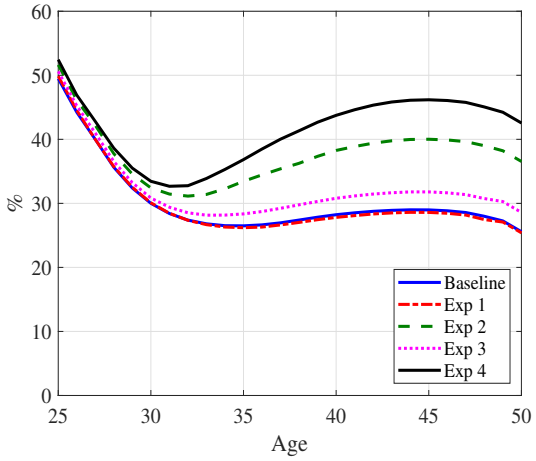
Table 3 shows the average participation rates of women in the baseline model, and under the four experiments. Figure 7 shows the overall participation rates by age, and the breakdown by employment type.

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

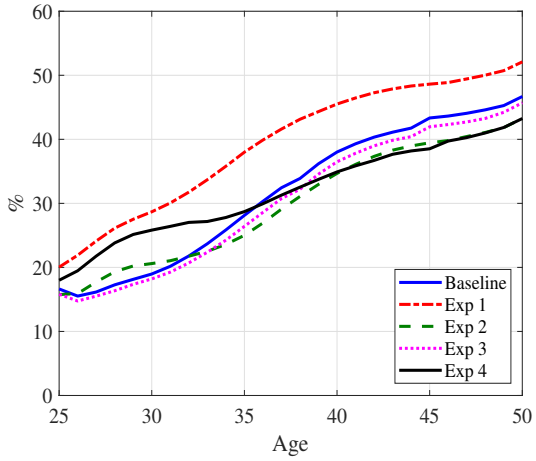
	Baseline	Exp 1	Exp 2	Exp 3	Exp 4
Employed	64.6	71.1	71.2	65.9	77.1
- Regular	26.8	26.6	35.6	29.2	40.2
- Contingent	37.8	44.5	35.6	36.7	36.9
NILF	35.4	28.9	28.8	34.1	22.9



(a) Total (Regular+Contingent)



(b) Regular



(c) Contingent

Figure 7: Women's Participation Rates Under Baseline and Alternative Scenarios

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

effects vary both quantitatively and qualitatively across the experiments. In Experiment 1, as shown in the second column of Table 3, the elimination of spousal deductions removes the disincentives to participate in the labor market since it no longer implies a loss of deductions from the husband's earnings. The deductions are a major obstacle to women's entry into the labor force since the effective tax rate on their earnings would be extremely high.[34] The 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 their earnings low and do not choose regular jobs so that they continue to enjoy the exemptions from social insurance taxes. In addition to labor income taxes, earnings are subject to social insurance premiums at rate 15% once they exceed 1.3 million yen. An increase in the participation rates come entirely from a shift from NILF to contingent jobs, whose share rises from 37.8% to 44.5%, while the share of regular workers barely changes.

In Experiment 2, when the exemptions from social insurance premiums are removed, the average participation rate increases by 6.6 percentage points, 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, from 26.8% to 35.6%, as shown in Table 3. Since women are no longer exempted from the social insurance premiums, and both non-working and low-income wives would have to contribute, married women have stronger incentives not to leaave the labor market. If they participate, they are incentivized to earn more by taking on a regular job.

This change in the composition of working women leads to the higher average earnings of women, as shown in Figure 8. The 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 their career. In Experiment 2, the average earnings of women aged 25-49 are 12.8% higher than in the baseline economy, and women aged 50-64 earn 21.3% more. This increase is concentrated among married women as shown in the middle panel of Table 4. There is a limited change in the earnings of single women. Both low and high-skilled women are more likely to be engaged in regular jobs, and their earnings increase by 16.9% and 14.0%, respectively.

[34]The maximum deductions vary over time. They are 760,000 yen until 2003, or until they are 39 years old, and they lose the entire deductions if the earnings exceed 1.4 million yen. Their 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% on lost exemptions.

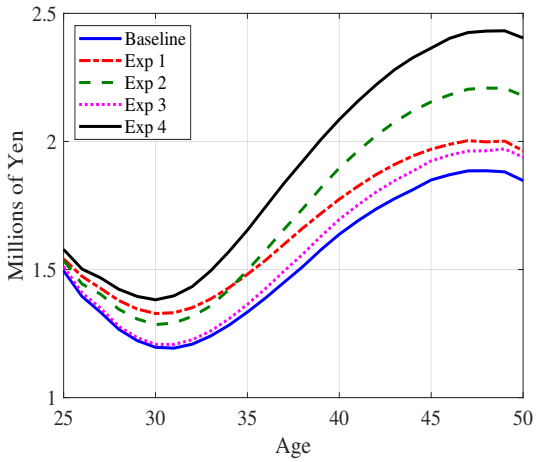


Figure 8: Women's Earnings under Baseline and Alternative Scenarios

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	+8.2	+12.8	+2.9	+23.1
Age 50-64	+5.1	+21.3	+6.0	+34.4
By marital status				
Single	+1.4	+1.3	+1.2	+2.9
Married	+9.2	+22.3	+5.3	+37.7
By skill				
Low	+6.9	+16.9	+3.6	+28.1
High	+7.0	+14.0	+6.3	+26.1

Table 5 shows further decomposition of the 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	86.9	89.2	87.5	87.5	89.9
- Regular	57.4	57.6	58.7	58.6	59.1
- Contingent	29.5	31.5	28.8	29.0	30.7
Married: Employed	59.9	67.2	67.7	61.3	74.4
- Regular	20.4	20.0	30.7	23.0	36.2
- Contingent	39.5	47.2	37.1	38.3	38.2
By age group					
Age 25-49: Employed	61.5	69.0	66.9	62.2	72.8
- Regular	30.5	30.3	37.7	32.5	41.5
- Contingent	31.0	38.7	29.2	29.8	31.3
Age 50-64: Employed	69.8	74.5	78.4	72.0	84.2
- Regular	20.7	20.5	32.2	23.8	38.1
- Contingent	49.1	54.0	46.2	48.2	46.1
By skill					
Low	64.6	71.1	70.9	65.5	76.3
High	65.0	71.1	73.5	69.0	82.6

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

When we combine the three experiments, the average participation rate rises by 12.5 percentage points, and the share of regular workers exceeds that of the contingent workers. The increase is concentrated among married women as shown in Table 5, whose participation rates increase by 14.5 percentage points, from 59.9% to 74.4%. The participation rates of single women also increase by 3.0 percentage points. Although single women are not directly impacted by policy changes, they are more likely to work since they anticipate different policy treatments once they are married in the future.

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

economy.

Consumption and Taxes: Table 6 shows the 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 the changes in the amount of taxes and social insurance premiums paid by single women and married couples under the four scenarios. Not surprisingly, the average tax payment increases in all the scenarios.

Although the tax liabilities of women increase, the average consumption increases for all the groups in Experiments 1 and 2. Women participate, accumulate more human capital, and hence earn more due to their higher productivity. The positive outcomes of a higher income outweigh the negative effects of the higher tax burden.

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

In Experiment 4, where all the three policies are removed, the average consumption is 3.0% higher than in the baseline, though the consumption of single old women is 6.9% lower. The positive effects of removing deductions and exemptions are not enough to offset a loss from a removal of the survivors' pension benefits.

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

	Exp 1	Exp 2	Exp 3	Exp 4
All	+0.8	+2.0	−0.2	+3.0
By Age Group				
Age 25-64	+1.1	+2.4	+0.5	+4.2
Age 65-95	+0.4	+1.2	−1.6	+0.7
By Skill (age 25-64)				
Low	+0.9	+2.2	+0.3	+3.6
High	+1.9	+3.8	+1.6	+7.4
By Marital Status and Age				
Single (25-64)	+0.5	+1.0	+0.9	+1.5
Single (65-95)	+0.3	+0.8	−9.3	−6.9
Married (25-64)	+1.2	+2.7	+0.4	+4.6
Married (65-95)	+0.4	+1.4	+1.4	+3.7

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	+4.7	+14.9	+1.2	+20.5
High	+4.8	+9.1	+2.6	+14.4
By Marital Status				
Single	+0.4	+1.1	+0.9	+1.6
Married	+5.1	+15.0	+1.4	+21.0

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

	Exp 1	Exp 2	Exp 3	Exp 4
All	+0.5	+4.5	−8.6	−1.7
By Marital Status				
Single	+0.2	+1.5	−22.0	−17.8
Married	+0.8	+6.9	+1.8	+10.7

Welfare Effects with and without Tax Rebate: Table 9 shows the welfare effects of the four scenarios. These are measured as the 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 the consumption equivalence based on our simulations presented above, where women pay more taxes and premiums due to a policy change, but the additional revenues are not paid back to them. The lower panel labeled "With Tax Rebates" shows the results when we assume that the additional taxes collected from single and married women are paid back to them as a transfer to raise their consumption across all possible states by the same percentage.

The removal of tax deductions, premium exemptions, or survivors' benefits unanimously implies an additional financial burden, and lower welfare, even if more women earn a much higher income. The welfare loss is the highest under Experiment 2. The average loss is 2.2% in consumption equivalence, and in this case, the low-skilled women lose by much more. 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. The negative welfare effects are not surprising since taxes are higher or benefits are lower, and the extra revenues are "thrown away."

However, if additional revenues are transferred back, all three experiments generate a welfare gain, ranging between 0.3% to 1.4% in consumption equivalence, as shown in the lower panel of Table 9. When the policy changes occur at the same time in Experiment 4, the welfare gain is 2.1% in consumption equivalence on average. These positive outcomes could be considered as a lower bound for the potential welfare gain. If, for example, distortionary taxes are reduced to balance the government budget, the 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	+0.3	+1.1	+1.4	+2.1
Low	+0.3	+1.0	+1.4	+2.0
High	+0.5	+2.0	+1.5	+3.5

6 Conclusion

Data reveal that women lags far 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 very little with experience. This paper builds a quantitative life-cycle model to account for the labor supply and earnings of women and also to evaluate the role of fiscal policies.

We focus on three policies: spousal income tax deductions, exemptions from the payment of social insurance premiums, and survivors' pension benefits. We find that removing the three policies raises the participation rates of women by 6.5, 6.6, and 1.3 percentage points respectively, or by 12.5 percentage points in total when policies are removed altogether. There is also a large shift in the distribution of employment types. The removal of spousal deductions induces more women to participate in the workforce, but it comes entirely from a rise in the number of lower-income contingent workers. They do not opt for regular jobs because they prefer to keep their earnings low enough to be eligible for exemptions from the payment of social insurance premiums. Removing the premium exemptions raises the participation rates of women by a similar magnitude, but the share of regular workers rises significantly. Women accumulate more human capital on a regular job and their average earnings increase by 16.3%, while the change is smaller at 7.0% when the spousal deductions are removed. Although women would pay more to the government in taxes and social insurance premiums under the policy experiments, their consumption is not necessarily lower since they earn more. The welfare effects are positive in the order of 0.3 to 1.4% in consumption equivalence when the additional tax revenues are transferred back to them.

The Japanese government says they are working hard to encourage the participation

of women in the professional sphere. This paper demonstrates that the removal of policies that act as a disincentive to work, and to the skill accumulation of women would raise the 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 the welfare of women. Eliminating these barriers will also contribute to the mitigation of the labor shortages that are expected over the coming decades, in addition to the fiscal tensions due to demographic aging, a topic that we leave for future research.

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