DISSERTATION

GOVERNMENT FINANCING IN JAPAN: AGING POPULATION, TAX SYSTEM AND FEMALE LABOR PARTICIPATION

LE ANH XUAN

2013

National Graduate Institute for Policy Studies

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GOVERNMENT FINANCING IN JAPAN:
POPULATION AGING, TAX SYSTEM AND
FEMALE LABOR PARTICIPATION

A Dissertation

Submitted to the Faculty of the National Graduate Institute for Policy Studies (GRIPS)

in Partial Fulfillment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY IN PUBLIC ECONOMICS

by

Le Anh Xuan

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To Mom and Dad

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Le Anh Xuan

Tokyo, Japan | August, 2013

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EXECUTIVE SUMMARY

This dissertation aims to tackle the government financing challenges for Japan. The study is timely and important as Japan has been facing many challenges in recent years such as population aging, shrinking workforce, high public debt, persistent deflation and stagnation. The dissertation starts with a brief overview of the current challenges (Chapter 1). We focus on three key challenges: population aging, weak fiscal health and the shrinking workforce (with low female labor participation).

In Chapter 2, we assess the cost of population aging for Japan in terms of the tax burden to finance an increase in social security benefit spending, which is caused by the growing number of elderly people in Japan. For that purpose, we construct a life-cycle model with stochastic aging style to capture the structural changes in the Japanese demography. The model also incorporates a pay-as-you-go social security system to mimic the current system in Japan. We then calculate the total government expenditures, including general expenditures and the social security benefit payments, and compare them with the tax and social security premium revenues. The deficit from this budget balancing will be financed by one form of taxation. We do several experiments to find the best financing option for Japan by comparing the social welfare gained from each policy option. We use the Consumption Equivalent Variation method to do the welfare comparisons. Our study shows that under the coming demographic shift, Japan has three options in 2050: (i) increase the labor income tax by 20 percentage points, (ii) increase the consumption tax rate from 5 percent to nearly 28 percent, or (iii) reduce social security benefit from 50 percent recently to 5 percent. Moreover, among the several options for the tax reform, we suggest that financing by increasing the consumption tax is better than using the labor income tax or cutting social security benefit as financing by the consumption tax returns the highest welfare for the society.

To alleviate an extreme tax hike to balance the budget, we propose a reform in the Japanese tax system to encourage female labor participation. A number of empirical studies have pointed out many reasons explaining the low female labor participation in Japan. Among others, the tax system and childcare are revealed as the most crucial factors.

In Chapter 3, we employ a standard neo-classical model with two representative households, which are differentiated by the wives' education level: normal education level and high education level, to investigate the impact of the tax system on females' working decisions, on the aggregate labor supply as well as on the whole economy. We first examine the tax system and identify four income thresholds, which are generated by the tax system, for married Japanese women. We then incorporate all of these thresholds in our model. Among these thresholds, 1.03 million yen has been pointed out as the most significant threshold by many empirical studies because if a wife's annual income is equal to or below the threshold, she does not have to pay income tax and social security premiums, and her husband is entitled to a total spousal deduction of 380 thousand yen. Consistent with the empirical results, our study shows that the current tax system creates disincentives to work for married Japanese women. Quantitatively, removing the spousal deduction policy could increase aggregate labor and output by 4.11%. Furthermore, if the Japanese government removes all of the income thresholds, the aggregate labor supply will increase by 7.52%, and it will boost the output by almost the same level.

In Chapter 4, we abridge the tax system and extend our previous model in Chapter 3 by adding the childcare cost because it is also a crucial reason for the low female labor participation in Japan. The model is then calibrated to represent the Japanese economy in 2004. We look not just at the childcare burden on the female's working decision but also find methods to finance the childcare system. We perform a number of policy experiments to reform the current childcare system in Japan. The study shows four important findings.

First, reforming the tax system by removing all of the income thresholds could boost the economy by 4.78% and reduce the labor income tax rate by 8 percentage points; second, without any reform of the tax system, subsidizing more on childcare expenditures has a very limited impact on the economy; third, reform of both the tax system and childcare subsidies could return a significant improvement on Japan's aggregate labor and output. Finally, the key message from the study is that the effectiveness of childcare subsidies is much higher if the Japanese government could reform its tax system. Thus, the first effort to encourage female labor participation should be dedicated to reform the tax system.

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CHAPTER 1 .

An Overview on the Key Challenges facing Japan: Aging Population, Poor Fiscal Health and Low Female Labor force Participation

Abstract.

As Japan faces the problem of aging population, the government expenses on social security benefit is expected to increase sharply in coming years while shrinking working-age population causes lower tax revenues. Thus, the nation's government public financing situation seems not to be sustainable in the future. In this chapter, we provide an overview on the three issues: i) aging population, ii) public finance situation, and iii) labor market, particularly, female labor participation because it is important in order to deal with the financing problem. Subsequently, we state our research objectives, research questions and set up our research framework for the study. Finally, we make mention of the significance of the study to the related literature.

1 Introduction

Japan has never faced as many difficult challenges in public finance as in recent years. In 2009, total government expenditure was 101 trillion yen while the tax revenue was only 38.7 trillion yen; consequently, the government budget deficit was more than 60 trillion yen. In order to cover the deficit, the government has been issuing special deficit financing bonds. According to Sugimoto (2012), the outstanding national debt amounted to 637 trillion yen at the end of FY2010, and this amount corresponded to 17 times the size of the annual tax receipts of the General Account Budget, which was 37.4 trillion yen in the same fiscal year. Therefore, Japan is at the worst level in the world in the context of fiscal deficit and public debt (both in terms of gross debt outstanding to GDP, almost 240% and net debt balance to GDP, more than 130%).

In addition, Japan is now facing a dramatically shrinking labor force and aging population, which creates huge pressures on government expenditure on social security benefits. The social security expenditure account for almost 30% of total government expenditures and are expected to increase rapidly in the near future with the aging population.

The question here is how can Japanese government finance their expenditure in order to have fiscal stability in the long run? Therefore, this dissertation aims to tackle the government financing problem in Japan. We first need to identify more clearly the challenges facing the economy in order to have suitable reform policies. In fact, there are several challenges that Japan has been facing recently such as aging population, weak fiscal health, shrinking workforce and economic stagnation (i.e., low growth rate together with a persistent deflation or low inflation rate). All of these are inter-connected and largely caused by the aging population.

2 Aging Population

The World Population Prospects: The 2012 Revision, released by the United Nations (2013), shows the past, current and projected situation of the demographic change in the world up to the year 2100. According to this report, Japan's population of 127.353 million in 2010 (its peak) is projected to decrease by approximately 20 million people within the next 40 years, dropping to 108.329 million in 2050, and to further decrease to 84.471 million in 2100 (see Figure 1-1)[1].

Total fertility, the number of children per woman, in Japan has been below 2.0 more than three decades ago and currently stay at 1.39 in 2012 (Figure 1-1). Given the significant improvements in healthcare services and technology, Japan has a high life expectancy of almost 83 years old (in 2012, Figure 1-1). The low birth rate together with the high life expectancy has resulted in the substantial rise in the population above 65 years of age. Data from the Japanese Statistic Bureau showed that in 2011, the old aged (65+) population marked a record high of 29.75 million, accounting for 23.3 percent of the total population. The proportion of old aged population was only 7.1 percent in 1970 and doubled in scale to 14.1 percent in 1994, and is projected to be nearly 40% in 2050. These numbers clearly show the rapid aging in Japan.

Besides the aging population, a decreasing trend of the working aged population (15-64 years) should also be noticed. The working aged population achieved its peak in 1995 with about 87 million people, declined to 81.34 million in 2011 (accounted for 63.7 percent of the entire population), and is projected to be 55 million in 2050 (less than 50% of the entire population).

Finally, the Japanese child population (0-14 years) has maintained a declining trend for an extended period, and is projected to continue in the future. In 2011,

[1] The data are medium-variant projection.

there were 16.71 million in this cohort, accounting for 13.1 percent of the total population.

From a macroeconomic point of view, an aging population possibly creates many economic consequences from both the supply side and the demand side. On one hand, the aging population with the low fertility rate will result in a smaller labor force. On the other hand, the aging population will change the consumption and saving behavior of the households. In addition, the aging population will also create social security expense pressure on the government's fiscal budget. At this point, the question for the Japanese government is how to finance the increase in social security expenses.

3 Japanese Fiscal Health

Japan's fiscal health over the 1975-2013 is shown in figure 1-2. As can be seen there is an increasing trend in both the government's total expenditures as well as tax revenues from 1975 to 1990. The government's budget deficit in this period was small and quite stable at about 10 trillion yen per year. However, from that point onward the government's fiscal budget has been very precarious. The tax revenues have been trending down while total expenditure has been rising. The government budget deficit was about 10 trillion yen at the beginning of 1990s and jumped to 38.6 trillion yen at the end of the decade. The deficit became worse during the global financial crisis period and achieved its peak in 2009 at 62.3 trillion yen as the total expenditures were 101 trillion yen and the tax revenues were only 38.7 trillion yen in the same year. Remarkably, the deficit has been financed by "Special deficit financing bonds" for last two decades. The total amount of the special deficit bonds issued in 2013 was 37.1 trillion yen. In late 2009, when the Eurozone sovereign-debt crisis started in Greece and then spread in the Eurozone area, many people thought that the fiscal health of the Eurozone should be the worst in the world. However, the

Eurozone was not at the worst level in the world in the context of fiscal deficit and public debt. Japan is at that bottom, both in terms of gross debt outstanding to GDP (almost 240%) and net debt balance to GDP (more than 130%) (see Figure 1-3). Fortunately, the majority segment of the public debt is in the hands of domestic investors.

Looking at the Japanese government expenditure, there is a considerable increase in social security spending, in term of both value (approximately 30 trillion yen) and its share (about 30%) (see Figure 1-4 and 1-5). The social security spending as a share of overall government expenses has increased 10 percentage points within the last 10 years, from 20 % in 2000 to 30% in 2010. This increase could be considered as the most serious impact of the nation's rapidly aging population.

Looking at the share of tax revenue, the shares of the individual income tax and the corporate income tax have been decreased since 1992 to 2000, and the shares of the individual income tax has been quite stable at 20% recent years. Since the early 1990s, the share of the consumption tax in the total tax revenue has been increased and staying around 20% as can be seen in Figure 1-6.

In short, as a consequence of the aging population, the Japanese government's spending on social security benefits is expected to rise in the future. This issue together with high government debt and the huge budget deficit recently has forced the Japanese government to take more action and consider reform on the tax and social security system in order to ensure a sustainability fiscal position in the long run.

4 Female Labor Participation

Many industrialized economies are now facing a decline in their labor force due to aging and a shrinking population; in order to deal with this problem, these

governments have three options: extending the retirement age, relaxing immigration policies or increasing female labor participation. The first two options are quite controversial; the last one, in contrast, contains many advantages and is the most feasible and attainable.

Briefly taking a look at the current situation of the Japanese female labor participation (JLP), according to OECD (2008), only 67.4% of Japanese working-age (25-54 years old) women have a job. In addition, Japanese women are the third most educated among OECD countries. Data in 2005 show that 42.5% of them completed tertiary education compared with an average of 28.5% in the OECD countries. Therefore, the OECD claims that this represents a "considerable waste of valuable human resources".

From an economic point of view, increasing female employment could be a crucial boost to the economy. Firstly, the higher labor input will increase the economic growth rate since labor is one of the key determinants for economic growth. Secondly, increased female participation will contribute towards tax revenues and will reduce the social security spending burden for the Japanese government. Therefore, the nation's fiscal health will become stronger and more sustainable.

Kathy Matsui *et al.* (2010), in one comprehensive report titled "Womenomics 3.0", reported that 70%of Japanese women quit their jobs and only 65% of college-educated women were employed in 2010. They also estimate that if Japan could bring the female labor participation rate to the male level, this will add 8.2 million more workers in the nation's labor force. More importantly, the increased number of women in the workforce can boost Japan's GDP level up to 15%. That significant impact leads the author of the report to state that "Womenomics should become a national priority".

Empirically, Steinberg and Nakane (2012) estimate the scenario in which Japan's female labor participation rate is equal to that of the G7 economies (excluding Italy and Japan).Their estimation shows that GDP per capita could be permanently higher by approximately 4 percent.

Recently, İmrohoroğlu, Kitao and Yamada (2013) use micro-data for a large-scale overlapping generation model that incorporates rich heterogeneities (age, gender, working status, income and asset holding) and carry out an accounting exercise to calculate projections for Japanese government expenditures and revenues in the next 50 years. Remarkably, after many experiments, they found that increasing female labor force participation is the best way to achieve fiscal balance in Japan.

5 Research Questions and its Framework

This study aims to answer the following questions:

Given the aging population and the increase in social security spending, how serious is the government financing problem in Japan? And how should Japan finance their budget in the future (by alternative tax schemes)? These questions will be answered in Chapter 2.

To alleviate an extreme tax hike to balance the government budget, we propose a reform to encourage female labor participation as we expect that the higher female labor participation will lead to a higher number of tax and social security premium payers or contributors. So, how can the Japanese government encourage women to go to work? We try to answer this question from two dimensions: the tax and childcare issues as these factors are the most crucial in restraining women from going to work.

In Chapter 3, the role of tax is considered in greater detail. We investigate if there are any tax disincentives to work for Japanese women? If there are some,

what is the magnitude of the tax and social security distortion on the female labor supply and on the whole economy quantitatively?

In Chapter 4, we ask: what is the role of childcare on determining the female labor supply? We attempt to investigate whether the Japanese government should subsidize childcare expenditures more and what the economic consequences of the subsidies are.

Figure 1-7 presents our research framework for this study. We touch on three main issues in Japan: (i) aging population, (ii) the tax and social security system; and (iii) female labor participation. The study starts by measuring the impact of the aging population in terms of the tax burden and finding the best way to achieve sustainable fiscal balance in the next 40 years in Japan. Next, we try to improve the Japanese female labor participation in order to reduce the impact of the aging population by reforming the tax and social security system. Finally, we examine the impacts of childcare on determining female employment and thereby, on the whole economy.

For that purpose, we use a macroeconomic modeling approach. In Chapter 2, we employ the heterogeneous agent model with stochastic aging and dying characteristics. For chapter 3 and 4, we use a representative agent model.

6 Significance of the Study

This study adds to the existing literature that uses a macroeconomic approach to analyze the Japanese economy, its public finance and female labor participation. The existing literature only concentrates on describing the behavior of aggregate variables such as the capital to output ratio, saving rate or real interest rate (Hayashi and Prescott, 2002, Chen *et al.*, 2006, 2007). Some other scholars incorporate demographic shifts in Japan into their models to see the impact of population aging on the economy (Braun, Ikeda and Joines, 2009;

Ikeda and Saito, 2012). However, their focus is on the Japanese saving rate. The others consider the long term public finance situation in Japan. These studies focus more on solving the high public debt problem for Japanese government (İmrohoroğlu and Sudo, 2011a, 2011b; Hansen and İmrohoroğlu, 2012). Their limitation is that the social security expense is exogenous in their models. We use a macroeconomic approach, incorporating the demographic changes in Japan, to study the stability of public finance in the future for the Japanese government. We find that under the coming demographic shift, Japan has three options in 2050: (i) increase the labor income tax by 20 percentage points, (ii) increase the consumption tax rate from 5 percent to nearly 28 percent, or (iii) reducing social security benefits from 50 percent recently to 5 percent. Moreover, among several options for the tax reform, we suggest that financing by increasing the consumption tax is better than using the labor income tax or cutting the social security benefit as financing by the consumption tax creates lowest welfare lost for the society.

Also, another significance of the study is to examine another possibility of financing for Japanese public expenditure to alleviate an extreme tax hike to balance the budget as shown above. We propose a reform to encourage female labor participation in Japan. A number of empirical studies have pointed out many reasons for the low female labor participation in Japan. Among others, Akabayashi (2006), Takahashi, Kawade and Kato (2009) and Takahashi (2010) statistically observe the determinant role of the tax system on the Japanese women's working decision. However, the impacts of the tax system have not been aggregated on the economy as a whole. In addition, childcare might be another crucial reason for the low female labor participation in Japan as it is observed in many developed economies (Connelly, 1992; Duncan *et al.*, 2001, Choné, Leblanc and Robert-Bobée, 2003, Haan and Wrohlich, 2011). However, the empirical results for Japan are diverse (Komamura, 1996; Niimi, 2002; Oishi, 2002). Therefore, a study to understand deeper the mechanism of the impacts is

important. For that purpose, we employ a macroeconomic approach to model the Japanese economy, its tax system and childcare cost to investigate the impact of these factors on women's working decision as well as on the whole economy. We find that (i) the tax system does have an impact on the low educated women cohort; (ii) reforming the tax system can boost the economy by 4.78% and reduce the labor income tax rate by 8 percentage points; (iii) without any reform of the tax system, providing more subsidies on childcare expenditures has a very limited impact on the economy; (iv) reform of both the tax system and childcare subsidies could result in a significant improvement in Japan's aggregate labor and output. The key message from this study is that the effectiveness of childcare subsidies is much higher if Japan could reform her tax system. So, the first effort to encourage female labor participation should be dedicated to reforming the tax system.

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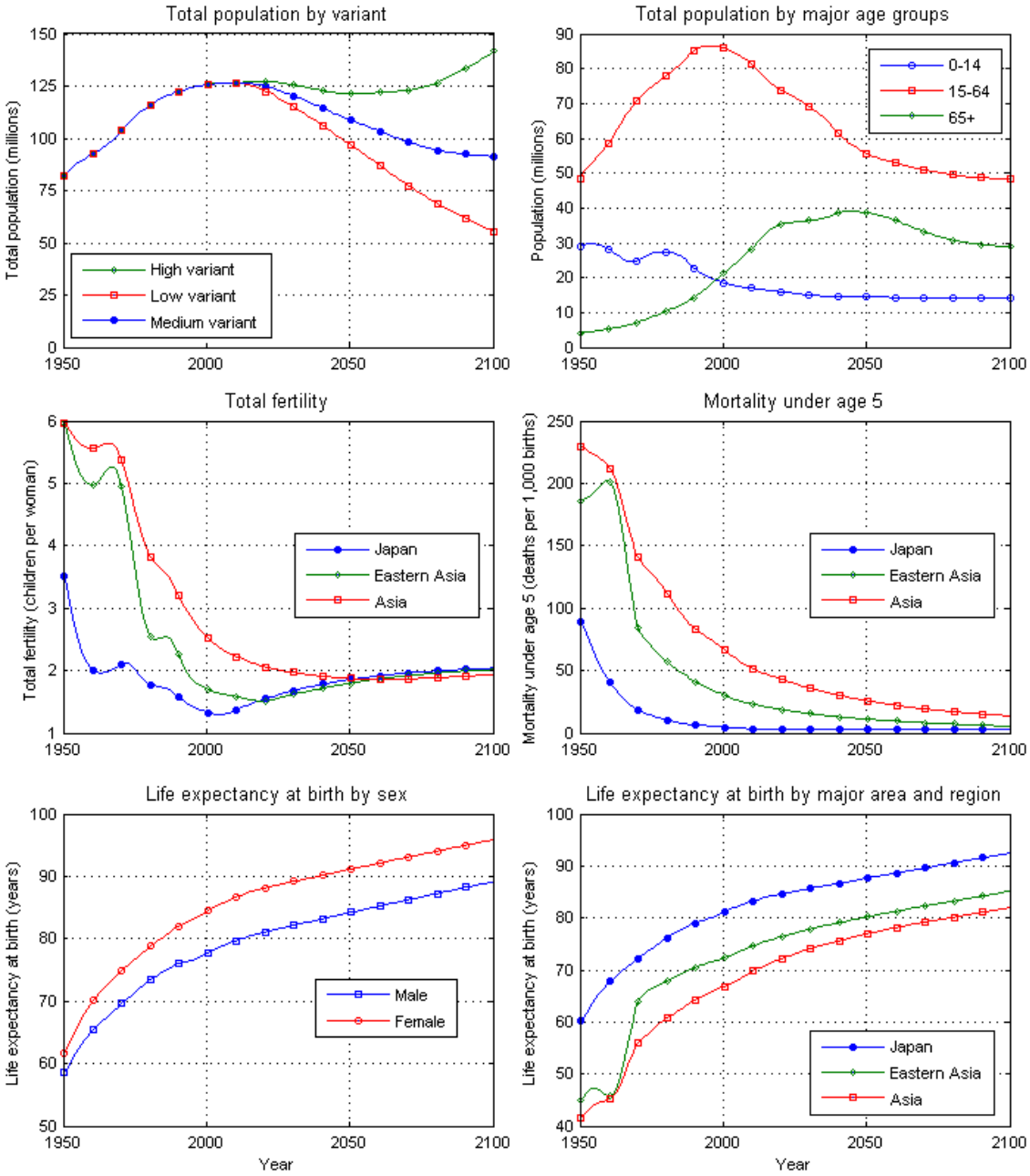
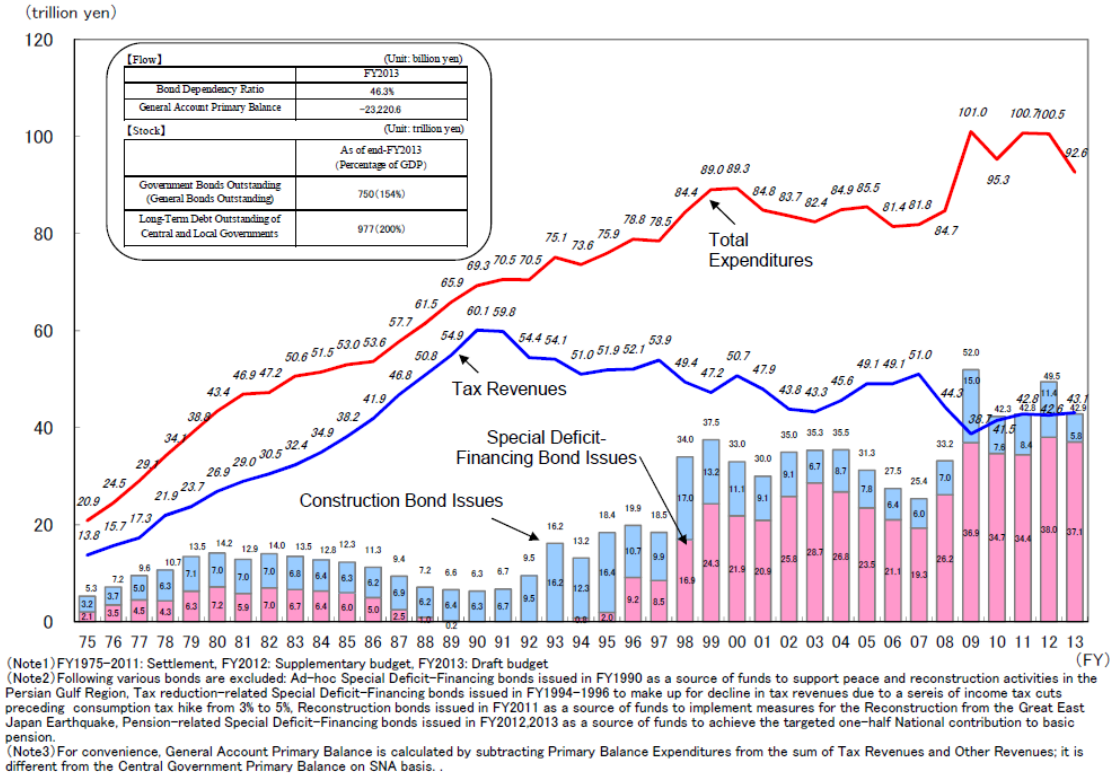
Figures

Figure 1-1. The Population of Japan



Source: United Nations (2012). The World Population Prospects: 2012 Revision.

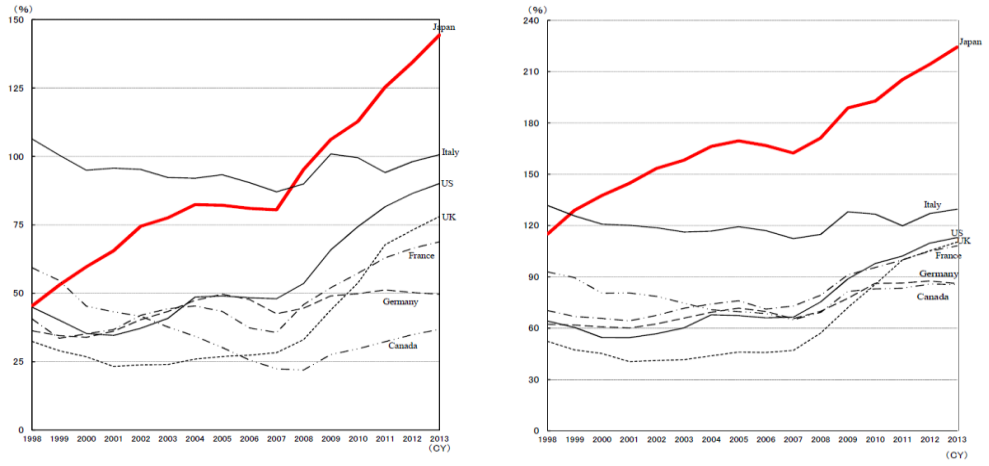
Figure 1-2. Japanese Fiscal Health



(Note1) FY1975–2011: Settlement, FY2012: Supplementary budget, FY2013: Draft budget
(Note2) Following various bonds are excluded: Ad-hoc Special Deficit-Financing bonds issued in FY1990 as a source of funds to support peace and reconstruction activities in the Persian Gulf Region, Tax reduction-related Special Deficit-Financing bonds issued in FY1994–1996 to make up for decline in tax revenues due to a sereis of income tax cuts preceding consumption tax hike from 3% to 5%, Reconstruction bonds issued in FY2011 as a source of funds to implement measures for the Reconstruction from the Great East Japan Earthquake, Pension-related Special Deficit-Financing bonds issued in FY2012,2013 as a source of funds to achieve the targeted one-half National contribution to basic pension.
(Note3) For convenience, General Account Primary Balance is calculated by subtracting Primary Balance Expenditures from the sum of Tax Revenues and Other Revenues; it is different from the Central Government Primary Balance on SNA basis. .

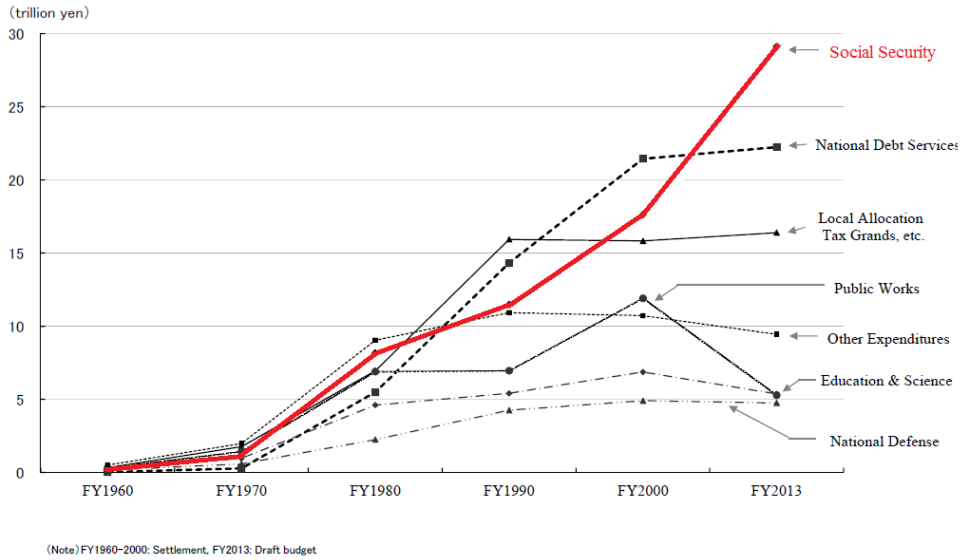
Source: Ministry of Finance, Japan, 2013a.

Figure 1-3. General Government Debt: Net (Left) vs. Gross (Right)



Source: Ministry of Finance, Japan, 2013a.

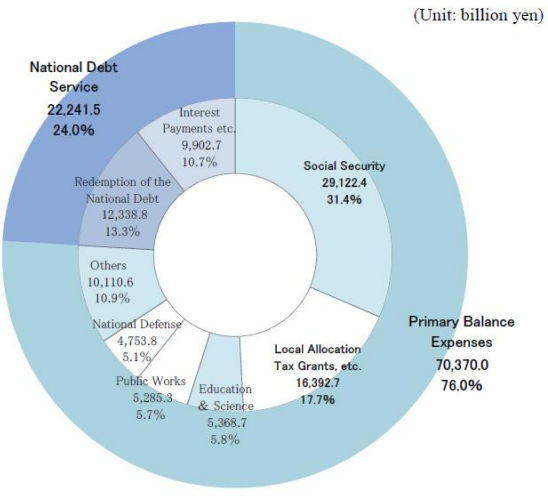
Figure 1-4. Main Expenditure Trends



Note: The baby boom generations (born in 1947–49) started retiring in 2007.

Source: Ministry of Finance, Japan, 2013a.

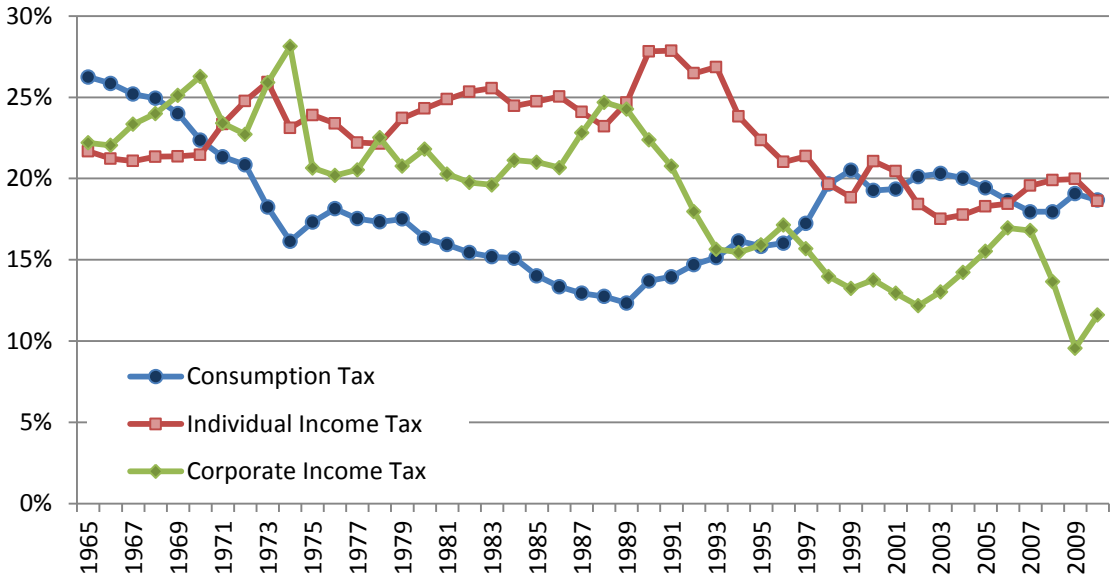
Figure 1-5. The 2013 Japanese Government Tentative Budget Plan



(Note1) Figures may not add up to the totals due to rounding.
(Note2) The ratio of Social Security expenses to General Expenditures*: 54.0%
*General Expenditures equals to the Primary Balance Expenditure minus Local Allocation Tax Grants, etc.

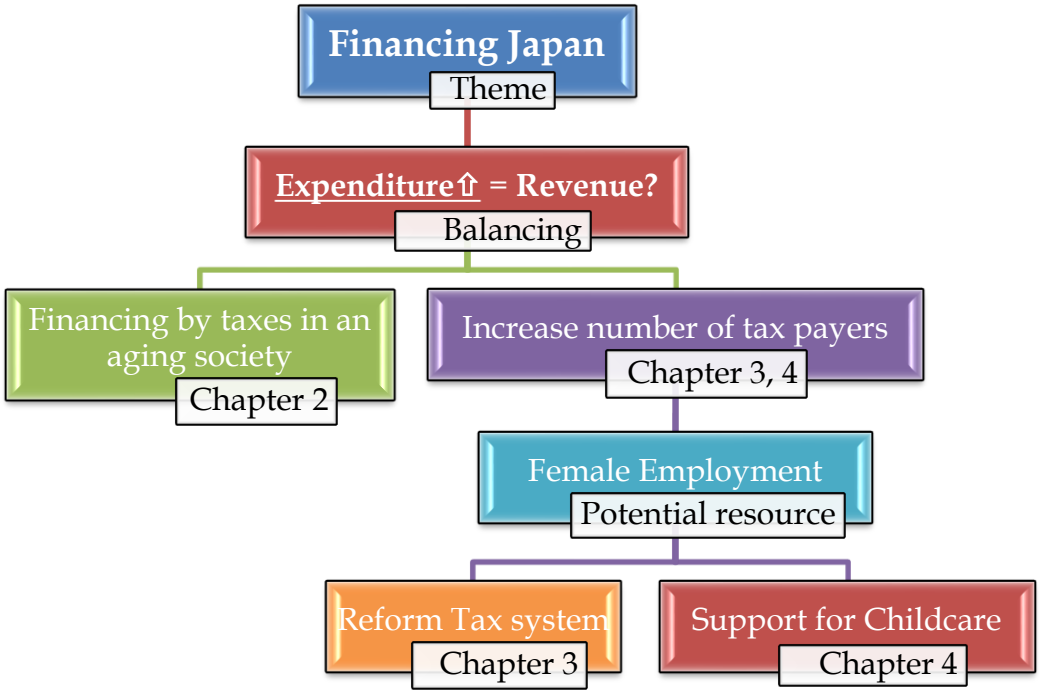
Source: Ministry of Finance, 2013b.

Figure 1-6. Tax Revenue Decomposition (Share in overall tax revenue)



Source: OECD database, 2013.

Figure 1-7. The Study Framework



CHAPTER 2 .
Financing Japan: The Challenge of an Aging Population

Abstract.

This chapter aims to investigate the cost of the aging population in Japan. We employ a heterogeneous agent model with stochastic aging and dying to calculate the sufficient tax rate to balance Japanese government's budget in the future. We find that under the coming demographic shift, Japan has three options in 2050: (i) add 20 percentage points to the current labor income tax rate, (ii) increase the consumption tax rate from 5 percent to roughly 28 percent, or (iii) reduce the social security benefit from 50 percent to 5 percent. In addition, among the several options for the tax reform, we find evidence to suggest that financing by increasing the consumption tax is better than using the labor income tax or cutting the social security benefits in terms of minimizing welfare lost.

1 Introduction

The public finance situation in Japan is seriously impaired due to four key reasons. First, Japan has the worst fiscal deficit and public debt in the world, both in terms of gross debt outstanding to GDP (almost 240%) and net debt balance to GDP (more than 130%). Second, as found in Hayashi and Prescott (2002), Japan has been suffering from a low productivity (TFP) growth rate during the 1990s - the lost decade -, and the TFP growth rate is still low. Third, the country is now facing a dramatically shrinking and aging population, and therefore, the Japanese government expenditure for social security is expected to increase rapidly. Last but not least, due to the massive effects of the 11 March 2011 Tohoku Earthquake, the Japanese government requires about 23 trillion yen in the next 10 years for recovery efforts in Fukushima, Miyagi, Iwate and Tochigi prefectures and other affected areas. A "Road to Recovery" [2] was developed and shown clearly; however, financing the government budget has been challenging.

Looking at the decomposition of the Japanese government expenditure (see Figure 2-1), the government's general expenditure, which include national defense, education, public works and some other subsidies, have declined steadily from 85% in 1965 to 60% recently. Interest payment expenses have also declined sharply since the mid-1980s and are around 10% of government expenditure. In contrast, we clearly see an increasing trend in the expenses related to social security benefits. The expenses were quite stable from 1970 to 2000 and accounted for less than 20% of government expenditure. The share however has been increasing sharply since 2000 and accounted for almost 30% of government expenditure in 2012.

[2] See The Japan's Cabinet Office of Japan (June 24, 2011). "Road to Recovery".

As mentioned in the previous chapter, Japan's population is projected to decrease from 127 million to 108 million in 2050. In addition, the proportion of elderly population was 15% in 2000, 25% in 2010 and is projected to be roughly 40% in 2050 (see Figure 2-2). This coming demographic change puts high pressure on the public finance situation in Japan as government expenses related to the elderly population is expected to increase dramatically. Given the increasing trend of government expenditure, the question is how can the Japanese government finance such a large budget in the future?

In this study, we follow Jeske and Kitao (2009) and Hsu and Lee (2010) to build an overlapping generation model with stochastic aging and dying characteristics. This version of the overlapping generation model enables us to calculate the fractions of young and elderly population in the economy. Accordingly, we can endogenize social security expenses paid by the government. The model is then calibrated to match the economy in the period 1990-2000[3] as a benchmark for further quantitative analyses. Afterwards, we perform a number of policy experiments to examine alternative financing methods for sustaining the Japanese government budget for the next 40 years. We find that given the demographic changes, Japan has three options in 2050: (i) add 20 percentage points to the current labor income tax rate, (ii) increase the consumption tax rate from 5 percent to roughly 28 percent, or (iii) reduce the social security benefits from 50 percent to 5 percent of the wage rate. In addition, our study suggests that financing by consumption tax is better than the other financing schemes in terms of minimizing welfare lost.

The chapter is subsequently organized as follow: In Section 2, we proceed to briefly review the literature on the Japanese growth model and Japanese government financing. Section 3 will describe the Japanese economy by

[3] We choose this study period since the GDP growth rate and population growth rate in this period are quite stable.

modeling the problem of three sectors: households, firms and government. We do a calibration in Section 4. In Section 5 of the paper, we compute the cost of the aging population in terms of the tax burden. In Section 6, we run our policy experiments to consider different financing schemes. To select the best policy, we do a welfare comparison in Section 7. Finally, Section 8 concludes.

2 Literature Review

Taking a step back to review the literature, we find that there are two strands of literature related to this study[4]: (i) using a macroeconomic approach to replicate the behavior of macroeconomic variables, and (ii) examining the public finance situation for Japanese government.

In the first strand, Hayashi and Prescott (2002) show that the actual time series behavior of aggregate quantities in the 1990s in Japan can be predicted. They successfully replicate the performance of the Japanese capital-to-output ratio and also point out that the key determinant of their study period is the low TFP growth rate. Later on, Chen *et al.* (2006) also successfully describes the performance of the Japanese saving rate between 1956 and 2000.

In an effort to enrich the literature, some economists incorporate the demographic changes in Japan into their model. Chen *et al.* (2007) use an overlapping generation model with demographic factors (survival probability and population growth rate) to redraw the Japanese saving rate. The impacts of the demographic changes on the saving rate are quite small compared with the

[4] In addition to these cited theoretical studies, empirical studies have also highlighted the impact of an aging population on the economy. Japan is taken as the typical case for economists to examine the impact of an aging population. For example, Yashiro (1997) shows the impact of an aging society on saving and investment of Japan. He observes that the negative effects of an aging population can be reduced by stimulating labor-augmenting technological change and extending the retirement age. In addition, Faruqee (2000, 2003) shows that change in demographics can lead to economic impacts through both the supply side (i.e., work force structure) and the demand side (i.e., saving and consumption behavior of individual and household).

TFP growth rate. In contrast, Braun, Ikeda and Joines (2009) find that lower fertility rates and population aging are important determinants of the Japanese saving rate. Quantitatively, they find that the demographic factors account for 2 to 3 percentage points of the 9% decline in the saving rate between 1990 and 2000, and it is expected to contribute to a persistent low saving rate in the future. More recently, Ikeda and Saito (2012) confirm the important role of the demographic changes on the Japanese real interest rate in an overlapping generation model, where demographic factors are represented by the proportion of the working age population.

The other strand of the literature examines fiscal stability for Japan. Among others, İmrohoroğlu and Sudo (2011a, 2011b), Hansen and İmrohoroğlu (2012) are closely related to our study. They all follow Hayashi and Prescott (2002) in using a standard growth model to study fiscal stability in Japan from long run perspectives. Their focus is to solve the high public debt problem in Japan in order to achieve fiscal stability in the future. İmrohoroğlu and Sudo (2011b) show that a TFP growth rate of 6% per year is necessary to eliminate the nation's public debt by 2050. Checking other financing schemes, İmrohoroğlu and Sudo (2011a) consider a combination of a 15% consumption tax and a constant annual GDP growth rate of 3% over the next 20 years as the best financing scenario for the Japanese government. This combination however still cannot turn the government budget into a surplus. Hansen and İmrohoroğlu (2012) find that an additional 30 percentage points are needed either in the consumption tax rate or labor income tax rate to balance the budget in the future. In addition, they suggest that the consumption tax is a better financing method as it causes less welfare loss.

Their studies however have some limitations. First, the inelastic labor supply prevents İmrohoroğlu and Sudo (2011a, 2011b) from capturing the shrinking workforce in Japan. Second, social security expenses and government

expenditures are exogenous in their studies. Therefore, they cannot capture the increase in social security benefit expenses. Finally and most importantly, their model cannot capture the structural changes in Japanese demographics.[5] This is a crucial factor when analyzing the Japanese economy, particularly its public finance. Our study deals with all of these issues in a systematic way.

3 The Model

Let us describe our model in detail: demographics, agents' problem and the general equilibrium.

3.1 Demographics

We follow Jeske and Kitao (2009), and Hsu and Lee (2010) in modeling the demographics of the population. The model is an extension of the overlapping generation model and incorporates stochastic demographic changes, namely, ageing and dying. The economy is populated by a continuum of finitely-lived agents, measured as one. All agents are either young or old.

Young agents supply labor, earn wage income and retire with the probability ρ_o in every period of time. They retire from the labor market to become old agents. They receive social security benefits from the government until they die with the probability ρ_d.

We assume that the size of the population remains constant over time. Therefore, an old agent who dies is replaced by a new young agent.

There are four theoretical implications from our model.

[5] They do consider the number of working age population in their model. However, this factor cannot help them to capture the structural changes of Japanese demographics as well as its impact on government expenditures.

First, on average, young agents work for $1/\rho_o$ years and old agents live for $1/\rho_d$ years after their retirement.

Second, the set-up of the model generates a fraction of young agents, $\rho_d/(\rho_o + \rho_d)$ and a fraction of old agents, $\rho_o/(\rho_o + \rho_d)$ in the economy.

Third, the old to young ratio is ρ_o/ρ_d.

Finally, to simplify the model, we assume that each new entrance agent enters the economy with zero assets and all bequests from agents who died will be collected by the government and redistributed to the society via a lump-sum transfer. We further assume that there is no insurance market in the economy.

3.2 Preferences

We employ a standard *log*-utility function of an agent with consumption and leisure.

$$U(c_t, h_t) = log(c_t) + \alpha log(T - h_t), \tag{1}$$

where α is the preference parameter in the utility function between consumption (c_t) and leisure. T is the constant endowment of time and h_t is the labor supply.

3.3 Social Security System

The social security system applied in this study follows a simple pay-as-you-go system. This means, a proportional social security premium, τ_{ss} , is imposed for all working agents based on their labor income. The premium is fixed at a constant rate and applied for all regardless of their income level.

Once the social security contributor reaches her retirement age, she can start to receive social security benefits, ss_t, which are calculated as a fraction of the current wage rate.

3.3 Individuals' Problem

Young Agent's problem

As described above, a young agent spends income obtained from holding asset returns and wages into two components: consumption and asset. The young agent's problem is now choosing $c_{y,t}, a_{y,t+1}, h_{y,t}$ to maximize value function:

$$V(s) = \max_{c_{y,t},\, a_{y,t+1},\, h_{y,t}} \Big\{ U\big(c_{y,t}, h_{y,t}\big) + \beta \Big(\big(1-\rho_{o,t}\big) E[V(s')] + \big(\rho_{o,t}\big) E[V_o(s')] \Big) \Big\} \tag{2}$$

subject to budget constraint:

$$\begin{aligned} \big(1+\tau_{c,t}\big)c_{y,t} + a_{y,t+1} &= \big(1+\big(1-\tau_{k,t}\big)r_t\big)a_{y,t} + \big(1-\tau_{h,t}-\tau_{ss,t}\big)\omega_t h_{y,t} \\ &\quad + \xi_t \end{aligned} \tag{3}$$

$$a_{y,t+1} \geq 0, \tag{4}$$

$$T > h_t \geq 0, \tag{5}$$

where (s) is a state vector summarizing all the state variables, and ξ is a lump-sum transfer/tax. β is the subjective discount factor.

Old Agent's problem:

An old agent does not supply labor after her retirement. She gets the assets' returns and social security benefits and spends on consumption and asset holding.

An old agent's problem is choosing $c_{o,t}, a_{o,t+1}$ to maximize the value function:

$$V_o(s) = \max_{c_{o,t}, a_{o,t+1}} \{U(c_{o,t}, 0) + \beta(1 - \rho_{d,t})E[V_o(s')]\} \quad (6)$$

subject to budget constraint:

$$(1 + \tau_{c,t})c_{o,t} + a_{o,t+1} = (1 + (1 - \tau_{k,t})r_t)a_{o,t} + ss_t + \xi_t, \quad (7)$$

$$a_{o,t+1} \geq 0, \quad (8)$$

where (ss_t) is the social security benefits.

3.4 Production Technology

We use a standard Cobb-Douglass aggregate production function with constant return to scale property:

$$Y_t = A_t K_t^{\theta} H_t^{1-\theta}, \quad (9)$$

where θ is the income share of capital and the A_t is the total factor productivity (TFP). The firm rents capital with rental rate (r_t) and applies the depreciation rate (δ_t). In addition, they hire labor with a wage rate of (ω_t). Given a perfect competitive market, thus, they rent the input factors at the marginal productivity of the factor.

$$\omega_t = (1 - \theta)A_t \left(\frac{K_t}{H_t}\right)^{\theta}, \quad (10)$$

$$r_t = \theta A_t \left(\frac{K_t}{H_t}\right)^{\theta-1}, \tag{11}$$

3.5 Government

Expenditures

We decompose total government expenditures into three components. The first item is total general purchases, which contain many kinds of expenses such as government officers' salaries and investment on public works. The second item is the interest rate and redemption of the government bonds. This component refers to the "National Debt Service" of the Japanese government. In this study, we treat these two components exogenously. However, the last item, which is social security expense, is treated as an endogenous variable in order to capture the increase in social security spending associated with the aging population.

Revenues

The government revenues come from five different forms of taxes: Labor Income tax ($\tau_{h,t}$), Capital Income tax ($\tau_{k,t}$), Consumption tax ($\tau_{c,t}$) and social security tax ($\tau_{ss,t}$); and issuing Bond (B_t) and Lump-sum Transfer (ξ_t). These forms of taxes have different impacts on the model. For example, the labor income tax just affects the young agent, whereas the consumption and capital income taxes affect all agents. Lump-sum transfers adjust the fiscal surplus or deficit and help the government balance its budget.

Budget Balance

The government balance can be written as follows:

$$G_t + ss_t\left(\frac{\rho_{o,t}}{\rho_{d,t}+\rho_{o,t}}\right) + (1+i_{t-1})B_{t-1} = \left(\tau_{h,t} + \tau_{ss,t}\right)\omega_t H_t + \tag{12}$$

$$\tau_{k,t}(r_t - \delta_t)K_t + \tau_{c,t}C_t + B_t + beq_t + \xi_t,$$

where G_t is the total government consumption, $ss_t\left(\rho_{o,t}\ /\left(\rho_{d,t} + \rho_{o,t}\right)\right)$ is the total social security expenses, which are the costs related to pension, health care and long term care expenditures, ss_t is the social security benefits paid by the government to each retired person. Note that $\rho_{o,t}\ /\left(\rho_{d,t} + \rho_{o,t}\right)$ is the number of population age 65 and over in Japan. beq_t is the bequest from the old agent when he/she dies. In addition, the government issues one period bond and pays interest rate (i_t). The bonds can be held by either young or old agents.

3.6 Stationary Competitive Equilibrium

We now define the stationary competitive equilibrium for the economy. A perfect competitive equilibrium consists of household decisions with regards to consumption, asset holding and labor supply - c, a', h respectively, a set of firm decision rules on rented capital K and effective labor, H, a set of prices, wage, ω and capital rental, r, a set of government fiscal policies: labor income tax, social security tax, capital tax, consumption tax, lump-sum tax and Bond $\tau_h, \tau_{ss}, \tau_k, \tau_c, \xi, B$ respectively and finally, a distribution of household over state variables $\Phi(s)$ such that:

- given the set of prices, the firm maximizes its profit;
- give the set of prices, fiscal policy package, the household maximizes its lifetime utility function;
- the government budget is balanced;
- the distribution of household over state variables $\Phi(s)$ is stationary;
- all markets are clear. $H = \int(h)d\Phi(s)$ and $K + B = \int(a + beq)d\Phi(s)$;
- the economy resource constraint for the close economy is satisfied:

$$Y_t = C_t + G_t + I_t, \tag{13}$$

where I_t is the economy's investment, which follows the following capital law of motion: $K_{t+1} = (1 - \delta_t)K_t + I_t$ where $0 \leq \delta_t \leq 1$.

4 Calibration

We now calibrate our model in order to match with the Japanese economy in 1990- 2000. The data are provided by Hayashi and Prescott (2002) and Chen *et al*. (2007). The model parameters are reported in table 2-1 as explained below.

4.1 Capital Share, TFP and Depreciation Rate

We follow Hayashi and Prescott (2002) and Chen *et al*. (2006, 2007) to set the capital share to 0.362 and the depreciation rate δ to 0.083. We normalize the TFP to 1 for the benchmark.

4.2 Demographic Parameters

We first assume that young agents start working at age 20 (the start age of an individual in our model since we ignore the population under 20 year-old) and then they will retire after working for 45 years. Therefore, the probability of being retired is set to (1/45). After retirement, the person will live a period of time, then, he will die and leave the economy with a probability of death, which is set to 0.0795 in order to fit with the "Old to Young ratio" of Japan's population in 2000[6].

For our simulation and experiment, we also set the probability of being retired and probability of death at (1/45) and 0.0271 respectively; for that, we assume that the Japanese government will not change retirement age, and the Old to Young ratio is based on a Population Projections for 2050 by Japan's National Institute of Population and Social Security Research (2011).

[6] The Old to Young ratio equates to $(\frac{\rho_o}{\rho_d})$, which is the ratio of the number of people aged 65 and over to the number aged 20 to 64. We ignore the population from 0 - 19 years old in our model.

4.3 Discount Factor

The discount factor (β) is now calibrated to match the average annual capital-output ratio of Japan in 1990-2000, 2.13, and set to $\beta = 0.963$.

4.4 Preference

We then calibrate household preference (α) equals to 0.44 so that the labor supply is equal to the average hours of labor input in the Japanese data between 1990 and 2000, 0.3819 (i.e., 40.1 weekly hours worked over the total discretionary hours in a week, 105).

4.5 Fiscal Package

We set the capital tax (τ_k) to 43.5%, that is the average capital income tax in the studied period as reported in Chen *et al*. (2006); the consumption tax (τ_c) set to 5%, equal to the average consumption tax rate in Japan in the period studied[7] and Labor income rate (τ_h) is set to 0.281, that is the average labor income tax rate between 1990 and 1996 as calculated by Mendoza *et al.* (1994), and lastly, the social security tax ($\tau_{ss,t}$) is set to 0.11.

4.6 Other Exogenous Parameters

The government debt share is set to 0.80, roughly equal to the actual debt to GNP ratio in 2000. The average government expenditure to output is set to 20%, and the social security benefit is set to 50% of wages to match the social security benefits to total government expenditure ratio (20%) and general expenses to total government expenditure ratio (60%).

[7] The tax was first introduced in 1989 at 3% and then adjusted to 5%. However, during the early life of the tax, some kinds of consumption were taxed at a higher rate. Thus, we set the tax equal to 5% on average.

5 The Cost of the Population Aging

In order to estimate the cost of the population aging, we calculate and compare two different steady state levels for Japan in the year of 2000 and 2050.

First, the initial steady state achieved in 2000 is calculated to be the benchmark economy as explained in Section 4. Second, based on the projected value of Japan's population in year 2050's (Medium Variant/old-to-young) by the National Institute of Population and Social Security Research (IPSS/Japan), we calculate a new steady state for the economy in 2050 by changing the old to young ratio from 2000 to 2050 and keeping all other factors constant. We also assume that the government's general expenditures and lump-sum transfers are fixed at the level in the benchmark economy. We keep these items the same across experiments and let the labor income tax adjust the fiscal surplus or deficit.

Table 2-2 shows the differences between the 2000 benchmark economy and the 2050 economy. In 2050, the Japanese working age population (15-64 years old) is projected to be 55 million (compared to its peak in 1995, 87 million people) and the number of old people will increase sharply. This significant change in Japanese demographics is captured in our model. The total labor supply and output decrease by 27% and 25% respectively, compared with the benchmark level. Labor wage rates will rise by 3%. In addition, as the number of old people increase, the government spending on social security benefits also increase. In particular, the share of social security benefits in the total output will be doubled, from 7% to approximately 14%. This increased spending needs to be financed by some forms of taxes. If we assume that there is no significant reform of the social security system and use the labor income tax as the only channel to finance the increased spending, the labor income tax needs to rise to 48.5% from the current rate of 28.1%. In short, the cost of the population aging

is 25% lower in the total output and 20 percentage points are added to the labor income tax rate in 2050.

6 Policy Options

We do several experiments to find the best financing schemes for Japan. In our experiments, we always keep the government expenditure constant at the benchmark level (also the same level as the reference economy). We construct three scenarios for our policy experiments. In each experiment, we find the appropriate value of a policy parameter to balance the government budget.

Scenario 1. Alternative financing policies with no reform.

Scenario 2. Financing given the reformed consumption tax system.

Scenario 3. Financing given the reformed social security system

6.1 "No Reform" Scenario

We first take the "no-reform" scenario and alternatively simulate the three most possible financing options for the Japanese government to fill the budget deficit. These options are listed as follows.

- *Option 1.* Increasing the labor income tax rate.
- *Option 2.* Increasing the consumption tax rate.
- *Option 3.* Cutting the social security benefit.

Note that once we take an option, we keep the other tax financing schemes at the benchmark level, so that, the experiment results are comparable. Table 2-3 shows our simulation results for the three alternative financing schemes in 2050.

Option 1. *Increasing labor income tax.*

In this case, the Japanese government has to increase the labor income tax to 48.5% (from 28.1% recently). The effect of this is major contraction in key aggregate variables ie. (Capital: -20%, Consumption: -47%, Output: -25.05%), compared with the benchmark economy. Noticeably, the total government share in the output will also increase due to the drop in the total output and the increase in the social security benefits. Now, we take this option as the reference for further experiments.

Option 2*. Increasing consumption tax.*

Among OECD countries, Japan's consumption tax rate is the lowest and currently stands at 5% (the same level as the U.S.'s, compared with the other OECD countries at 10%). Moreover, as mentioned above, the consumption tax share in the total tax revenue is also quite low in Japan. Therefore, there is actually substantial room for Japan to use this instrument. If the increase in social security expenses is financed by only consumption tax revenue, Japan has to increase the consumption tax rate up to 27.7% (from the current level of 5%).

Despite the increase in the consumption tax rate, individuals consume more than in the reference economy. This increase reflects the fact that people have higher income (as the young people work longer and the social security benefits for the old people are quite high). The average consumption increases approximately 33%, the labor supply increases by 21.4%, and the social security benefit is still at 50% of wage rate. Remarkably, all the macroeconomic variables such as the total output and consumption responded positively in our simulation (they all rise approximately 20%).

Option 3. *Cutting social security benefit.*

Since the current social security replacement rate is quite high in Japan (about 50% of the wage rate). Cutting the social security benefits could also be

considered. If the replacement rate is selected to be the policy parameter, our simulation shows that the Japanese government has to reduce the social security replacement rate to 5% from 50% currently. It means that they almost have to remove the social security system or just maintain a symbolic social security system.

Due to the cut-off in the social security benefit, individuals have to save more to compensate their consumption in the future; consequently, aggregate capital increases by 42%. Consumption is also raised sharply by 49%.

The biggest advantage of this financing method is to remove the burden for Japanese government. However, this option hurts old people and is quite controversial.

6.2 Financing Given the Reformed Consumption Tax System

The Japanese government is planning to raise the consumption tax rate to 8% from the 2014 fiscal year and further to 10% from October 2015. We take this forthcoming reform as a scenario in our experiments. In addition to this reform, we also investigate a further reform of the consumption tax, that is, increasing the consumption tax rate to 15%. The corresponding changes in the 2050 steady state structure and the required labor income tax rate in order to balance Japanese government are reported in Table 2-4.

One of the advantages of imposing a higher consumption tax is to redistribute the tax burden between the old and the young generations. Since the tax burden is shared by old people, young people now have a lower burden on the labor income tax; thus, they will have more incentive to work and thereby, it will help to increase the labor supply and the total output. Our simulation result shows that aggregate variables (output, capital, consumption and labor) response positively with the reform of the consumption tax system. The higher

consumption tax rate leads to a better performance of aggregate labor, consumption and output in our experiments. At the highest consumption tax rate of 15%, the required rate for the labor income tax is 38% to balance the government budget.

6.3. Financing Given the Reformed Social Security System

We now investigate the financing issues under two potential reforms in the social security system: cutting social security benefits (i.e., lowering the social security replacement rate) to 40% and to 30%. In these experiments, we keep the consumption tax rate at 10% as the tax rate is applied from 2015 and we assume that there is no further reform of the consumption tax. Table 2-5 compares the reference economy and the financing policies under the two reforms of the social security system.

Given the cut of the social security benefits, individuals have to save and accumulate their wealth in order to compensate for their consumption in the future. The aggregate stock of capital increases by 13.58% and 20.95% when the benefit is cut from 50% to 40% and to 30% respectively.

With regards to the labor tax rate, when the replacement rate of 40% is applied, the required rate for the labor income tax to balance the government budget is 39.27%. However, when the replacement rate of 30% is applied, the labor income tax rate required is almost 35%. Compared with the labor tax rate of 48.5% under the 2050 reference economy, this is a considerable decline in labor income tax rate and encourages young people to supply more labor.

7 Welfare Comparison

In this section, we follow Hsu and Yamada (2013) to do a welfare comparison by calculating the certainty equivalent consumption variation (CEV) from each experiment. We measure the welfare by the expected life time value over the

equilibrium distribution of the entire population. The 2050 steady state with the labor financing method once again is used as our reference economy. The deviation from the 2050 reference economy with full-financing by the labor income tax is calculated by using the CEV method.

Given our *log*-form utility function, the CEV for a representative agent can be expressed by the following equation:

$$\mathrm{CEV}_{\mathrm{individual}} = \frac{e^{V_{\mathrm{new}}}}{e^{V_{\mathrm{reference}}}} - 1, \tag{14}$$

where V_{new} and $V_{\mathrm{reference}}$ are the welfare in the economy with a new policy and the reference economy, respectively. Accordingly, the CEV based on the whole population is defined as:

$$\mathrm{CEV}_{\mathrm{all}} = \frac{e^{\int V_{\mathrm{new}}(s)d\Phi(s)}}{e^{\int V_{\mathrm{reference}}(s)d\Phi(s)}} - 1, \tag{15}$$

where s is a vector of the state variables and $\Phi(s)$ is the stationary cumulative distribution of the population over the state variables.

Table 2-6 reports the CEV for each policy option that we have performed in Section 6. We still use the 2050 economy with the labor income tax financing as the reference value for this comparison. The results show that increasing the consumption tax rate to 27.7% produces the highest value of CEV (+12.63%, compared with the reference case), in the sense that it causes the least social welfare loss. In contrast, cutting the social security benefit from 50% to 5% is the worst option (as the value of CEV is – 0.65%, worse than the reference case). Since the agents in our model face an uncertain lifespans: if they live longer than expected and do not have enough savings, they will suffer from low consumption. The social security benefits act as insurance in preventing old agents from running out of savings when they live longer than expected.

8 Concluding Remarks

The Japanese public finance situation is serious due to multiple factors: high Debt to GDP rate, low TFP growth rate, aging population, and the massive rebuilding costs related to the March 11th Tohoku Earthquake. We aim to investigate how the Japanese government can finance this large budget in the future? For this purpose, we employ an overlapping generation model with an extension by incorporating stochastic aging and dying to capture the demographic changes in Japan. The model is calibrated to match some descriptive statistics of the Japanese economy in 2000. We perform a number of policy experiments to examine several potential financing possibilities for sustaining Japan's government budget in the next 40 years. We find that given the expected demographic shifts, Japan has three options in 2050: (i) add 20 percentage points to the current labor income tax rate, (ii) increase the consumption tax rate from 5 percent to roughly 28 percent, or (iii) reduce the social security benefit from 50 percent to 5 percent of the wage rate.

By calculating and comparing the welfare loss of each financing option, using the consumption equivalent variant method, we suggest that financing the government budget by increasing the consumption tax rate is better than using the labor income tax or cutting the social security benefits as it causes less welfare loss for the society.

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Tables

Table 2-1. Summary of the Model Parameters

Parameters	Description	Value	Note/Sources
β	Discount Factor	0.963	Calibrated to match with average capital-output ratio of Japan in 1990-2000, 2.14
θ	Capital Share	0.362	Standard - Hayashi and Prescott (2002)
α	Preference Parameter	0.44	Calibrated to match with average hours labor input of 40.1 (weekly hours worked)
δ	Depreciation Rate	0.083	Average rate 1990-2000
$\tau_{h,t}$	Labor Income Tax	0.281	Average rate 1990-1996 (latest update).
$\tau_{ss,t}$	Social Security Tax	0.11	Average rate 1990-2000
$\tau_{k,t}$	Capital Income Tax	0.435	Average rate 1990-2000
$\tau_{c,t}$	Consumption Tax	0.05	Average rate 1990-2000
ρ_o	Aging Probability	0.0222	The young works for 45 years
$\rho_{d,2000}$	Probability of Death in 2000	0.0795	Calibrated to match with Old to Young Ratio in 2000, 28%
$\rho_{d,2050}$	Probability of Death in 2050	0.0271	Calibrated to match with Old to Young Ratio in 2050, 82%
D/GNP	Government Bond	0.80	In 2000
G/GNP	General Expenditure	0.20	Exogenous (Excluding SS benefit)
ss/w	Social Security benefit	0.50	Exogenous (match with S.S./G)
TFP	Total Factor Productivity	1	Normalized for the benchmark.

Table 2-2. The Benchmark 2000 and the Economy in 2050

Variables	The Benchmark 2000	The 2050 Economy *(Increase Labor Income Tax)*
Prices		
Interest rate	8.57%	7.7%
Wage	-	+3.13%
Aggregate variables		
Capital	-	-20.82%
Labor	-	-27.34%
Consumption	-	-46.93%
Output	-	-25.05%
Fiscal		
G/Y share	33.82%	49.23%
S.S/Y share	6.97%	14.36%
S.S/G share	20.61%	29.18%
Tax rates		
Consumption tax	5%	5%
Capital income tax	43.5%	43.5%
Labor income tax	**28.1%**	**48.5%**
Social security tax	11%	11%
Social security (S.S.)		
S.S. Replacement rate	50%	50%

Table 2-3. Three Alternative Financing Options in 2050

Variables	**OPTION 1** Increasing Labor Income Tax *(reference)*	**OPTION 2** Increasing Consumption Tax	**OPTION 3** Cutting Social Security benefit
Prices			
Interest rate	7.67%	7.22%	5.21%
Wage	-	+1.64%	+9.96
Aggregate variables			
Capital	-	+26.70%	+41.92%
Labor	-	+21.42%	+8.95%
Consumption	-	+32.87%	+49.04%
Output	-	+23.19%	+19.89%
Fiscal			
G/Y share	49.23%	42.28%	28.33%
S.S/Y share	14.36%	14.37%	1.43%
S.S/G share	29.18%	33.97%	5.06%
Tax rates			
Consumption tax	5%	**27.7%**	5%
Capital income tax	43.5%	43.5%	43.5%
Labor income tax	**48.5%**	28.1%	28.1%
Social security tax	11%	11%	11%
Social security (S.S.)			
S.S. Replacement rate	50%	50%	**4.99%**

Table 2-4. Labor Income Tax Financing Given the Reformed Consumption Tax System

Variables	The 2050 economy *(reference)*	Consumption Tax Reform	
		$\tau_{c,2050} = 10\%$	$\tau_{c,2050} = 15\%$
		OPTION 4	**OPTION 5**
Prices			
Interest rate	7.67%	7.52%	7.40%
Wage	-	+0.51%	+0.95%
Aggregate variables			
Capital	-	+8.44%	+14.65%
Labor	-	+6.07%	+11.11%
Consumption	-	+9.89%	+17.95%
Output	-	+6.92%	+12.38%
Fiscal			
G/Y share	49.23%	46.79%	45.12%
S.S/Y share	14.36%	14.33%	14.34%
S.S/G share	29.18%	30.62%	31.79%
Tax rates			
Consumption tax	5%	***10%***	**15%**
Capital income tax	43.5%	43.5%	43.5%
Labor income tax	**48.5%**	**43.05%**	**38.31%**
Social security tax	11%	11%	11%
Social security (S.S.)			
S.S. Replacement rate	50%	50%	50%

Table 2-5. Labor Income Tax Financing
Given the Reformed Social Security System

Variables	The 2050 economy *(reference)*	Reform of Social Security System	
		$SC = 40\%$ **OPTION 6**	$SC = 30\%$ **OPTION 7**
Prices			
Interest rate	7.67%	7.13%	6.67%
Wage	-	+1.99%	+3.73%
Aggregate variables			
Capital	-	+13.58%	+20.95%
Labor	-	+7.67%	+9.31%
Consumption	-	+18.40%	+28.09%
Output	-	+9.77%	+13.38%
Fiscal			
G/Y share	49.23%	42.73%	38.43%
S.S/Y share	14.36%	11.49%	8.62%
S.S/G share	29.18%	26.90%	22.42%
Tax rates			
Consumption tax	5%	**10%**	**10%**
Capital income tax	43.5%	43.5%	43.5%
Labor income tax	**48.5%**	**39.27%**	**35.04%**
Social security tax	11%	11%	11%
Social security (S.S.)			
S.S. Replacement rate	50%	**40%**	**30%**

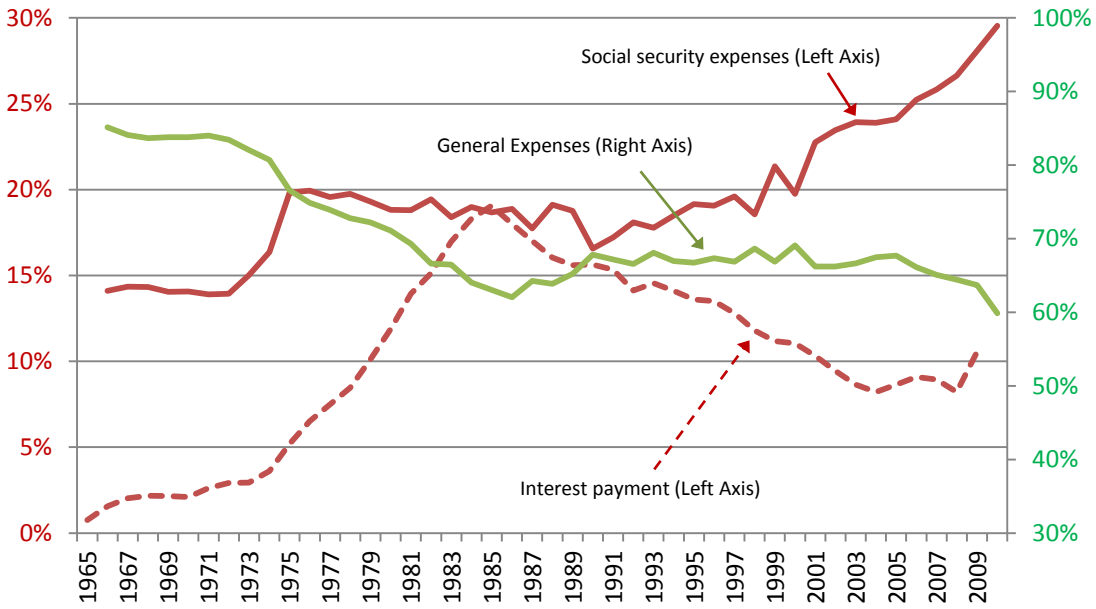
Table 2-6. Welfare Comparison: All experiments

	Policy Packages	Welfare (CEV)
Financing with no reform		
Option 1 *(reference)*	$\tau_{h,2050} = 48.5\%$ * $\tau_{c,2050} = 5\%$ $ss_{2050} = 50\%$	-
Option 2	$\tau_{h,2050} = 28.1\%$ $\tau_{c,2050} = 27.7\%$* $ss_{2050} = 50\%$	+12.63%
Option 3	$\tau_{h,2050} = 28.1\%$ $\tau_{c,2050} = 5\%$ $ss_{2050} = 5\%$*	-0.65%
Financing given the reformed consumption tax system		
Option 4	$\tau_{h,2050} = 43.05\%$* $\tau_{c,2050} = 10\%$ $ss_{2050} = 50\%$	+1.72%
Option 5	$\tau_{h,2050} = 38.31\%$* $\tau_{c,2050} = 15\%$ $ss_{2050} = 50\%$	+4.28%
Financing given the reformed social security system		
Option 6	$\tau_{h,2050} = 39.27\%$* $\tau_{c,2050} = 10\%$ $ss_{2050} = 40\%$	+1.75%
Option 7	$\tau_{h,2050} = 35.04\%$* $\tau_{c,2050} = 10\%$ $ss_{2050} = 50\%$	+1.46%

Note: * indicates the policy parameter that we use in our experiment

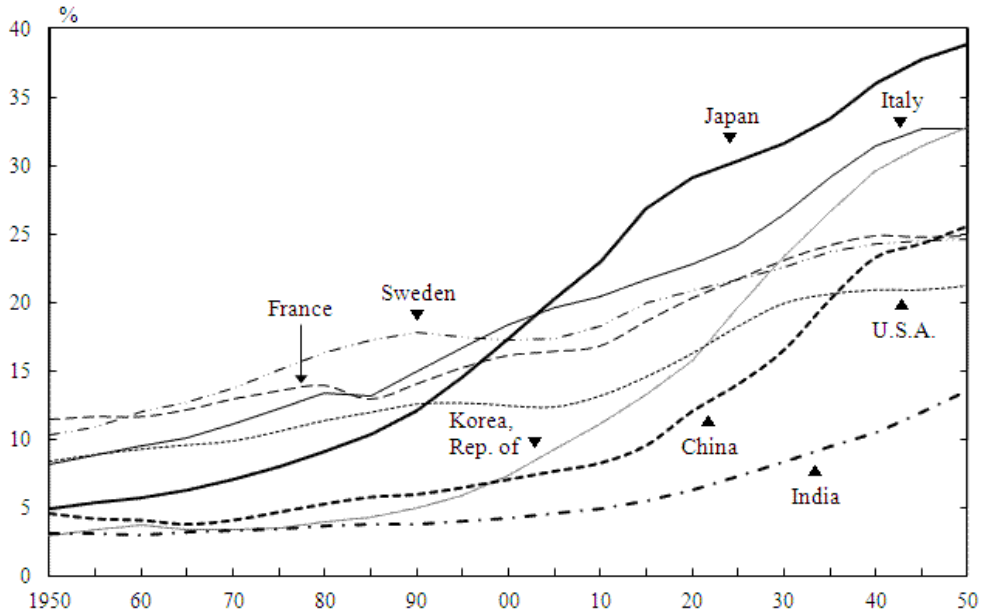
Figures

Figure 2-1. Decomposition of Japanese Government Expenditure 1965-2010



Source: Ministry of Finance, Japan, 2012.

Figure 2-2. Proportion of Elderly Population by Country (Aged 65+)



Source: The Statistical Handbook of Japan 2012

CHAPTER 3 .
Female Labor Supply and Tax System in Japan

Abstract.

The spousal deduction policy may have created disincentives for Japanese married women to work. However, we do not know the magnitude of this distortion and its adverse effect on the economy. Based on a representative agent model and general equilibrium analysis, we study the impact of the tax and social security system on married Japanese women's working and households' saving behavior as well as on the aggregate economy. We find that the total labor supply and total output will increase by 7.52% if the government could reform its tax and social security system.

1 Introduction

There are concerns being voiced recently in Japan regarding shrinking workforce. At the same time, as showed in the previous chapter, the Japanese public finance situation does not seem to be sustainable in the future. Both of these problems are mainly caused by the demographic changes in Japan (i.e., extremely low fertility rate, shrinking and aging population). The projected contraction in the number of the working age population may cause a shrinking workforce problem. The greater elderly population imposes considerable pressure on public finance balancing as the social security benefit payment for this cohort is expected to increase. Searching solutions for such challenges is therefore crucial and timely for Japan. Among others, increasing female labor participation might be the most promising and comprehensive solution for Japan due to its availability and effectiveness.

First of all, female labor is a large and untapped resource in Japan. According to OECD (2008), the female labor participation rate in Japan ranks among the lowest OECD countries (Japan: 60%, U.S: 66%, Norway: 75%, Korea: 53%, Italy: 47% approximately). The female participation rate by age group has formed a welknown M-shaped curve, where women in the 30s are at the bottom of the curve. Compared with the other developed countries, this M-shaped pattern is unique as can be seen on Figure 3-1. In terms of scale, according to Japan Statistic Bureau, the female workforce in 2011 was 26.3 million[8]. *The 2007 Employment Status Survey* shows that 80% of all male employees were regular staffs[9] while only 44.7% of all female employees were regular staff, more than 42% of females were non-regular staff. In addition, within the part-time workers cohort, 93.7% women have annual incomes of less than 2 million yen,

[8] Sum of employed and unemployed women, excluding Iwate, Miyagi and Fukushima Prefectures, the 3.11 earthquake and tsunami's affected areas.
[9] Regular staff is full-time staff. Non-regular staff includes: part-time workers, *arbeit* (temporary workers), dispatched worker from temporary labour agencies, contract employees or entrusted employees and others.

and 53.5% of them have annual incomes of less than 1 million yen. Similar numbers apply for temporary workers. Fewer than 50% of Japanese households are dual earners (both husband and wife work). In short, a huge number of Japanese females are still not in the labor force, and the resource is therefore high potential for Japan to use for the long-term growth model.

Secondly, in terms of effectiveness, encouraging more women to go to work could help Japan achieve two targets at the same time. On the one hand, it can solve the shrinking workforce problem. In fact, Matsui *et al.* (2010) assess that if the female labor particapation rate is equal to the rate of male participation, the country will have additional 8.2 million workers added to their labor force and boost the country's GDP level up by 15% every year. More importantly, Japanese women are among the top three most educated women in the world (Matsui *et al.* 2010). Thus, a higher female participation rate could not only solve the shrinking workforce in the context of quantity but could also help Japan to restructure and reallocate their labor force more efficiently because the more productive female workers can replace the less productive male workers. On the other hand, it helps Japan to reduce the balancing pressure on Japanese public finance as once Japanese women go to work, the tax and social insurance premium revenues are expected to increase steadily.

In this chapter, we employ a standard neo-classical model with two representative households, which are differentiated by the females' education level, to investigate the impact of the tax system on on married Japanese women's working behavior as well as on the whole economy. We find that the tax system has different impacts on different women cohorts. Quantitatively, we show that a comprehensive reform on the tax system could boost the aggregate labor supply and output by 7.52%.

The rest of the study is organized as follows. Section 2 provides a brief overview on the related literature. Section 3 summarizes the Japanese tax system; Section 4 presents the model economy. Next, the calibration of the model is discussed in Section 5. Sections 6 and 7 present our numerical results. The last section concludes.

2 Literature Review

Empirical studies on the Japanese female labor market pointed out four important reasons for the low female labor participation: educational level, childcare, marital status, and tax disincentive to work.

First of all, Hirao (2001), Abe (2011) and Steinberg and Nakane (2012) all highlight the important role of education in determining the female labor supply in Japan. Hirao (2001) shows that university graduates are more likely to stay in the labor force longer than high school graduates. Abe (2011) does a cohort analysis and shows that regular employment ratios are much higher for university graduates than for senior high school graduates. Steinberg and Nakane (2012) show that for every 10 percent increase in education level there is a corresponding 1.1 percentage point increase in the female labor participation rate.

In addition, Nakamura and Ueda (1999) empirically document that not only the education level of female, but also the availability of childcare facilities are key determinants for women to return to the workforce after childbirth. Sasaki (2002) found that a married woman has a higher probability of participating in the workforce if she resides with her parents or in-laws because they will share the childcare burden with her.

Next, there exists a unique and large concentration of married women's income at 1.03 million yen observed in the data (See Figure 3-2). The concentration

might be caused by the Japanese tax system. To verify this judgment, Abe and Otake (1995, as cited in Akabayashi, 2006) first test the work disincentive of single women and married women; they come up with the conclusion that the tax and social security system does not affect the working decision of single women but does affect the decision of married female. Thus, marital status seems to play an important role in the female labor supply behavior. In fact, Japan applies a spousal tax exemption for primary earners if his/her spouse's income is lower than 1.03 million yen. Akabayashi (2006), Takahashi, Kawade and Kato (2009) and Takahashi (2010) have successfully confirmed the important role of the spousal deduction policy on determining female labor supply. Furthermore, Kawata and Naganuma (2010) and Kohara (2010) find that a wife returns to work and works longer when her husband suffers from a decline in income.

Although the Japanese female labor participation has attracted much attention, almost all of the efforts have been dedicated to empirical studies. Little is known from a macroeconomic perspective. A limited number of studies can be found in the literature explaining the mechanism or the theoretical choice of Japanese women. To our best knowledge, Abe (2009) is the only one who tried to explain the impact of the spousal tax deduction by a dynamic theoretical model. She does a partial equilibrium analysis of a representative woman. However, the scope of Abe (2009) is limited because (i) the budget constraint for women is too simple; (ii) it lacks a general equilibrium channel, thus, she could not measure the magnitude of the tax distortion on the economy as a whole.

Motivated by Attanasio, Low and Sanchez-Marcos (2006), our study aims to enrich the theoretical literature and to better understand how married Japanese women's working decisions affect the Japanese economy. Attanasio, Low and Sanchez-Marcos successfully explain female labor supply in a life-cycle model by using a unitary household utility, which depends on the household's

consumption and labor supply choice of the wife. The husband's labor supply is inelastic in thier model while the wife's is elastic. The one important point of thier study is applying a human capital accumulation process. However, thier study is a partial analysis.

Our study follows Attanasio, Low and Sanchez-Marcos (2006) on two points: First, we use a unitary utility function with consumption and the labor supply of the wife. Second, we follow the assumption that men always work (i.e., they will work at constant hours and their labor supply is inelastic). This assumption matches well with the case of Japan, where 80% of males are regular staff. More importantly, we examine the issues under two distinguished dimensions: (i) we mimic the Japanese tax system in the study; (ii) we do a competitive general equilibrium analysis to see the impact of the tax system on the aggregate level of the economy.

3 Japanese Tax and Social Security System

Let us discuss some key features of the Japanese individual income tax and social security system. To keep the context simple and consistent with our study, we assume that within a Japanese household, the husband will be the primary earner and the wife the secondary earner.

3.1 Individual Income Tax

In Japan, individual income tax is based on a self-assessment system, and taxpayers calculate the income payable tax by themselves. In the calculation process, many deductions are applied, for example, deduction from income (employment income deduction, deductions for insurance premiums) and deductions from earnings (deduction for casualty losses, medical expenses, other insurance premiums, donations, disabled, spouses and dependents, etc.).

Figure 3-3 shows how the income tax is generally calculated. First, the "amount of income" is calculated by subtracting "deductions from earnings" from the "amount of earnings". From this "amount of income", the "amount of taxable income" is calculated by subtracting "deductions from income". Next, the "amount of income tax" is calculated by multiplying the amount of taxable income by an appropriate tax rate. Finally, the taxpayers may also get some other deductions and is responsible for paying the tax owing.

Marginal Tax Rate

Currently, the Japanese income tax rate is divided into 6 brackets, from 5% through to 40%, depending on the taxable income of the taxpayers. From 1999 to 2011, there were only four brackets. We report these tax brackets and the reform in Table 3-1.

Basic and Employment Deduction

Japanese employees are eligible to have a basic deduction (380 thousand yen, fixed for all) and an employment deduction, which depends on his/her income level and the lowest deduction is 650 thousand yen. Table 3-2 shows this basic and employment deduction schedule by income levels. Notice that this deduction policy leads means that people who have annual income lower than 1,030 thousand yen per year do not have to pay individual income tax.

Spousal Deduction

For a married couple, if the wife's annual income is lower than 700 thousand yen, the husband can have a deduction of 760 thousand yen when he calculates his taxable income. In addition, if the wife's income is in between 700 thousand yen and 1,430 thousand yen, for each 50 thousand yen higher in her income, the amount of tax deduction for her husband decreases by 50 thousand yen as well. The husband will lose this subsidy if the wife has an income higher than 1,430

thousand yen and she also has to pay both individual income tax and social security premiums (see Figure 3-4). The spousal deduction policy, however, is not applied to husbands, whose incomes are higher than 10 million yen.

3.2 Social Security System

This part aims to provide a snapshot on the current the social security system in Japan[10]. We focus only on the pension system and its insurance premium policy.

Pension Insurance Structure

Figure 3-5 shows a comprehensive picture of the Japanese pension system of recent years. The Japanese pension system is multi-tiered and rung by both public and private sectors. The subscribers or social security contributors in Japan are categorized into three groups. Category No.1 is farmers, students, self-employed subscribers; Category No.2 is working employees, and Category No.3 is the spouses of the working employees, who belong to Category No.2.

There are three tiers in the pension system. The first tier is the Basic Pension (*Kiso Nenkin*), which is mandatory for residents 20 years old or above in Japan, including foreigners. A flat rate is applied for all of the three subscriber-categories. The basic pension aims to provide a basic income guarantee for the old age people in Japan. The second tier, the Employees' Pension Insurance (*Kose Nenkin Hoken*), covers Category No. 2 and it is co-paid by employers and employees, and it is mandatory for all firms over a certain size. These two pensions are both controlled by the Japanese government, i.e., they are public pensions.

[10] We skip the discussion on health care, public assistance, etc., which are also important parts of the social security system.

The third tier, however, is an optional scheme and operated either by corporations themselves for their employees, or by a government insurer for the self-employed people (collective national pension fund).

Spousal Category

As mentioned above, if a husband is working, he is listed in Category No. 2 and has to pay social security premiums. In addition, his wife is listed in Category No.3 (i.e., the spouses of the working employees). According to the current social security system, if her annual income is lower than 1,300 thousand yen, she does not have to pay the social security premiums.

3.3 The Income Thresholds

Combining the tax policy and the social security system, we can clearly see that there are four income thresholds for a Japanese spouse: 700 thousand yen, 1,030 thousand yen, 1,300 thousand yen and 1,430 thousand yen. Figure 3-6 plots these four thresholds and a typical family income schedule. A summary of the income schedule could also be seen in Table 3-3 (the second and last column).

First, if the spouse's income is lower than the first threshold (T1 dashed-line, 700 thousand yen), she does not have to pay income tax as well as social security premiums; moreover, her husband can deduct 760 thousand yen out of his tax base as the spousal deduction policy is applied. Second, if the spouse's annual income is higher than 700 thousand yen but lower than 1,030 thousand yen (T2 dashed-line), she still does not have to pay either personal income tax or social security premiums; however, the reduction in tax base for her husband is lower than the previous level (i.e., linearly decreases as her income increases). Third, when the spouse's income is above 1,030 thousand and under 1,300 thousand yen (T3 dashed-line), the wife now has to pay individual income tax, but not social security premiums. The husband still can enjoy the lower spousal

reduction when paying tax. Fourth, if the wife's income is between 1,300 thousand yen and 1,430 thousand yen (T4 dashed line), the wife now has to pay both individual income tax and social security premiums, and the husband enjoys the last opportunity for the spousal deduction. Finally, if the wife's income is above the 1,430 thousand yen, they are separate in terms of tax and social security contributions; this means both husband and wife have to pay personal income tax and social security premiums; more seriously, the husband will lose the spousal deductions.

4 The Model

We employ a standard Neo-classical model with three sectors in this study.

4.1 Household/Family

The household is categorized as two representative households based on the wife's education level (i.e., normal educated women family, NEW - hereafter and high educated women family, HEW - hereafter). Each household has two individuals, husband and wife[11]. The husband is assumed to work full time at constant working hours. The wife's working hours, however, vary endogenously. The household's preferences are represented by a unitary utility function, which has the following form:

$$U\left(C_t^i, H_t^i\right) = log\left(C_t^i\right) + \alpha log\left(L - H_t^i\right). \quad (1)$$

The parameter α represents the weight on utility from time spent for her family relative to consumption. The parameter $i = [N, H]$ indicates the status of the family, i.e., NEW or HEW respectively. L is the time endowment for the wife in the household, and H_t^i is her working hours supply. C_t^i is the consumption of

[11] To simplify the model, we did not include the size of the family in our study. A simple way to model the size of household (i.e., families with different numbers of children) can be seen in Attanasio, Low and Sanchez-Marcos (2006).

the household with status i. In this paper, we assume that if the wife chooses to work, it will reduce the family's utility since she will have less time to take care of the family.

The family's pooling budget[12] is:

$$(1+\tau_c)C_t^i + K_{t+1}^i = [1+(1-\tau_k)(r_t-\delta_t)]K_t^i + [\underbrace{(1-\tau_s^i)w_t e^i H_t^i}_{\text{After S.S. Tax Income}} - \underbrace{T_t(y_t^i)}_{\text{Tax payment by the wife}}] + [(1-\tau_s)w_t\overline{H^m} - \underbrace{T_t(y_t^m)}_{\text{Tax payment by the husband}}] + \zeta, \quad (2)$$

where w_t is the labor wage rate, which is applied to all workers in the economy. However, their income are different based on their different efficiency level (i.e., male employees' efficiency is normalized at one; normal and high educated female employees' efficiency are e^N and e^H respectively).

τ_s^i and τ_s are the social security premium rates paid by the wife and husband respectively. τ_s is set to a fixed rate. τ_s^i takes the following options:

$$\tau_s^i = \begin{cases} 0 & w_t e^i H_t^i \le \xi \\ \tau_s & w_t e^i H_t^i > \xi \end{cases}. \quad (3)$$

The parameter (ξ) [13] is the social security tax threshold level, which characterizes the current Japanese social security system. A married woman whose income is lower than (ξ) does not have to pay social security premiums as discussed above.

[12] A more simple income resource can be seen in Takahashi, Kawade and Kato (2009). They, however, treat the husband's income exogenously.
[13] In reality, a married woman whose income is lower than 1.3 million yen does not have to pay employee's pension insurance.

Furthermore, within the budget, $T_t(y_t^i)$ is the progressive tax component (tax payment). It is calculated as a linear function of the taxable income.

$$T_t(y_t^i) = \{\tau_h \times y_t^i\}_{i=N,H,m}, \tag{4}$$

where (y_t^m) and (y_t^i) are the taxable income of the husband (m) and the wife (i) respectively. The wife's taxable income takes the following formula:

$$y_t^i = \begin{cases} 0 & w_t e^i H_t^i \le \lambda \\ \max\{[(1-\tau_s^i) w_t e^i H_t^i - \underbrace{(a w_t e^i H_t^i + b)}_{\text{Basic and Employment Deduction}}], 0\}_{i=N,H} & w_t e^i H_t^i > \lambda \end{cases}, \tag{5}$$

where (λ)[14] is a constant basic and employment income deduction for low-income people or part-time workers. Thus, people who have income lower than this level do not have to pay individual income tax.

Note also that $\{a w_t e^i H_t^i + b\}_{i=N,H,m}$ is the basic and employee income deduction, which is applied to each individual worker. It is set to be a linear function of her/his earnings. (a, b) represent the parameter and intercept of the linear function respectively.

The taxable income of the husband takes the following formula:

$$y_t^m = \max\{[\underbrace{(1-\tau_s) w_t \overline{H^m}}_{\text{After S.S. Tax Income}} - \underbrace{(a w_t \overline{H^m} + b)}_{\text{Basic and Employment Deduction}} - S_t], 0\}, \tag{6}$$

where (S_t) is the spousal tax deduction as discussed above. This deduction follows the following rules.

[14] To be consistent with reality, we set $0 < \lambda < \xi$. In fact, people whose incomes are lower than 1.03 million yen do not have to pay labor income tax.

$$S_t = \begin{cases} \overline{AS} + \overline{SAS} & 0 \le w_t e^i H_t^i < \chi_1 \\ \left(\chi_2 - w_t e^i H_t^i\right) & \chi_1 \le w_t e^i H_t^i \le \chi_2 \\ 0 & \chi_2 < w_t e^i H_t^i \end{cases}. \quad (7)$$

$\overline{AS}$ and $\overline{SAS}$ are the Allowance for Spouse and Special Allowance for Spouse, which is applied to all married couples and χ_1, χ_2[15] are the threshold level for the (Special) Allowance for Spouse as explained above. Note also that (ζ) is a lump sum tax or transfer, which is equally collected or distributed by the government.

From this setting, the household's pooling budget could be dropped into one of the following five brackets, depending on the wife's income:

- Bracket 1 : $0 \le w_t e^i H_t^i < \chi_1$

$$\begin{aligned} (1+\tau_c)C_t^i + K_{t+1}^i &= \left(1 + (1-\tau_k)(r_t - \delta_t)\right)K_t^i + w_t e^i H_t^i \\ &+ (1-\tau_s)w_t\overline{H^m} \\ &- \tau_h\left((1-\tau_s)w_t\overline{H^m} - (aw_t\overline{H^m} + b) - \bar{S}\right) + \zeta \end{aligned} \quad (8)$$

- Bracket 2: $\chi_1 \le w_t e^i H_t^i \le \lambda$

$$\begin{aligned} (1+\tau_c)C_t^i + K_{t+1}^i &= \left(1 + (1-\tau_k)(r_t - \delta_t)\right)K_t^i + w_t e^i H_t^i \\ &+ (1-\tau_s)w_t\overline{H^m} \\ &- \tau_h\Big((1-\tau_s)w_t\overline{H^m} - (aw_t\overline{H^m} + b) \\ &- \left(\chi_2 - w_t e^i H_t^i\right)\Big) + \zeta \end{aligned} \quad (9)$$

- Bracket 3: $\lambda < w_t e^i H_t^i \le \xi$

[15] In fact, χ_1, χ_2 were at 0.7 million yen and 1.43 million yen respectively until 2003. In 2003, the Japanese Diet passed the 2004 tax reform proposal, which abolished a part of the Special Allowance for Spouse. This legislation would take effect in the fiscal year 2004. Therefore, χ_1 has been increased to 1.03 million yen since 2004. The reform policy will be discussed in Session 4.

$$
\begin{aligned}
(1+\tau_c)C_t^i + K_{t+1}^i &= \big(1+(1-\tau_k)(r_t-\delta_t)\big)K_t^i \\
&+ \Big(w_t e^i H_t^i - \tau_h\Big(w_t e^i H_t^i - \big(a w_t e^i H_t^i + b\big)\Big)\Big) \\
&+ \Big((1-\tau_s) w_t \overline{H^m} \\
&- \tau_h\Big((1-\tau_s) w_t \overline{H^m} - (a w_t \overline{H^m} + b) \\
&- \big(\chi_2 - w_t e^i H_t^i\big)\Big)\Big) + \zeta
\end{aligned} \tag{10}
$$

- Bracket 4 : $\xi < w_t e^i H_t^i \leq \chi_2$

$$
\begin{aligned}
(1+\tau_c)C_t^i + K_{t+1}^i &= \big(1+(1-\tau_k)(r_t-\delta_t)\big)K_t^i \\
&+ \Big((1-\tau_s) w_t e^i H_t^i \\
&- \tau_h\Big((1-\tau_s) w_t e^i H_t^i - \big(a w_t e^i H_t^i + b\big)\Big)\Big) \\
&+ \Big((1-\tau_s) w_t \overline{H^m} \\
&- \tau_h\ \Big((1-\tau_s) w_t \overline{H^m} - (a w_t \overline{H^m} + b) \\
&- \big(\chi_2 - w_t e^i H_t^i\big)\Big)\Big) + \zeta
\end{aligned} \tag{11}
$$

- Bracket 5: $\chi_2 < w_t e^i H_t^i$

$$
\begin{aligned}
(1+\tau_c)C_t^i + K_{t+1}^i &= \big(1+(1-\tau_k)(r_t-\delta_t)\big)K_t^i \\
&+ \Big((1-\tau_s) w_t e^i H_t^i \\
&- \tau_h\Big((1-\tau_s) w_t e^i H_t^i - \big(a w_t e^i H_t^i + b\big)\Big)\Big) \\
&+ \Big((1-\tau_s) w_t \overline{H^m} \\
&- \tau_h\Big((1-\tau_s) w_t \overline{H^m} - (a w_t \overline{H^m} + b)\Big)\Big) + \zeta
\end{aligned} \tag{12}
$$

After a simple rearrangement, these budgets can be simplified as:

- Bracket 1 : $0 \leq w_t e^i H_t^i < \chi_1$

$$
\begin{aligned}
&(1+\tau_c)C_t^i + K_{t+1}^i \\
&\qquad = [1+(1-\tau_k)(r_t-\delta_t)]K_t^i + w_t e^i H_t^i \\
&\qquad + [(1-\tau_s) - \ \tau_h(1-\tau_s-a)]w_t\overline{H^m} + (b+\bar{S})\tau_h \\
&\qquad + \zeta
\end{aligned} \tag{13}
$$

- Bracket 2: $\chi_1 \le w_t e^i H_t^i \le \lambda$

$$
\begin{aligned}
&(1+\tau_c)C_t^i + K_{t+1}^i \\
&\qquad = [1+(1-\tau_k)(r_t-\delta_t)]K_t^i + [1-\tau_h]w_t e^i H_t^i \\
&\qquad + [(1-\tau_s) - \ \tau_h(1-\tau_s-a)]w_t\overline{H^m} + (b+\chi_2)\tau_h \\
&\qquad + \zeta
\end{aligned} \tag{14}
$$

- Bracket 3: $\lambda < w_t e^i H_t^i \le \xi$

$$
\begin{aligned}
&(1+\tau_c)C_t^i + K_{t+1}^i \\
&\qquad = [1+(1-\tau_k)(r_t-\delta_t)]K_t^i \\
&\qquad + [1-\tau_h(2-a)]w_t e^i H_t^i \\
&\qquad + [(1-\tau_s) - \tau_h(1-\tau_s-a)]w_t\overline{H^m} + (2b+\chi_2)\tau_h \\
&\qquad + \zeta
\end{aligned} \tag{15}
$$

- Bracket 4: $\xi < w_t e^i H_t^i \le \chi_2$

$$
\begin{aligned}
&(1+\tau_c)C_t^i + K_{t+1}^i \\
&\qquad = [1+(1-\tau_k)(r_t-\delta_t)]K_t^i \\
&\qquad + [(1-\tau_s) - \tau_h(2-\tau_s-a)]w_t e^i H_t^i \\
&\qquad + [(1-\tau_s) - \ \tau_h(1-\tau_s-a)]w_t\overline{H^m} + (2b+\chi_2)\tau_h \\
&\qquad + \zeta
\end{aligned} \tag{16}
$$

- Bracket 5: $\chi_2 < w_t e^i H_t^i$

$$
\begin{aligned}
&(1+\tau_c)C_t^i + K_{t+1}^i \\
&\qquad = [1+(1-\tau_k)(r_t-\delta_t)]K_t^i \\
&\qquad + [(1-\tau_s) - \tau_h(1-\tau_s-a)]w_t e^i H_t^i \\
&\qquad + [(1-\tau_s) - \ \tau_h(1-\tau_s-a)]w_t\overline{H^m} + 2b\tau_h + \zeta
\end{aligned} \tag{17}
$$

For our computation purpose, we denote:

$$
\phi^m \quad = \ 1 - [\tau_s + \ \tau_h(1-\tau_s-a)] \tag{18}
$$

$$\phi^i = \begin{cases} 1 & 0 \le w_t e^i H_t^i \le \chi_1 \\ 1-\tau_h & \chi_1 < w_t e^i H_t^i \le \lambda \\ 1-\tau_h(2-a) & \lambda < w_t e^i H_t^i \le \xi \\ 1-[\tau_s+\tau_h\,(2-\tau_s-a)] & \xi < w_t e^i H_t^i \le \chi_2 \\ 1-[\tau_s+\ \tau_h(1-\tau_s-a)] & \chi_2 < w_t e^i H_t^i \end{cases} \quad (19)$$

$$sub^i = \begin{cases} (b+S)\times\tau_h & 0 \le w_t e^i H_t^i \le \chi_1 \\ (b+\chi_2)\times\tau_h & \chi_1 < w_t e^i H_t^i \le \lambda \\ (2b+\chi_2)\times\tau_h & \lambda < w_t e^i H_t^i \le \xi \\ (2b+\chi_2)\times\tau_h & \xi < w_t e^i H_t^i \le \chi_2 \\ (2b)\times\tau_h & \chi_2 < w_t e^i H_t^i \end{cases} \quad (20)$$

Therefore, the household's problem is generalized as:

$$Max \sum_{t=0}^{\infty} \beta^t U\left(C_t^i, H_t^i\right) \quad (21)$$

where

$$U\left(C_t^i, H_t^i\right) = log\left(C_t^i\right) + \alpha log\left(L - H_t^i\right) \quad (22)$$

Subject to:

$$\begin{aligned} (1+\tau_c)C_t^i \ + K_{t+1}^i & \\ &= [1+(1-\tau_k)(r_t-\delta_t)]K_t^i + \phi^i w_t e^i H_t^i \\ &+ \phi^m w_t \overline{H^m} + sub^i + \zeta \end{aligned} \quad (23)$$

The First Order Condition (F.O.C):

Although we have five different brackets for the household's budget constraint in this study, the Euler equation is the same for all cohorts since they are homogeneous in terms of saving and investment behavior.

$$\frac{C_{t+1}^{i}}{C_{t}^{i}} = \beta[1 + (1 - \tau_k)(r_{t+1} - \delta_{t+1})] \tag{24}$$

The heterogeneity therefore can be observed in their labor supply behavior.

$$C_{t}^{i} = \phi^{i} \frac{w_t e^{i}\left(L - H_{t}^{i}\right)}{\alpha} \tag{25}$$

Note that we have five different values for $[\phi^{i}]$, thus, we actually have five different labor supply functions for each household. This component can be put together with the efficiency wage rate ($w_t e^{i}$) in order to interpret the numerator $[w_t e^{i} \phi^{i}]$ as the after-tax marginal efficiency-wage for the women. Theoretically, the higher the numerator, the longer the working hours will be supplied by the wives.

4.2 Production Technology

In this study, we simply follow a standard Cobb-Douglas aggregate production function with constant return to scale property. The firms are identical and of measure one.

$$Y_t = A_t K_t^{\theta} H_t^{1-\theta} \tag{26}$$

We assume that all firms are operating in a perfectly competitive market; thus, they rent the input factors at the marginal productivity of the factor, that is,

The wage rate equals the marginal productivity of labor:

$$\omega_t = (1-\theta)A_t\left(\frac{K_t}{H_t}\right)^{\theta} \tag{27}$$

The capital rental rate equals the marginal productivity of capital:

$$r_t = \theta A_t\left(\frac{K_t}{H_t}\right)^{\theta-1} \tag{28}$$

4.3 Government and Fiscal Balancing

In our model, the government collects the consumption tax, capital income tax and labor income tax to finance their general expenses and subsidies.

$$G_t + Sub_t + \zeta = \tau_c C_t + \tau_k(r_t - \delta_t)K_t + (1-\phi^m)w_t\overline{H^m} + TAX_t, \tag{29}$$

where Sub_t is the transfer of the government, which is related to the spousal deduction, basic and employment subsidies policies. It can be represented as:

$$Sub_t = \sum_{i=N,H}\{\pi^i sub_t^i\} \tag{30}$$

and TAX_t is the tax and social security premium revenues paid by working women:

$$TAX_t = \sum_{i=N,H}\{\pi^i(1-\phi^i)w_t e^i H_{w,t}^i\} \tag{31}$$

and (ζ) is a lump sum tax, which helps the government to balance their budget.

4.4 Competitive Equilibrium

We now define the competitive equilibrium of our economy as follows:

Given a set of the government's fiscal policies $\{G_t, \tau_c, \tau_k, \tau_s, \tau_h, \}_{t=0}^{\infty}$, a set of working efficiency parameters for males, high educated women and normal educated women, i.e. $\{1, e^H, e^N\}$ respectively, and finally, a set of prices $\{w_t, r_t\}$, a stationary competitive equilibrium is defined as an allocation of $\{C_t^N, H_t^N, K_{t+1}^N, C_t^H, H_t^H, K_{t+1}^H, H_t, K_t, C_t, Y_t\}_{t=0}^{\infty}$, such that

- The allocation solves the households' problem,
- The allocation also solves the firm's profit maximization problem in a perfectly competitive market,
- The government's budget is balanced,
- Aggregate economy:
    - Aggregate labor follows:

$$H_t = \overline{H^m} + [\pi^H e^H H_t^H + (1 - \pi^H) e^N H_t^N], \tag{32}$$

    - Aggregate capital follows:

$$K_t = \pi^H K_t^H + (1 - \pi^H) K_t^N, \tag{33}$$

    - Aggregate consumption follows:

$$C_t = \pi^H C_t^H + (1 - \pi^H) C_t^N, \tag{34}$$

    where π^H is the fraction of high educated women family in the society.

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

$$K_{t+1} = \left((1 - \delta) + (1 - \psi_t) A_t \left(\frac{K_t}{H_t}\right)^{\theta - 1}\right) K_t - C_t, \tag{35}$$

where $\psi_t = G_t / Y_t$, is the government share.

5 Calibration

In this section, we describe how we calibrate our model in order to match the model with the Japanese economy. A summary of the model parameters are reported in table 3-3 as explained below.

5.1 Data Sources

We now calibrate our model in order to match our model with the Japanese economy in 2000-2010. There are several data sources that we have used in this study. First, for the capital to output ratio, we take data from Hayashi and Prescott (2002) and Chen *et al.* (2007). Data related to the Japanese demographics were collected from Japanese Statistics Bureau, Ministry of Finance, Ministry of Health, Labour and Welfare and The Japan Institute for Labour Policy and Training. As we are studying the Japanese tax system, much information and data are collected from the Japanese Tax Agency (NTA).

5.2 Functional Forms

All functional forms (i.e., utility, production and tax function) selected are the most simple and standard in the related literature, which can capture the features of the sector's decision making, i.e., utility is a constant elasticity of the substitution (CES) function; production function is a standard Cobb-Douglas function; tax function is progressive.

5.3 Capital Share, Discount Factor and Depreciation Rate

We first set the capital share to 0.363 as the standard for Japan's economy in the literature. Next, we set the depreciation rate δ to 0.083 as in Chen *et al.* (2007). The discount factor (β) is then calibrated using the model Euler equation, given the above parameters, to match the average annual capital-output ratio of Japan in 2000, approximately 2.34, and set to $\beta = 0.961$.

5.4 Women's Educational Cohorts

In this study, Japanese women are classified into two cohorts based on their education level:

Cohort 1. Normal Educated Women (NEW) refers to those who graduated from one of the following three categories: (i) Primary or Junior school; (ii) Senior high school and (iii) Vocational school.

Cohort 2. High Educated Women (HEW) includes those who graduated from one of the following categories: (i) Junior college; (ii) College or university, and (iii) Graduate school.

We use the data from *2010 Basic Survey of Schools* [16] to calculate the share of these two cohorts. Accordingly, the fraction of the HEW in 2010 is 26.5% (see table 3-6).

5.5 Efficiency Levels

We normalize the working efficiency of Japanese men - the husbands - at one and calculate the working efficiency of the normal educated woman and high educated women based on their average monthly income[17] as 0.607 and 0.8 respectively.

5.6 Household preference and labor supply

We use the labor supply decision (i.e., the F.O.C with respect to the working hours of the wife and the related thresholds as discussed in Section 3.3.) to calibrate the household preference parameter (α) equal to 0.552. This implies that the normal educated women decide to work at 1.03 million yen threshold and the high educated women will work at their optimal level (i.e., above the

[16] The result of this Survey was reported in the Japan Statistical Yearbook, 2013.
[17] Data was provided in Basic Survey on Wage Structure, 1-30, June, 2010 by Ministry of Health, Labour and Welfare. See table 6

highest threshold – 1.43 million yen), and their weighted average working hours closely matched with the adjusted average working hours of Japanese female in 2000 – 2010, i.e., 24.4 hours per week (see table 3-7). The purpose of this matching is to capture the concentration of income earned by married women around 1.03 million yen in the Japanese data.

The time endowment in our model is normalized as 105 hours. The husband's working hours are set to 46.11 hours as the average working hours of Japanese men in studied period (2000 – 2010, see table 3-7).

5.7 Basic and Employment Deduction

Using a simple linear regression on the actual basic and employment deduction schedule, we are able to estimate the parameters for the basic and employment deduction. The slope of the model employment deduction (a) equals 0.163 and the intercept (b) is 980 thousand yen, which is converted to 27.22% of the male average income (see Figure 3-7).

5.8 Spousal Deduction, Tax and Social Security Thresholds

Finally, all the tax and social security thresholds mentioned in the text are converted into the model value as a percentage of the male's average income, i.e., $\chi_1 = 19.44\%$, $\lambda = 28.61\%$, $\xi = 36.11\%$, $\chi_2 = 39.17\%$, $AS \equiv SAS = 10.56\%$.

5.9 Fiscal Policy Set

Concerning the government's parameters, we set the capital tax (τ_k) to 43.5%, equate to the average capital income tax in the studied period [18], the consumption tax (τ_c) set to 5%, equate to the average consumption tax rate in

[18] The data of Capital Income tax were taken from Chen *et al.* (2006).

Japan in the studied period[19] and the labor income rate (τ_h) is set to 0.235, which is estimated by using a simple linear regression (R-square is 95%, see Figure 3-8). Lastly, the social security premium is about 15% of the total income (NIPSSR, 2011) and it is equally distributed between employer and employee. Thus, we set the social security premium (τ_{ss}) paid by the household at 7.5%[20]. The average government expenditure to output is commonly set at 15 % in the literature.

6 The Benchmark Economy

As discussed above, we calibrate our model in order to match with the Japanese economy in 2000-2010; thus, we take the year 2000 as our benchmark economy. However, we do not take the year 2000 as our baseline economy for further experiments due to a reform in 2003, which took effect in 2004 (the 2004 reform, hereafter).

The 2004 reform, which abolished the Special Allowance for Spouse, has been considered as the most major reform policy on the tax system so far. The reform was proposed in 2003 and officially implemented since fiscal year 2004 (1 April 2004). Details about the reform and its impact on the labor supply and the economy are discussed in Section 6. Due to the 2004 reform, we use the economy after the reform was implemented as our reference economy for our further experiments.

In the remaining part of this section, we discuss our benchmark economy and the microeconomic behavior of Japanese women in their working choice or the mechanism of the decision making with regards to work.

[19] The tax was first introduced in 1989 at 3% and then adjusted to 5%. However, during the early life of the tax, some kinds of consumption were taxed at a higher rate. Thus, we set the tax equal to 5% on average.

[20] This is relatively smaller than social security tax in other studies since they don't separate for employer and employee. We do, since we want to capture the real impact of the tax on household's working and saving decision.

In the benchmark economy, Japanese normal educated women choose to supply their labor at a level where they can get an income equal to the second threshold, which is 1.03 million. This is very reflective of the concentration of Japanese married women at this income level in the data. However, the high educated women's working decision does not depend on the spousal subsidy. Actually, they make decisions on working based on their optimization problem. To see how this fact could happen, we can look at Figure 3-9 (A, B), which is a space with the household's consumption on the vertical axis and wife's time spent for the family on the horizontal axis. Panel A shows the case of the normal educated wife, and Panel B shows the case of the high educated wife. The space is characterized as follows:

First, since the current tax and social security system created four thresholds for Japanese women as mentioned above, their household's budget line is non-linear and discontinuous. The outbound of the line is infeasible allocation, and vice versa.

Second, in this study, we assume the husbands' working hours are constant and identical among cohorts; thus, their incomes are also the same. Hence, the slope of the budget line depends only on the wives' after-tax income, which depends on three components: wage rate, efficiency level and working hours.

Third, we have two types of women in our model differentiated by education or working efficiency level. For the normal educated women, since they have a lower efficiency wage, the slope of their budget line (panel A) is greater or steeper than the slope of the high educated women (panel B). It means the budget line of the normal educated women is flatter.

Fourth, although the four thresholds are the same for all women in the society in terms of monetary income, it can be converted into thresholds in terms of working hours for different types of women by dividing the income thresholds

by the efficiency wage rate. Note also that the working hours' threshold levels are different for each type of women, and the gap among thresholds is bigger for the normal educated women since they have a lower efficiency wage.

As can be seen in Panel A, the first allocation for normal educated woman is point A, where the utility intersects with the No-Tax budget line. However, this allocation is infeasible. Thus, she has to lower her utility. The second allocation for her, where she can have the highest feasible utility, is point B, when she decides to work at the second threshold level. At this level, she has to pay neither tax nor social security premiums and her husband still enjoys a fraction of the spousal deduction. Of course, the decision also depends on the "dip" in her family budget line. If the dip is large enough, she will choose to work at the second allocation. However, if the dip is too small, her second option could be another choice. Our model suggests that the current tax and social security system have created a dip, which is high enough for married women to choose to work and consume at the second threshold level.

On the other hand, for the high educated woman, the first allocation is also infeasible (Point C, panel B). The second allocation for them could be point D, when she and her husband are totally independent in terms of being tax and social security contributors.

In short, our model shows that HEW's decision to work is not impacted by the spousal deductions. There is much evidence supporting this argument. First, Japanese data in 2011 show that only 37% normal educated women were working as regular staff; 63% of them are non-regular staff. In contrast, high educated women, who graduated from junior college and college or university, including graduate school, tend to engage in regular work (i.e., 57% of them are regular workers, the remaining are non-regular workers – see Table 3-4). In addition, this argument is also supported by two other empirical studies by

Sasaki (2002) and Hirao (2001) (i.e., Sasaki, 2002 shows that employed married women are more highly educated than housewives, and Hirao, 2001, shows that university graduates are more likely to stay in the labor force).

7 Policy Experiments

In this section, we provide some experiments to examine the impact of the Japanese tax and social security system on women's working behavior as well as on the aggregate economy. We perform three experiments including (i) The 2004 reform proposal, (ii) Removing Spousal Deduction and (iii) Removing all threshold levels and treating tax payers independently. Below we report our experiment results. All mathematical and technical changes needed for the experiments are provided in the endnote of this Chapter. All results are reported in Table 3-8.

7.1 Does the 2004 Reform Proposal really work?

In 2003, in order to respond to structure changes in Japanese society, Japanese Prime Minister Koizumi's government proposed a tax reform package. One important point was to abolish part of the special deduction for spouses (added-on portion in Figure 3-4, A & B). The proposal then was successfully passed by the Japanese Diet took effect from 1 April 2004. Until now, that has been considered the most significant reform in the individual tax system.

In order to examine the impact of the reform, Sakata and McKenzie (2004) using survey data collected in 2004, 2005 and applying a difference-in-differences approach show the negative impact of the 2004 tax reform; that is, married women actually reduced their labor supply after the reform policy took effect rather than increased it. They called this finding as a "puzzling unexpected impact" and then try to explain the puzzle with some possible reasons. Does the 2004 tax reform really work? Our theoretical model and experiment shows that

the 2004 reform does not really help Japan in terms of encouraging women back into work. In fact, our simulation shows that the 2004 reform could not change the working behavior of the normal educated cohort. The high educated women, however, increased their labor supply after the amendment (increased by 0.76%). This impact on high educated women could be mainly caused by the income effect on their working decision as a result of the general equilibrium (Since the government budget is financed by the labor income tax, a reduction in government spending leads to a lower tax revenue needed, and thus, lowers the labor income tax. This lower labor income tax encourages HEW to work slightly more. NEW, however, still get stuck at the concentration points; the reform is too small to change their working decision). Consequently, the economy's output increases at a modest level (0.10%).

7.2 Removing the Spousal Deduction

We attempt to investigate the magnitude of the distortion that is caused by the current spousal deduction policy. In this experiment, we remove the spousal deduction for husband and compared the result with the benchmark economy.. Our simulation shows that by applying this reform, Japan could increase her aggregate labor by 4.11%. This will boost the economy's output to 4.11%. The increase in aggregate labor could be seen by each cohort. For the normal educated women family, the wives will increase their labor supply by 26.22%. The labor supply by the high educated woman family will also increase slightly, by 3.43%. The reasons for these adjustments are as discussed below.

Since the government removes the spousal deduction policy, it will have a surplus in the budget. Since in this experiment, we fix government expenditure and the lump-sum tax/transfer and let the labor income tax take the balancing role for the government budget. Due to the surplus, the government will decide to reduce the labor income tax (from 23.58% to 17.91%); consequently, high educated women have more incentive to work. For the normal educated

women, on the one hand, since the spousal deduction policy is removed, they have to work more in order to spend on their consumption. But on the other hand, due to the decrease in the labor income tax, they also have more incentives to work. These two effects have a positive impact on their working incentives boost their labor supply to significant levels (increased by 26.22%).

This means the distortion caused by the Japanese spousal deduction policy is quite significant (about 4.11% of the aggregate labor as well as the output).

7.3 Removing all Thresholds and Deduction

We now create a scenario whereby the Japanese government removes all of the thresholds that we discussed in Section 3.3 and also removes all of the subsidies for women (i.e., there is no special deduction for tax payers, except the basic and employment deduction; all people, who have income higher than the sum of the basic and employment deduction level, have to pay income tax and social security premiums). Our simulation shows that Japan could increase the total labor supply by up to 7.52%. Thereby, it will boost the economy's total output by 7.52%. More importantly, the normal educated women will work approximately 48.18% more than the current level, and the high educated women will also work longer by about 6.08%.

Notice that we fix the government expenditure and the lump-sum tax/transfer at the reference economy level. Once again, we let the labor income tax take the balancing role for the government budget. As discussed above, the government surplus leads to a decrease in the labor income tax (from 23.58% to 14.59%); this considerable decrease in the labor income tax encourages both the normal and high educated women to work more.

8 Concluding Remarks

We attempt to see the impact of the tax and social security system on Japanese women's working decision and quantify the impact on the whole economy. For that purpose, we have identified four income thresholds in the tax and social security system. We then construct a model to mimic these thresholds and the Japanese economy. Based on a general equilibrium analysis, we are able to show that the impacts are different on different education cohorts. It does create a tax disincentive to work for the normal educated women cohort while it does not have any impact on the high educated women cohort. Furthermore, our policy experiments show that by removing the spousal deduction policy, the aggregate labor and output could be boosted by 4.11%. Moreover, if the Japanese government removes all of the tax and social security thresholds, the Japanese labor supply will increase by 7.52% and it will boost the output by almost the same level. We also show that the 2004 reform has a limited impact on the economy. This finding is consistent with the result of an empirical study by Sakata and McKenzie (2005).

The exercise we proposed has some limitations. First and foremost, we have just focused on the tax and social security system and disregarded other constraints for Japanese women's working decision such as the childcare constraint. In the future, we will extend our study to this direction to better understand the Japanese women's working decisions. Particularly, we will examine the economic consequences if the Japanese government decides to provide more subsidies for childcare. Furthermore, since we have used a simple *log*-utility function in this study, the female labor elasticity might be either slightly overestimated or underestimated. A more precise utility function should be used in future research.

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Computational Notes

In this note, we will describe our mathematic model and computation process.

A1 The Generalized Model:

Putting all equations or conditions together, we now can see a generalized model as follows:

Euler equation for normal educated women family:
$$\frac{C_{t+1}^N}{C_t^N} = \beta[1 + (1 - \tau_k)(r_{t+1} - \delta_{t+1})] \quad \text{(M1)}$$

Euler equation for high educated women family
$$\frac{C_{t+1}^H}{C_t^H} = \beta[1 + (1 - \tau_k)(r_{t+1} - \delta_{t+1})] \quad \text{(M2)}$$

Labor supply of the normal educated women family:
$$C_t^N = \frac{\phi^L w_t e^N (L - H_t^N)}{\alpha} \quad \text{(M3)}$$

Labor supply of the High educated women family:
$$C_t^H = \frac{\phi^H w_t e^H (L - H_t^H)}{\alpha} \quad \text{(M4)}$$

Marginal Productivity condition for labor:
$$w_t = (1 - \theta) A_t \left(\frac{K_t}{H_t}\right)^{\theta} \quad \text{(M5)}$$

Marginal Productivity condition for capital:
$$r_t = \theta A_t \left(\frac{K_t}{H_t}\right)^{\theta - 1} \quad \text{(M6)}$$

Aggregate form for labor supply
$$H_t = \overline{H^m} + [\pi^H e^H H_t^H + (1 - \pi^H) e^N H_t^N] \quad \text{(M7)}$$

Aggregate form for capital
$$K_t = \pi^H K_t^H + (1 - \pi^H) K_t^N \quad \text{(M8)}$$

Aggregate form for consumption
$$C_t = \pi^H C_t^H + (1 - \pi^H) C_t^N \quad \text{(M9)}$$

Law of motion (Rearranged using the economy resource constraint):
$$K_{t+1} = \left((1 - \delta) + (1 - \psi_t) A_t \left(\frac{K_t}{H_t}\right)^{\theta - 1} \right) K_t - C_t \quad \text{(M10)}$$

The NEW family budget constraint:

$$\begin{aligned}(1+\tau_c)C_t^N + K_{t+1}^N &= [1+(1-\tau_k)(r_t-\delta_t)]K_t^N \\ &+ \phi^N w_t e^N H_t^N + \phi^m w_t \overline{H^m} \\ &+ sub^N + \zeta\end{aligned} \tag{M11}$$

The HEW family budget constraint

$$\begin{aligned}(1+\tau_c)C_t^H + K_{t+1}^H &= [1+(1-\tau_k)(r_t-\delta_t)]K_t^H \\ &+ \phi^H w_t e^H H_t^H + \phi^m w_t \overline{H^m} \\ &+ sub^H + \zeta\end{aligned} \tag{M12}$$

The government budget balance:

$$\begin{aligned}G_t + Sub_t + \zeta &= \tau_c C_t + \tau_k(r_t-\delta_t)K_t \\ &+ (1-\phi^m)w_t\overline{H^m} + TAX_t\end{aligned} \tag{M13}$$

Total transfer

$$Sub_t = \sum_{i=N,H}\{\pi^i sub_t^i\} \tag{M14}$$

Tax paid by women

$$TAX_t = \sum_{i=N,H}\{\pi^i(1-\phi^i)w_t e^i H_{w,t}^i\} \tag{M15}$$

In Steady State

In Steady state, assume that $A = 1$ as the benchmark of the economy and denote x= $\frac{K}{H}$.

We have:

Euler equation:

$$r = \frac{\frac{1}{\beta}-1}{1-\tau_k} + \delta \tag{S1}$$

K/H ratio

$$X = \left(\frac{\frac{\frac{1}{\beta}-1}{1-\tau_k}+\delta}{\theta}\right)^{\frac{1}{\theta-1}} \tag{S2}$$

Marginal Productivity condition for labor:

$$w = (1-\theta)X^{\theta} \tag{S3}$$

Marginal Productivity condition for capital:

$$r = \theta X^{\theta-1} \tag{S4}$$

Labor supply of the normal educated women family:

$$C^N = \frac{\phi^N we^N (L - H^N)}{\alpha} \quad \text{(S5)}$$

Labor supply of the high educated women family:

$$C^H = \frac{\phi^H we^H (L - H^H)}{\alpha} \quad \text{(S6)}$$

Aggregate form for labor supply

$$H = \overline{H^m} + [\pi^H e^H H^H + (1 - \pi^H) e^N H^N] \quad \text{(S7)}$$

Aggregate form for capital

$$K = \pi^H K^H + (1 - \pi^H) K^N \quad \text{(S8)}$$

Aggregate form for consumption

$$C = \pi^H C^H + (1 - \pi^H) C^N \quad \text{(S9)}$$

Law of motion (Rearranged using the economy resource constraint):

$$K = \left((1 - \delta) + (1 - \psi)(X)^{\theta - 1}\right) K - C \quad \text{(S10)}$$

The NEW family budget constraint:

$$(1 + \tau_c) C^N = (1 - \tau_k)(r - \delta) K^N + \phi^N we^N H^N + \phi^m w \overline{H^m} + sub^N + \zeta \quad \text{(S11)}$$

The HEW family budget constraint

$$(1 + \tau_c) C^H = (1 - \tau_k)(r - \delta) K^H + \phi^H we^H H^H + \phi^m w \overline{H^m} + sub^H + \zeta \quad \text{(S12)}$$

The government budget balance:

$$G + Sub + \zeta = \tau_c C + \tau_k (r - \delta) K + (1 - \phi^m) w \overline{H^m} + TAX \quad \text{(S13)}$$

Total transfer

$$Sub = \sum_{i=N,H} \{\pi^i sub^i\} \quad \text{(S14)}$$

Tax paid by women

$$TAX = \sum_{i=N,H} \{\pi^i (1 - \phi^i) we^i H^i\} \quad \text{(S15)}$$

A2 Simulation Note

Step 1. Given all parameters, by using the Euler equation, we calculate all prices (interest rate, wage) for the economy. Then, using the firm optimization rule, we calculate the aggregate Capital to Labor (K/H) ratio.

Step 2. Guessing the initial value of Capital holding by the normal educated women family and the high educated women family, we then simultaneously calculate the best allocation (i.e., a combination between consumption and working hours) of each family by using the labor supply function (The F.O.C. w.r. working hours), budget constraint and threshold levels[21]. The best allocation is selected if the allocation give the agent highest utility.

Step 3. After having the allocations of both families, we are now able to calculate the new capital holding by each family by using the law of motion, the aggregate form (i.e., the weighted average of individual allocation) and prices.

Step 4. Checking the convergence of the initial guessed value of capital and the newly calculated capital, if the difference is higher than the convergence criteria, which is a very small number; we update the initial guess and run the program again. If it is converged, then, we stop running and calculate all necessary variables.

Thanks to the lump-sum tax/transfer, the government budget is balanced in Benchmark economy. In our simulation, the lump-sum was also guessed at the beginning, updated in each simulation and finally converged at the end of our program. Later, in all other experiments, we fix the government general expenditures and lump-sum transfer at the benchmark economy level and let labor income tax hold the government budget balancing role.

[21] The allocation at the threshold level is calculated by using the threshold level and the budget constraints equation (the F.O.C does not hold at the level).

A3 Experiment 1: The 2004 Reform Proposal in the Model

As discussed in the text about the 2004 reform policy, the reform proposal can be implemented by the following rule in our model.

Equation (7) becomes:

$$S_{2004+} = \begin{cases} \overline{AS} & 0 \le w_t e^i H_t^i < \lambda \\ (\chi_2 - w_t e^i H_t^i) & \lambda \le w_t e^i H_t^i \le \chi_2 \\ 0 & \chi_2 < w_t e^i H_t^i \end{cases} \quad \text{(E1)}$$

and the government subsidy (equation 20) now follows the rule below:

$$sub^i = \begin{cases} (b + AS) \times \tau_h & 0 \le w_t e^i H_t^i \le \lambda \\ (2b + \chi_2) \times \tau_h & \lambda < w_t e^i H_t^i \le \xi \\ (2b + \chi_2) \times \tau_h & \xi < w_t e^i H_t^i \le \chi_2 \\ (2b \times \tau_h) & \chi_2 < w_t e^i H_t^i \end{cases} \quad \text{(E2)}$$

A4 Experiment 2: Remove Spousal Deduction

If the Japanese government removes the spousal deduction, the family budgets (equation 8-12) become:

- Bracket 1 : $0 \leq w_t e^i H_t^i \leq \lambda$

$$\begin{aligned}(1+\tau_c)C_t^i + K_{t+1}^i \\ &= [1+(1-\tau_k)(r_t-\delta_t)]K_t^i + w_t e^i H_t^i + (1-\tau_s)w_t\overline{H^m} \\ &- \tau_h[(1-\tau_s)w_t\overline{H^m} - (aw_t\overline{H^m}+b)] + \zeta\end{aligned} \tag{E3}$$

- Bracket 2: $\lambda < w_t e^i H_t^i \leq \xi$

$$\begin{aligned}(1+\tau_c)C_t^i + K_{t+1}^i \\ &= [1+(1-\tau_k)(r_t-\delta_t)]K_t^i \\ &+ \left[w_t e^i H_t^i - \tau_h\left(w_t e^i H_t^i - \left(aw_t e^i H_t^i + b\right)\right)\right] \\ &+ \left[(1-\tau_s)w_t\overline{H^m} - \tau_h\left((1-\tau_s)w_t\overline{H^m} - (aw_t\overline{H^m}+b)\right)\right] \\ &+ \zeta\end{aligned} \tag{E4}$$

- Bracket 3 : $\xi < w_t e^i H_t^i$

$$\begin{aligned}(1+\tau_c)C_t^i + K_{t+1}^i \\ &= [1+(1-\tau_k)(r_t-\delta_t)]K_t^i \\ &+ \left[(1-\tau_s)w_t e^i H_t^i\right. \\ &\left.- \tau_h\left((1-\tau_s)w_t e^i H_t^i - \left(aw_t e^i H_t^i + b\right)\right)\right] \\ &+ \left[(1-\tau_s)w_t\overline{H^m} - \tau_h\left((1-\tau_s)w_t\overline{H^m} - (aw_t\overline{H^m}+b)\right)\right] \\ &+ \zeta\end{aligned} \tag{E5}$$

and also can be simplified as:

- Bracket 1 : $0 \leq w_t e^i H_t^i \leq \lambda$

$$\begin{aligned}(1+\tau_c)C_t^i + K_{t+1}^i \\ &= [1+(1-\tau_k)(r_t-\delta_t)]K_t^i + w_t e^i H_t^i \\ &+ [(1-\tau_s) - \tau_h(1-\tau_s-a)]w_t\overline{H^m} + b\tau_h + \zeta\end{aligned} \tag{E6}$$

- Bracket 2: $\lambda < w_t e^i H_t^i \leq \xi$

$$\begin{aligned}(1+\tau_c)C_t^i + K_{t+1}^i \\ &= [1+(1-\tau_k)(r_t-\delta_t)]K_t^i + [1-\tau_h(1-a)]w_t e^i H_t^i \\ &+ [(1-\tau_s) - \tau_h(1-\tau_s-a)]w_t\overline{H^m} + 2b\tau_h + \zeta\end{aligned} \tag{E7}$$

- Bracket 3: $\xi < w_t e^i H_t^i$

$$
\begin{aligned}
&(1+\tau_c)C_t^i + K_{t+1}^i \\
&\qquad = [1+(1-\tau_k)(r_t-\delta_t)]K_t^i \\
&\qquad + [(1-\tau_s)-\tau_h(1-\tau_s-a)]w_t e^i H_t^i \\
&\qquad + [(1-\tau_s)-\ \tau_h(1-\tau_s-a)]w_t\overline{H^m} + 2b\tau_h + \zeta
\end{aligned}
\tag{E8}
$$

Therefore, the household's problem now becomes:

$$
Max \sum_{t=0}^{\infty} \beta^t U\left(C_t^i, H_t^i\right)
\tag{E9}
$$

$$
\text{where } U\left(C_t^i, H_t^i\right) = log\left(C_t^i\right) + \alpha log\left(L - H_t^i\right)
$$

Subject to:

$$
\begin{aligned}
&(1+\tau_c)C_t + K_{t+1} \\
&\qquad = [1+(1-\tau_k)(r_t-\delta_t)]K_t + \phi^i w_t e^i H_t^i + \phi^m w_t\overline{H^m} \\
&\qquad + sub^i + \zeta
\end{aligned}
\tag{E10}
$$

where:

$$
\phi^m \ = \ 1 - [\tau_s + \ \tau_h(1-\tau_s-a)]
\tag{E11}
$$

$$
\phi^i \ = \begin{cases} 1 & 0 < w_t e^i H_t^i \le \lambda \\ 1-\tau_h(1-a) & \lambda < w_t e^i H_t^i \le \xi \\ 1-[\tau_s + \ \tau_h(1-\tau_s-a)] & \xi < w_t e^i H_t^i \end{cases}
\tag{E12}
$$

$$
sub^i = \begin{cases} b\tau_h & 0 < w_t e^i H_t^i \le \lambda \\ 2b\tau_h & \lambda < w_t e^i H_t^i \le \xi \\ 2b\tau_h & \xi < w_t e^i H_t^i \end{cases}
\tag{E13}
$$

A5 Experiment 3: Completely Removing all Income Thresholds

In this experiment, the household's problem simply becomes:

$$Max \sum_{t=0}^{\infty} \beta^t U\left(C_t^i, H_t^i\right) \quad \text{where } U\left(C_t^i, H_t^i\right) = log\left(C_t^i\right) + \alpha log\left(L - H_t^i\right) \tag{E14}$$

Subject to:

$$\begin{aligned}(1+\tau_c)C_t + K_{t+1} &= [1 + (1-\tau_k)(r_t - \delta_t)]K_t \\ &+ \left[1 - [\tau_s + \tau_h(1-\tau_s - a)]\right] w_t e^i H_t^i \\ &+ \left[1 - [\tau_s + \tau_h(1-\tau_s - a)]\right] w_t \overline{H^m} + 2b\tau_h + \zeta\end{aligned} \tag{E15}$$

Tables

Table 3-1. Japanese Marginal Tax Rate

(Progressive Tax Rates)

Individual Taxable Income *(in Thousand Yen)*	National Income Tax *1999-2010*	National Income Tax *Since 2011*
$0 < y < 1{,}950$	10%	5%
$1{,}950 \leq y < 3{,}300$		10%
$3{,}300 \leq y < 6{,}950$	20%	20%
$6{,}950 \leq y < 9{,}000$		23%
$9{,}000 \leq y < 18{,}000$	30%	33%
18,000 and more	37%	40%

Source: Japanese Tax System, 2005, 2011

Table 3-2. The Employment Income Deduction

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

Source: Japanese Tax System, 2007

Table 3-3. The Model's Features

Since the model employs four thresholds for each married women worker (i.e., two for full AS/SAS deduction, χ_1, χ_2 and the other two for individual income tax threshold, λ and social security premium, ξ), the family budget constraint can be separated into 5 brackets based on the wife's original income (or gross income).

(In thousand Yen)

Income Brackets	Wife's Gross Income		Features
	Reality *(annually)*	Modeled Parameters *(weekly)*	
Bracket 1	(0.00 ~ 700]	$0 \leq w_t e^i H_t^i \leq \chi_1$	• No Income Tax for the wife • No S.S. Tax for the wife • Full AS/SAS deduction for the husband
Bracket 2	(700 ~ 1,030]	$\chi_1 < w_t e^i H_t^i \leq \lambda$	• No Income Tax for the wife • No S.S. Tax for the wife • Lower AS/SAS deduction for the husband
Bracket 3	(1,030~ 1,300]	$\lambda < w_t e^i H_t^i \leq \xi$	• Wife starts paying Income Tax • No S.S. Tax for the wife • Small AS/SAS deduction for the husband
Bracket 4	(1,300 ~ 1,430]	$\xi < w_t e^i H_t^i \leq \chi_2$	• Wife pays Income Tax • Wife starts paying S.S. Tax • Very small AS/SAS deduction for the husband
Bracket 5	(1,430 ~....)	$\chi_2 < w_t e^i H_t^i$	• Wife pays Income Tax • Wife pays S.S. Tax • No AS/SAS deduction for the husband

Note: the $(0 \leq \chi_1 \leq \lambda \leq \xi \leq \chi_2)$ *condition was hold in our model.*

Table 3-4. Summary of the Model Parameters

Parameters	Description	Value	Sources
β	Discount Factor	0.961	Calibrated to match KY ratio
θ	Capital Share	0.363	Standard
α	Preference Parameter	0.552	Calibrated/Labor Supply
δ	Depreciation Rate	0.083	Chen et al (2006)
$\tau_{h,t}$	Labor Income Tax	0.2358	Matched, see Figure 3-9
$\tau_{ss,t}$	Social Security Tax	0.075	Employee share
$\tau_{k,t}$	Capital Income Tax	0.435	Chen et al (2006)
$\tau_{c,t}$	Consumption Tax	0.050	Current tax
H^m	Male labor supply	46.11	Data[1]
e^H	Efficiency Level of HEW	0.800	Data[2]
e^L	Efficiency Level of LEW	0.607	Data[2]
π^H	Fraction of HEW	0.265	Data[3]
χ_1	Threshold 1	19.44	% of average male income
λ	Threshold 2	28.61	% of average male income
ξ	Threshold 3	36.11	% of average male income
χ_2	Threshold 4	39.17	% of average male income
AS/SAS	Spousal Deduction	10.56	% of average male income
a	Employment Deduction Parameter	0.1632	Matched, see Figure 3-8
b	Employment Deduction Intercept	27.22	% of average male income
G/GNP	General Expenditure	0.15	Exogenous

Data sources:

1. Statistics Bureau of Japan, see Table 3-7.

2. Ministry of Health, Labour and Welfare, Basic Survey on Wage Structure, 2010. Table 3-6.

3. Statistical Survey Department, Statistics Bureau, Ministry of Internal Affairs and Communications.

Table 3-5: Japanese Women's Job status and Education Level (2011)

Job Status	Graduated from school				
	Total	Primary school, junior or senior high school		Junior college, College or university (including graduate school)	
	(10.000 persons)	Level (10.000 persons)	Percent	Level (10.000 persons)	Percent
Regular staff	963	398	36.85	565	57.07
Non-regular staff	1107	682	63.14	425	42.92
Total	***2070***	***1080***	***100***	***990***	***100***

Source: The Japanese Statistics Bureau, 2011.

Table 3-6. Monthly Income and Population by Gender, Education (2010)

In 1,000 yen

Wage *(In yen)*	Colleges, Graduates of Colleges	Graduates of Higher Professional Schools or Junior Colleges	Graduates of Senior High Schools	Average
Male	395,300	300,100	289,100	328,300
Female	274,700	242,900	199,400	227,600

Source: Ministry of Health, Labour and Welfare, Basic Survey on Wage Structure, 2010,

Table 3-7. Average Weekly Working Hours

Year	Both sexes	Male	Female
2000	42.70	47.30	36.10
2001	42.20	46.70	35.70
2002	42.20	46.80	35.50
2003	42.00	46.60	35.30
2004	42.00	46.70	35.40
2005	41.80	46.50	35.10
2006	41.70	46.30	35.10
2007	41.10	45.60	34.60
2008	40.70	45.30	34.40
2009	40.20	44.60	34.10
2010	40.30	44.80	34.10
Average	41.54	46.11	35.04
Adjusted for employed & age cohort (20+)			
(The employment rate of female 20+ is about 68.75%.)			24.4

** Data for 2010 are not including three prefectures (Iwate, Miyagi and Fukushima).*

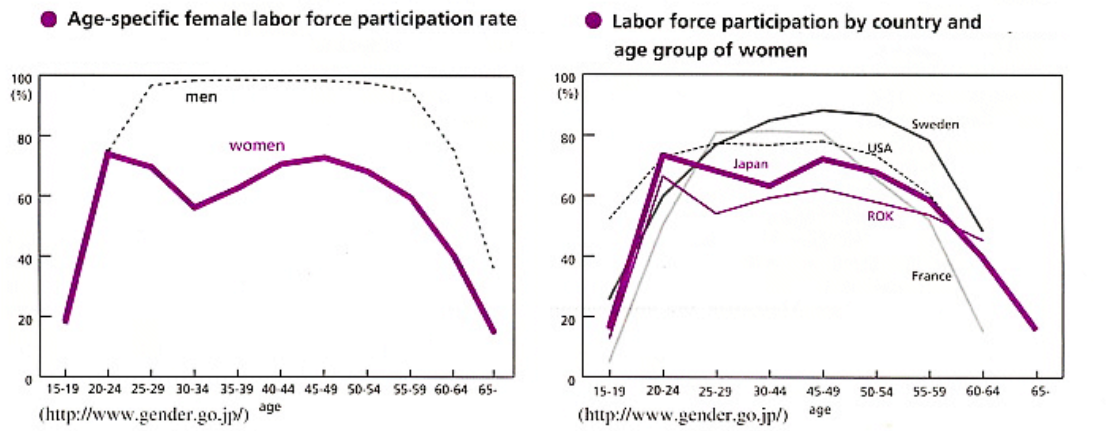
Source: Statistics Bureau of Japan

Table 3-8. Benchmark and Policy Experiment Result

Variables	Benchmark	The 2004 Reform *(reference)*	Remove the SAS Policy	Completely Remove All
Interest rate	15.48%	-	-	-
Wage	1.04	-	-	-
Aggregate variables				
Consumption	66.97	+0.12%	+5.05%	+8.40%
Labor	62.87	+0.10%	+4.11%	+7.52%
Capital	239.55	+0.10%	+4.11%	+7.52%
Output	102.17	+0.10%	+4.11%	+7.52%
Normal Educated Women				
Consumption	63.89	+0.22%	+5.72%	+9.77%
Labor supply	19.76	-	+26.22%	+48.18%
Capital	240.80	+1.56%	+5.74%	+12.26%
High Educated Women				
Consumption	75.49	-0.13%	+3.47%	+5.20%
Labor supply	37.49	+0.76%	+3.43%	+6.04%
Capital	236.08	-3.86%	-0.55%	-6.02%
Labor Income Tax	**23.58%**	**23.29%**	**17.91%**	**14.59%**

Figures

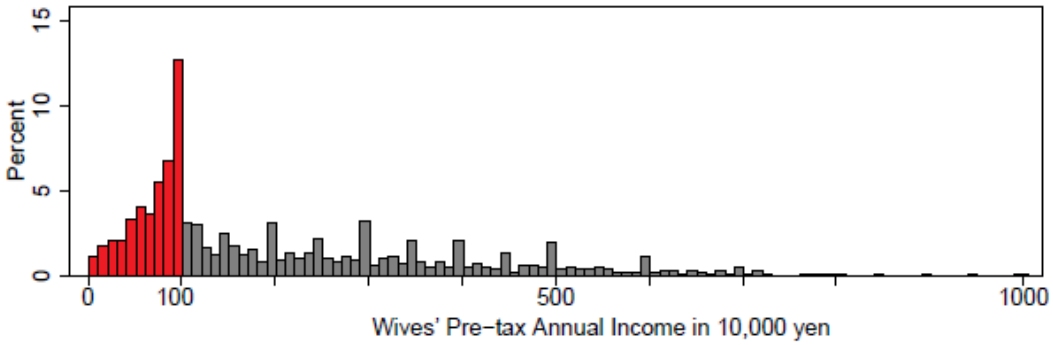
Figure 3-1. Female Labor Force Participation in Japan



Source: Hiroko Seino (____)

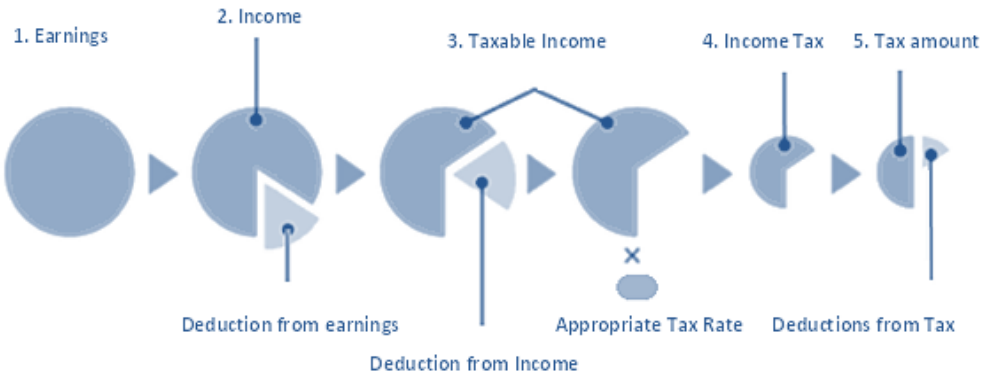
Figure 3-2. Annual Income Distribution

Wive's Pre-Tax Annual Income



Source: Takahashi, Kawade and Kato (2009)

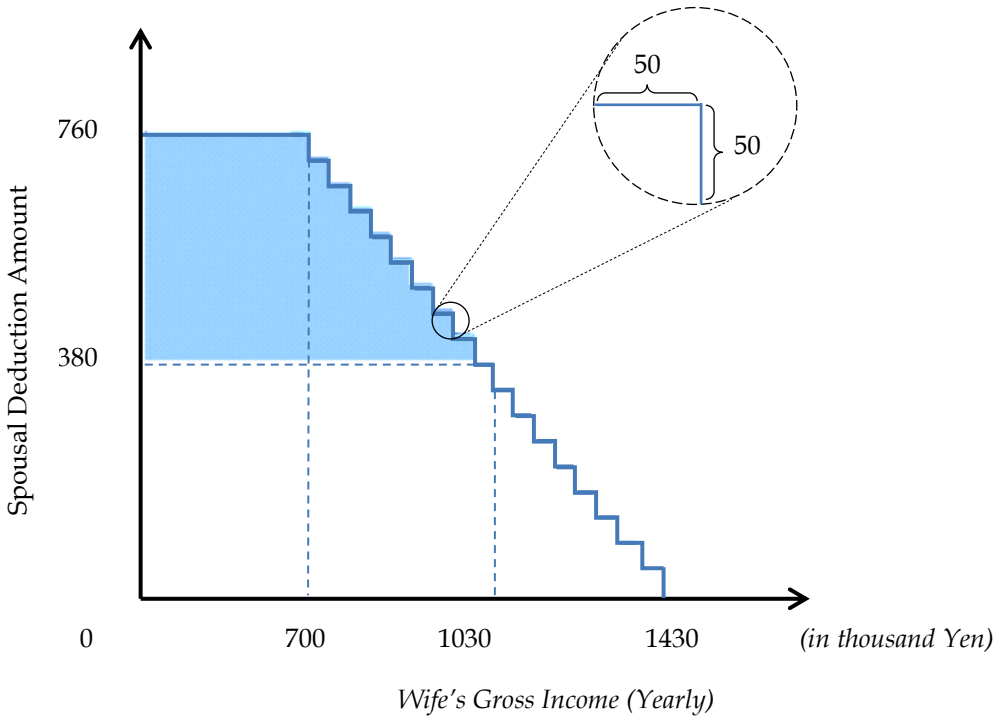
Figure 3-3. How to Calculate Income Tax in Japan



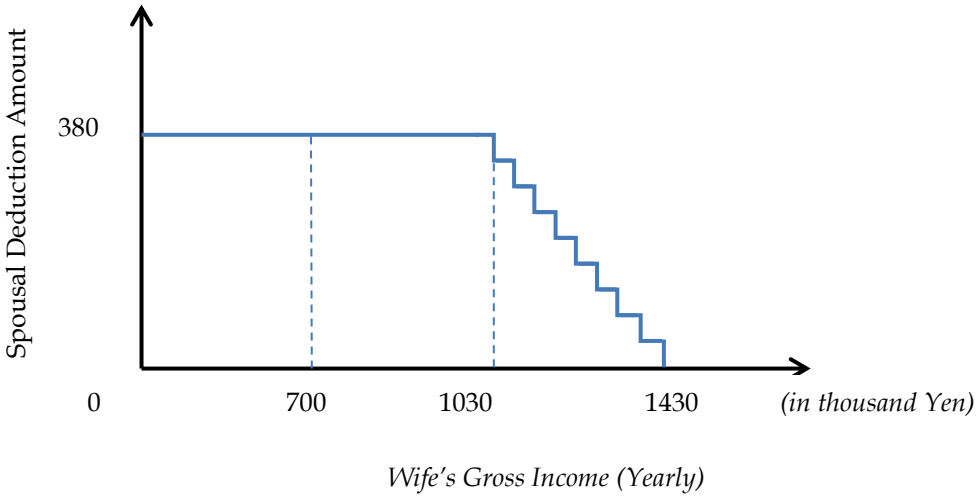
Note: Deductions from earnings include: Necessary deductible expenses (biz), Employment income deduction, Deduction for insurance premiums. Deduction from earnings includes: Deduction for casualty losses, medical expenses, other insurance premiums, donations, disabled, spouses and dependents, etc.

Source: Japanese Income Tax Guide (2011)

Figure 3-4. Spousal Deduction: 2003 vs. 2004



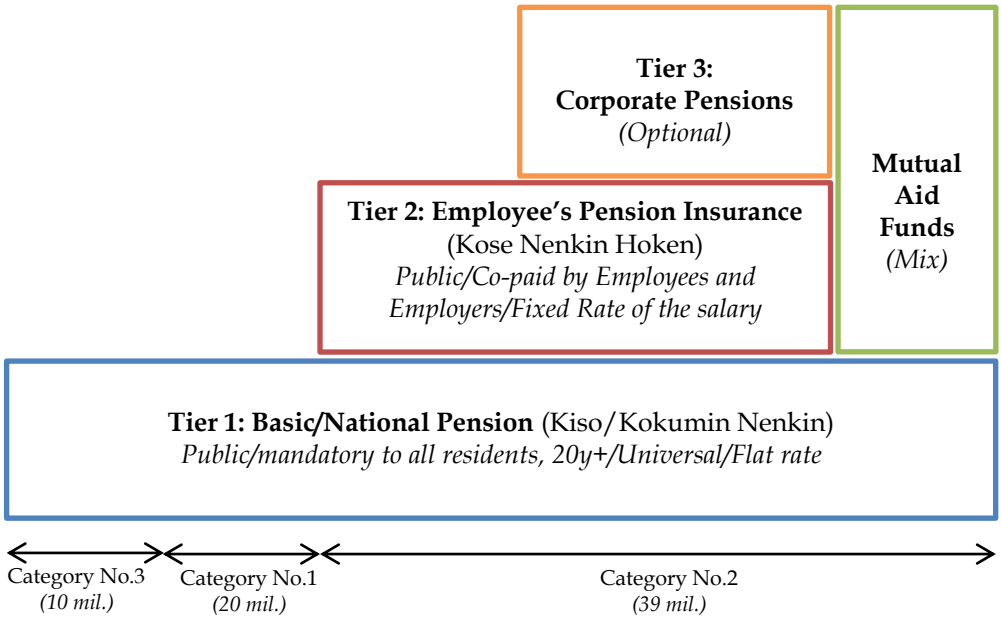
A. Spousal Deduction before 2003



B. 2004 Reform Proposal

Source: Japanese Tax System, 2003, 2005

Figure 3-5. Pension System in Japan



Note: Numbers in ( ) are number of subscribers in March 2010. | Category No.1, 2, & 3 denote categories of subscribers: No.1 is for self-employed, farmers, students, etc., No.2 is for employees, and No.3 is for spouses of No.2.

Source: NIPSS (2011). Social Security in Japan

Figure 3-6. The Family Income Schedule

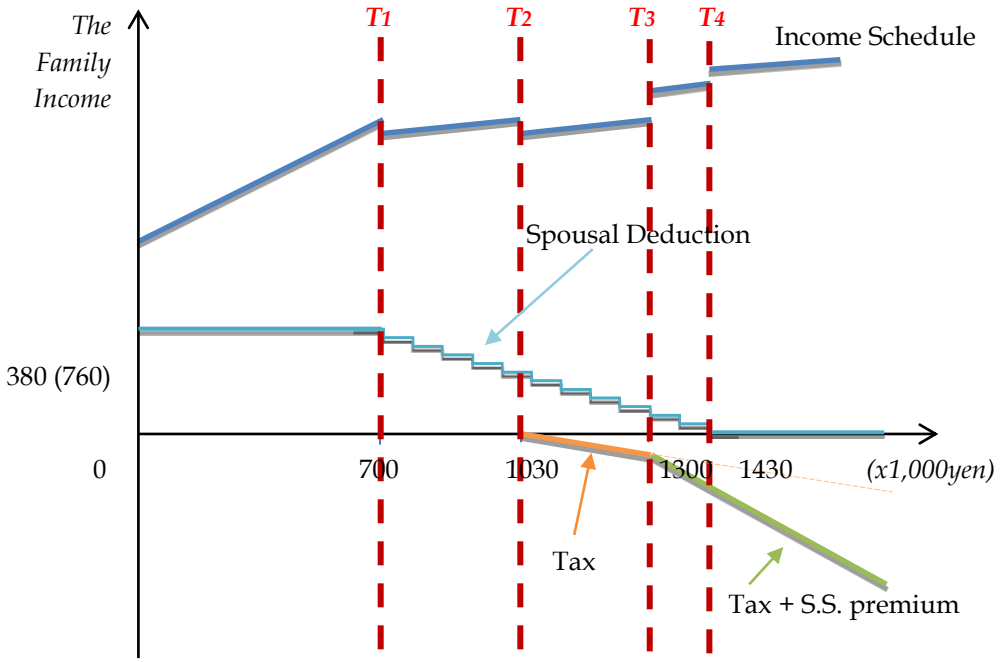


Figure 3-7. Basic and Employment Deduction Schedule

(in Thousand Yen)

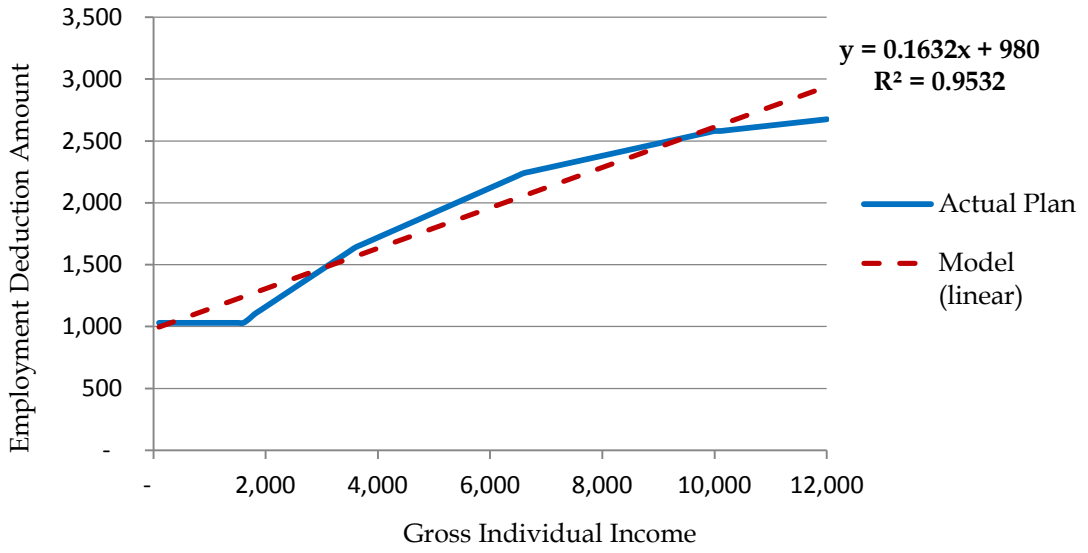


Figure 3-8. Tax Payment Schedule & Marginal Tax Rate

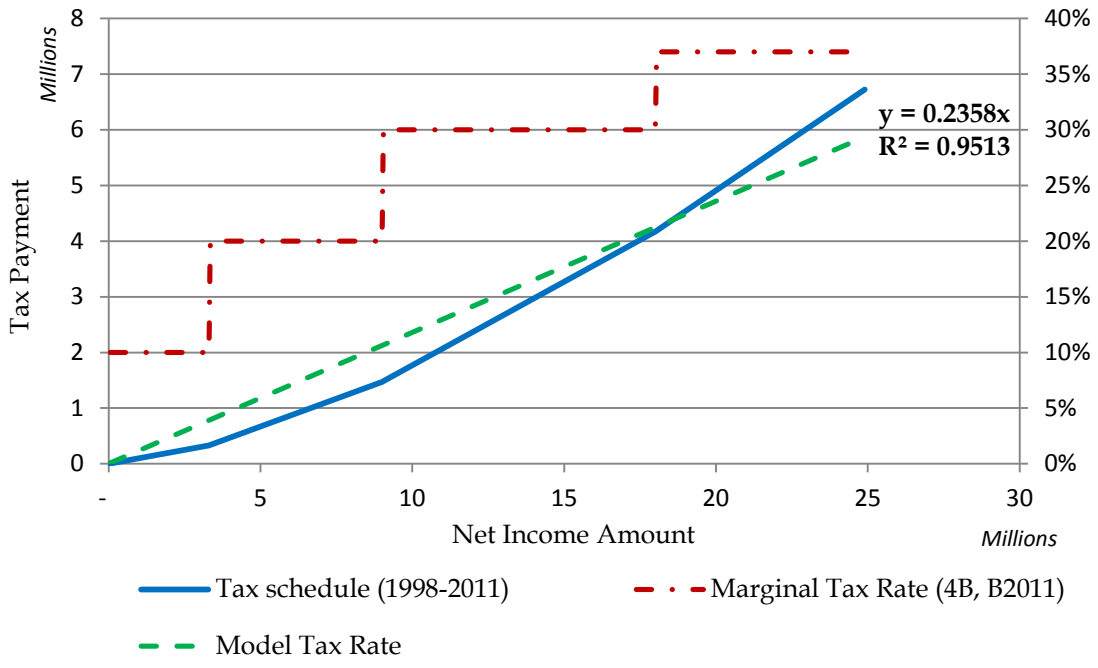
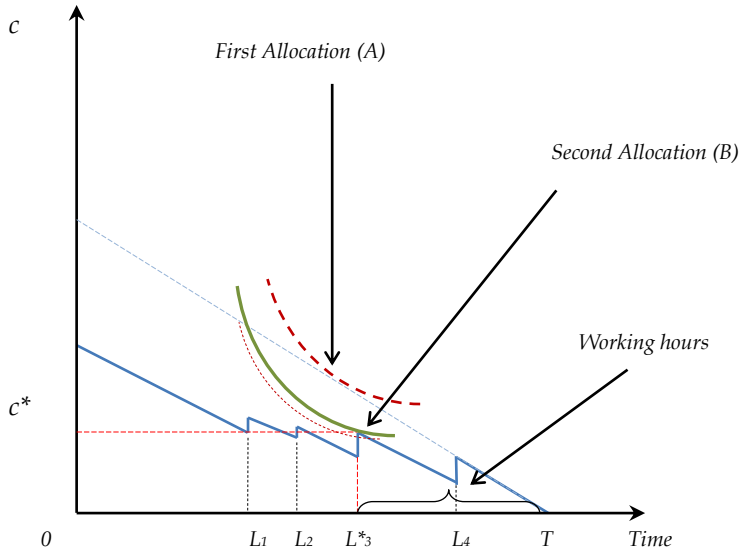
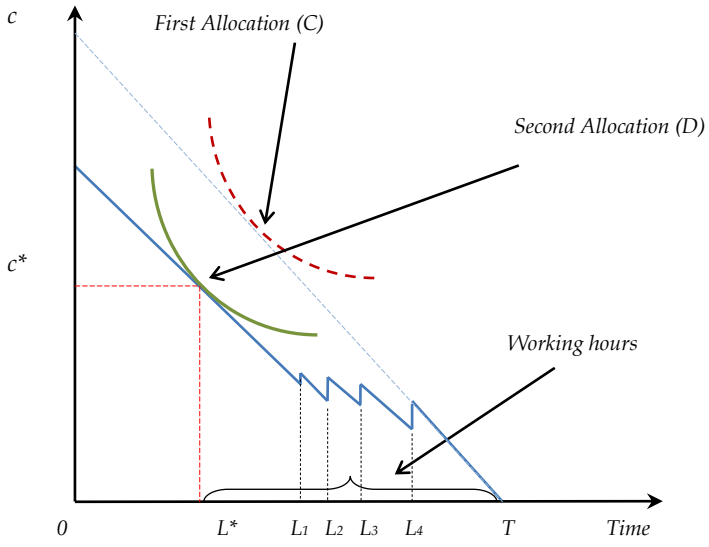


Figure 3-9. The Working Decision of the Married Japanese Women

(Micro-Behavior under Non-Linear & Discontinuous Budget Line)



Panel A. Normal Educated Women



Panel B. High Educated Women

Note. (T-L) is the optimal working hours. (L1, L2, L3 and L4) are working-hours thresholds, which refer to 1.43 mil., 1.3 mil., 1.03 mil. and 0.7 mil. yen threshold respectively.*

CHAPTER 4 .
Encouraging Female Labor Participation: The Role of Childcare

Abstract.

In this chapter, we explore the role of childcare on determining the Japanese female labor supply and its impact on the economy. For this purpose, we extend the model in the previous chapter by adding childcare cost to the budget constraint of Japanese households. We then do a number of experiments. We find that childcare costs restrain females from going to work, subsidizing childcare expenditure alone has a limited impact on the economy. However, reforming the tax and social security system together with improving the childcare could return a significant improvement on aggregate labor and the economy's output.

1 Introduction

In 2010, Japan had 6.5 million children less than 6 years old, of this 3.3 million were under 3 years old. The data on childcare facilities in the same year showed that there were 23,069 licensed day-care centers in Japan; 46.6% of them are operated by the government, and the rest were privately run. The maximum capacity of all day-care centers was 2.16 million persons, and they were actually taking care of 2.08 million children under the age of 3. Beside these daycare centers, there were 13,516 kindergartens (approximately 6,000 were publicly run) providing half-day-care and education for 1.63 million preschool children aged 3, 4 and 5. According to official reports[22], there were approximately 46,000 children on waiting lists for the licensed day-care centers [23] and the number of potentially eligible children who do not get a chance to be at nursery schools could even be as high as 850,000. These numbers clearly show a big gap between the number of preschool children who may need care and the current childcare capacity in Japan. Generally speaking, 40% of preschool children in Japan have not received day care services[24] (see table 4-1 for the latest available data; more information is provided in Section 2). Consequently, their parents (mostly, mothers) have to take care of them. For that, childcare should be considered as a major issue if we want to encourage Japanese women to go to work.

In fact, microeconomic simulations have been done in order to identify and highlight the impact of childcare on the female labor supply from many different aspects such as cost, quality, availability and type of services. Among them, childcare cost plays the most crucial role in determining the labor supply

[22] As of October 2012, MHLW/The Japan Times, Japan.
[23] Zhou and Oishi (2005) show that the number of children on the waiting list for licensed childcare services is much higher than that publicly announced; particularly, the shortage of service supply for infants is conspicuous.
[24] In fact, this huge demand could be served by the childcare services provided by non-licensed day-care centers. These centers, however, are normally small, non-equipped, low quality and quite expensive.

of women. The interaction between childcare cost and the female labor supply has been attracting a huge amount of research. Internationally, it seems that there exists a consensus on the interaction; i.e., higher childcare cost lowers the female labor participation. This phenomenon is statistically observed in several developed countries, such as the U.S. (Connelly, 1992; Ribar, 1992, Currie and Thomas, 1993; Griffen, 2011), the U.K. (Duncan *et al.,* 2001), Australia (Kalb, 2009[25]), France (Choné, Leblanc and Robert-Bobée, 2003[26]), Germany (Haan and Wrohlich, 2011) and Norway (Kornstad and Thoresen, 2007[27]).

In the case of Japan, the impacts of childcare cost on the female labor supply are nevertheless diverse. For example, Komamura (1996, as cited in Oishi, 2002) shows that childcare costs have no significant direct impact on a mother's labor supply. Niimi (2002) points out an important phenomenon of Japanese females; he shows that the childcare cost does have an impact on the high-income family group; however, it has no implication on the low-income family group. Oishi (2002) in contrast shows that childcare costs have significantly negative effects on the labor force participation of mothers. He finds that raising subsidies on the childcare cost could increase the employment of mothers, particularly that of low-income groups. In addition, Abe and Brunello (2013) show that the availability of childcare facilities is also an important determinant of the female employment.

Given the wide discussions on the impacts of childcare cost on the female labor supply across countries, particularly, in Japan, it is surprising how little we know about the effect of childcare costs and the government subsidies for childcare from a macroeconomic perspective.

---

[25] As noticed by the author, the effect found for Australia is at the lower end of the range of elasticities found in the international literature.

[26] The impact of child care costs on the female labor market is however very small.

[27] They show the relationship between the female labor participation rate and childcare. Interestingly, their motivation for doing this study is to encourage parents (females) to spend more time with their children.

From macroeconomics views, reducing the burden of childcare costs on parents could return good results from economic growth perspectives since it is expected to encourage women to go to work. On the one hand, it directly increases the aggregate labor supply and thereby boosts the national output. On the other hand, more workers will lead to higher tax and social security premium revenues.

A prominent policy implication from the cited studies, which are mainly from a microeconomic perspective, is that government should provide more support for childcare. This will free women from the childcare responsibility. As a result, they can work more and contribute actively and positively to the economy. The problem is that at which magnitude the government should subsidize the system because the increased spending on subsidizing childcare services should be financed by some form of taxation in the general budget of the government. If we use the labor income tax, for example, to finance the increased subsidy spending to balance the government budget, the labor income tax has to increase to a higher level. However, the higher labor income tax may effectively cancel out the mother's incentive to work. Additionally, it may discourage current workers in supplying their labor. Consequently, the net result of the increased childcare subsidy is uncertain. This is clearly a dilemma for governments, and solving it is crucial for any government, not just Japan. Unfortunately, the dilemma is still there and has been neglected in the literature. Our study, therefore, deals with this dilemma and tries to fill the gap in literature.

For that purpose, we apply a macroeconomic modeling approach. This approach allows us to investigate the impacts of the childcare cost on a representative mother's working decision. The impacts are then quantitatively aggregated for the whole economy. We are now able to see the impact of the childcare cost on the aggregate variables such as the total labor supply, capital, consumption and output. In addition, the approach enables us to make several

policy experiments on public financing issues. The main purpose of this experiment is to enhance the effectiveness of government spending. For example, we examine the possibility of increasing subsidies on childcare expenditures in Japan.

The rest of the chapter is organized as follows. Section 2 provides a brief overview on childcare subsidies in Japan. Section 3 presents the model economy, and the calibration of the model is discussed in Section 4. Sections 5 and 6 show our benchmark economy and our policy experiments respectively. Next, we do a sensitivity test in Section 7, and the last section concludes.

2 Childcare System in Japan

Many descriptions of the current childcare system in Japan have been done. Thus, the author will leave detailed information of such descriptions to Zhou, Oishi, and Ueda (2003), JETRO (2005) and Saito *et al*. (2013). Comprehensive comparisons on childcare between Japan and other developed countries can be found in Boling (2008) and OECD (2011). In this section, we just provide a brief overview of the system focusing on three aspects: (i) The ECEC structure; (ii) The ECEC Financing policy and (iii) Childcare Cost.

2.1 The ECEC Structure

In recent years, the spending on preschool education has increased internationally[28], Japan has also recently restructured her childcare system. The new system is now under the name of "Early Childhood Education and Care" or ECEC. There are basically three types of ECEC in Japan[29]: Kindergartens

[28] See a discussion about the trend in Saito et al. (2013).
[29] The other minor alternatives could be family daycare or nursing mothers.

(*youchien*), Day-care Centers (or Nursery Schools, *hoikujo*)[30] and new ECEC centers (*nintei kodomoen*, since 2006).

The kindergartens are administrated, supported and partially funded by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). The kindergartens admit children from ages 3 to 5, and they are education-oriented institutions and listed in the Japanese education system. A kindergarten could be publicly or privately run; however, both are supported and partially funded by the government. An important point that makes the kindergartens different and less preferred than the other alternatives is their short operating hours, only 4 hours per day.

Day-care centers are social welfare-oriented institutions and operated under the control and responsibility of the Ministry of Health, Welfare, and Labor (MHWL). They are open for 8 hours per day and admit children aged 0 to 5. Priority is given to children of working parents or families who have special difficulties in taking care of their children. There are 3 sub-categories for the day-care centers based on their establishment, registration and funding as follows: (i) Licensed-public centers: If they are established by the government and operated by the government (public-fun and public-run); (ii) Licensed-private centers: If they are privately established and operated and meet the standards of childcare centers set by each prefecture. A part of their operation cost is shared by the local government (public-fun and private-run); (iii) Non-licensed and completely privately operated centers[31]: if they do not meet the standards of childcare centers, they are not licensed and do not receive any funding from government (private-fund and private-run).

[30] The government is now trying to integrate these two types of childcare facilities in order to enhance the quality and efficiency of the ECEC system.

[31] In one effort to eliminate the number of children on waiting lists for licensed day care centers, the Japanese government and/or prefecture now creates one more category: Non-registered but recognized by the prefecture (municipal). This group can receive some financial support from the local government.

Other than the above, one more alternative type of childcare service with public financial aid (partially) is the newly authorized ECEC centers. They have been established since 2006 in order to solve the limitations of the kindergartens (i.e., short operating hours) and the day-care centers (i.e., admission depends on parents' working status). The government agencies, MEXT and MHLW, are responsible for ECEC operation. The ECEC centers are open for all children regardless of the parents' jobs and their childcare time is flexible to the parents' requirements [32].

Data on the number of childcare facilities by type, thier capacity and actual enrollment are reported in table 4-1. The subsidy share of the government and funding policies are also available in the table. In addition, childcare arrangements by age cohorts can also be seen in Figure 4-1.

2.2 The ECEC Financing Policy

As the ECEC system is heavily controlled and subsidized by the Japanese government. Total childcare expenditures are shared among the central government, local governments (prefecture and municipal administration) and users.

Our calculation based on the available data (table 4-1) shows that the government finances approximately 51.3% of total childcare costs of kindergartens and roughly 60% childcare costs of day care centers. On average, the government covers 56.6% of total childcare expenditures of the ECECs. The childcare expenditure is shared by three levels of administration (i.e., 50% of the subsidized expenditures are covered by the national budget, 25% by the prefecture budget and the other 25% by the municipal budget). According to

[32] A recent survey shows a very positive and high satisfaction from parents. See MEXT (2009a). In addition, the number of ECEC centers have been rising dramatically in recent years, from 229 centers (in 2008) to 762 centers (in 2011, Saito *et al*., 2013). However, the number of children who have benefited from the ECEC center is unavailable.

OECD (2011), in 2005, government spending on day-care centers and kindergartens amounted to 0.2% and 0.1% of Japan's GDP, respectively[33].

The government subsidies include per-child subsidies and lump-sum subsidies, i.e., ordinary and operating expenses (e.g., in 2002, the government provided 30 billion yen to licensed day care centers for the maintenance of building and facilities).

2.3 Childcare cost

Within the childcare issue, childcare cost is the most important aspect. It not only discourages mothers as discussed in Section 1 but also threatens the birth rate in Japan as shown in a survey of parents in the 25-to-49 age group (MEXT, 2009b).

As discussed above, there are basically two kinds of childcare options for parents[34] : kindergartens and day-care centers. Although the government plays a crucial and principal role in operation the childcare system, the childcare costs are diverse and depending on the status of the childcare facilities (1. public financed – public run, 2. public financed – private run or 3. completely private), the operating hours, location, type of services and availability. For example, Oishi (2002) reports that in the 19 wards of central Tokyo, the [private] licensed day-care centers charge 57,500 yen per month at most, while some [non-registered] private-run centers charge around 100,000 yen[35] (parent payment). For public licensed day-care centers, the cost is estimated at 21,904 yen. In addition, OECD (2011) reports that public kindergartens charge 80,000 yen per year (approximately 10,000 yen per month), while other private kindergartens charge 250,000 yen per year (approximately 30,000 yen per month). Note that

[33] This share however is relatively low compared with other OCED countries (OECD, 2011).
[34] As the data for ECEC centers are unavailable, we ignore their cost in this session.
[35] The rate has been quite stable recent years.

the kindergartens operate only 4 hours per day, while the day-care centers are open for 8 hours per day.

3 The Model

Previously, in Chapter 3, we constructed a neo-classical model to investigate how the tax and social security system distorts Japanese women's working decisions. In that study, we assume that besides tax and social security distortion, Japanese women do not face any other constraints. This means we have ignored the impact of the childcare constraint on the Japanese women's working decisions. This assumption is quite strong and may overestimate our results.

Relaxing this assumption could enable us to have a more precise investigation on the Japanese female labor participation. We simply extend our previous study by adding childcare cost to the family's budget constraint. We also follow Duncan *et al.* (2001), and Kornstad and Thoresen (2007) in assuming that there is a strong connection between a mother's working hours and the hours dedicated to taking care of her child; i.e., when she goes to work, her child needs as many hours as her working hours supplied in the market[36].

3.1. Household/Family

There are two representative households, which are differentiated by the wives' education level (i.e., normal educated women family, NEW - hereafter and high educated women family, HEW - hereafter). Each household has three individuals, husband, wife and a child[37]. The husband is assumed to work full time at constant working hours. The wife's working hours, however, vary

[36] As her husband is assumed to work full-time; he has no time for childcare.

[37] Currently, the average number of children in a Japanese household is about 1.96. However, as our study focuses on children aged 0 to 5, we assume that there is only one child in the representative household. The number of children, however, should not affect our result too much as it is set exogenously.

endogenously. She faces a trade-off between working to consume more goods or spending her time taking care of her family and children.

A representative family's problem is generalized as:

$$\max_{C_t^i, K_{t+1}^i, H_t^i} \sum_{t=0}^{\infty} \beta^t U\left(C_t^i, H_t^i\right) \text{ [38]} \tag{1}$$

where

$$U\left(C_t^i, H_t^i\right) = log\left(C_t^i\right) + \alpha log\left(L - H_t^i\right). \tag{2}$$

Subject to one of the following two budget arrangements[39]:

- Bracket 1: $0 \leq w_t e^i H_t^i \leq \lambda$

$$\begin{aligned}(1+\tau_c)C_t^i + (1-\rho)H_t^i p_t + K_{t+1}^i \\ = \left(1 + (1-\tau_k)(r_t - \delta_t)\right)K_t^i + w_t e^i H_t^i \\ + (1-\tau_s)w_t\overline{H^m} \\ - \ \tau_h\left((1-\tau_s)w_t\overline{H^m} - (aw_t\overline{H^m} + b)\right. \\ \left. - \left(\chi_2 - w_t e^i H_t^i\right) - S_C\right) + \zeta\end{aligned} \tag{3}$$

- Bracket 2: $\lambda < w_t e^i H_t^i$

[38] Although Currie and Thomas (1995, as cited in Duncan *et al.*, 2001) suggest that the quality of childcare service could be considered as a consumption good as it is beneficial to child development, we do not include "childcare service" in our utility function for simplicity as we have already assumed that there is a strong connection between a mother's hours of work and hours in care. In addition, as our study focuses on financing the childcare cost, we actually ignore other factors of the childcare issues. In the literature, some economists include childcare quality in the family's utility and the quality is a function of the mother's time dedicated to taking care of her children and some other factors. See Connelly (1992), Duncan *et al.,* (2001) and Kornstad and Thoresen (2007) for example.

[39] This is a simplified version of the family budget brackets in the previous chapter. For details of the model and how it is set, please see Chapter 3. A graphical simplified model can be seen in Figure 4-4, where we include only one corner solution for females.

$$
\begin{aligned}
(1+\tau_c)C_t^i + (1-\rho)H_t^i p_t + K_{t+1}^i \\
&= \left(1 + (1-\tau_k)(r_t - \delta_t)\right)K_t^i \\
&+ \Big((1-\tau_s)w_t e^i H_t^i \\
&- \tau_h\left((1-\tau_s)w_t e^i H_t^i - \left(a w_t e^i H_t^i + b\right)\right)\Big) \\
&+ \Big((1-\tau_s)w_t \overline{H^m} \\
&- \tau_h\left((1-\tau_s)w_t \overline{H^m} - (a w_t \overline{H^m} + b) - S_C\right)\Big) + \zeta
\end{aligned}
\tag{4}
$$

where β is the discount factor. The parameter $i = [N, H]$ indicates the status of the family (i.e., NEW or HEW respectively). C_t^i is the consumption of the household with status i. L is the time endowment of the wife, and H_t^i is her working hours supply. Note that (H_t^i), which appears as the second component of the budget, should be interpreted as the non-parental care time for the child. ρ is the government subsidy share. p_t is the per-hour cost of sending children to school.

We assume that if the wife chooses to work, it will reduce the family's utility since she will have less time to take care of the family. She, however, can gain more from her work to consume more. w_t is the labor wage rate and e^i is the efficiency level, which is set based on the wife's education level (i.e., e^N and e^H are the normal and high educated wives' efficiency respectively. Thus, $w_t e^i H_{w,t}^i$ is the wife's efficiency income. λ is the income tax threshold.

τ_s is the social security premium rate and $\left\{a w_t e^i H_t^i + b\right\}_{i=N,H,m}$ is the basic and employee income deduction, which is applied to each individual worker. S_C is the dependents deduction applied for families with children universally. (ζ) is a lump sum tax or transfer, which is equally collected or distributed by the government.

Rearranging the above budgets, we have:

- Bracket 1: $0 \leq w_t e^i H_{w,t}^i \leq \lambda$

$$
\begin{aligned}
(1+\tau_c)C_t^i + (1-\rho)H_t^i p_t + K_{t+1}^i \\
&= [1+(1-\tau_k)(r_t-\delta_t)]K_t^i + [1-\tau_h]w_t e^i H_{w,t}^i \\
&+ \left[[(1-\tau_s) - \tau_h(1-\tau_s-a)]w_t\overline{H^m}\right. \\
&+ \left.\tau_h(b+\chi_2+S_C)\right] + \zeta
\end{aligned} \tag{5}
$$

- Bracket 2: $w_t e^i H_{w,t}^i > \lambda$

$$
\begin{aligned}
(1+\tau_c)C_t^i + (1-\rho)H_t^i p_t + K_{t+1}^i \\
&= [1+(1-\tau_k)(r_t-\delta_t)]K_t^i \\
&+ [(1-\tau_s) - \tau_h(1-\tau_s-a)]w_t e^i H_{w,t}^i \\
&+ [(1-\tau_s) - \tau_h(1-\tau_s-a)]w_t\overline{H^m} + \tau_h(2b+S_C) \\
&+ \zeta
\end{aligned} \tag{6}
$$

Therefore, the household's problem is generalized as:

$$
Max \sum_{t=0}^{\infty} \beta^t U\left(C_t^i, H_t^i\right)
$$

subject to:

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

where

$$
\phi^i = \begin{cases} 1-\tau_h & 0 < w_t e^i H_{w,t}^i \le \lambda \\ 1-[\tau_s + \tau_h(1-\tau_s-a)] & \lambda < w_t e^i H_{w,t}^i \end{cases} \tag{8}
$$

where

$$
sub^i = \begin{cases} \tau_h(b+\chi_2+S_C) & 0 < w_t e^i H_{w,t}^i \le \lambda \\ \tau_h(2b+S_C) & \lambda < w_t e^i H_{w,t}^i \end{cases} \tag{9}
$$

The First Order Condition (F.O.C) of the household could be written as follows. The Euler equations are the same for the two families, regardless of their efficiency level:

$$\frac{C_{t+1}^{i}}{C_{t}^{i}} = \beta[1 + (1 - \tau_k)(r_{t+1} - \delta_{t+1})] \tag{10}$$

The heterogeneity of these families, therefore, can be observed in their labor supply behavior.

$$\alpha C_t^i = \{\phi^i w_t e^i - (1 - \rho)p_t\}(L - H_{w,t}^i) \tag{11}$$

3.2 Technology

Once again, we follow a standard Cobb-Douglass aggregate production function with constant returns to scale property. The firms are identical, measure one, and are operating in competitive market.

$$Y_t = A_t K_t^{\theta} H_t^{1-\theta} \tag{12}$$

3.3. Government

In our model, the government collects the consumption tax, capital income tax and labor income tax to finance their general expenses and subsidies.

$$\begin{aligned} G_t + Sub_t + Kids_t + \zeta \\ = \tau_c C_t + \tau_k (r_t - \delta_t) K_t + (1 - \phi^m) w_t \overline{H^m} + TAX_t \end{aligned} \tag{13}$$

where Sub_t is the transfer of the government, which is related to the spousal and dependent deductions, basic and employment subsidies policies, which follows the followings formula:

$$Sub_t = \sum_{i=N,H} \{\pi^i sub_t^i\} \tag{14}$$

where $Kids_t$ is the childcare subsidy by the government, which follows the following formula:

$$Kids_t = \sum_{i=N,H} \{\pi^i \rho H_t^i p_t\} \quad (15)$$

and TAX_t is the tax and social security premium revenues paid by working women:

$$TAX_t = \sum_{i=N,H} \{\pi^i (1 - \phi^i) w_t e^i H_{w,t}^i\} \quad (16)$$

(ζ) is a lump sum tax, which helps the government to balance its budget.

The workings of the model are carefully discussed in Le (2013).

4 Calibration

The benchmark version of the model is calibrated as in our previous paper, Le (2013). We report a summary of the model parameters in table 4-2. Some additional parameterizations are discussed as follows.

4.1 Demands for Childcare Service

We follow Duncan *et al.* (2001), and Kornstad and Thoresen (2007) in assuming that there is a strong connection between a mother's working hours and the hours dedicated to taking care of her child, in this model, we set the required time for childcare equal to the working hours supplied by the mother in the market.

4.2 Childcare Cost

As discussed in section 2, the childcare costs are diverse and depending on many aspects. The childcare costs in the model are calculated as follows. First, we collect the total costs from all the different kinds of childcare facilities, both paid by parents and subsidized by the government. We then calculate the weighted average of the cost as we know the number of each childcare facility type. Our calculation shows that the childcare service costs approximately 550

yen per hour. Finally, we normalize this cost as the percentage of male hourly income. It is thereby set at 31% of the male hourly wage (our calculation is shown in Table 4-3).

4.3 Preference

As in Le (2013), we calibrate the preference parameter in order to match available data: First, the concentration of married females around the threshold level of 1.03 million yen annual income. Second, female average working hours is set to closely match the actual data. Note that we have to adjust for married age (i.e., we remove females aged less than 20 in our calculation; thus, the participation rate of females aged 20+ is about 68.5% in our calculation). As the average working hours of females in 2004 is about 35.4 hours, thus, the average working hours of females aged 20+ is approximately 24.4 hours. We match our model's weighted average labor supplied by the females with this number as closely possible.

4.4 Government Childcare Subsidies

We have the data on parents' payment and government spending for childcare per child for different childcare arrangements (table 4-1). We also have the actual number of children who have benefited in 2007[40] by different types of childcare arrangements. Thus, we are able to calculate the weighted average of total spending per child per month and also the share of government and the share for parent. Accordingly, the share of government spending per child, who actual received the in-kind benefit in 2007 is approximately 56.6% and the rest is contributed by the parents.

However, there are only 56.49% of children aged 0 to 5 who actually benefited from the childcare subsidies. Thus, the share of the government subsidy on

[40] We use the data as of 2007 due to thier availability, and in fact, there has been no significant change in the childcare policies and prices in Japan recent years.

childcare needs to be adjusted with this number; finally, the actual government subsidy share on childcare expenditure is 31.97%.

4.5 Discount Factor

The discount factor is calibrated to match the capital to output ratio in 2004, 2.38, and is set to 0.962.

5 The Benchmark Economy

Although the study is extended from our previous chapter, we do not follow the benchmark economy that matches the Japanese economy in 2000. Instead, we calibrate the model to match with the Japanese economy in 2004 as we apply the 2004 reform in the tax system to our model for simplicity.

In our benchmark economy, the capital to output ratio is matched well with the actual data, 2.38. Male's and female's average working hours are 46.11 and 25.4 hours per weeks respectively, which captures the actual value in 2004.

In the benchmark economy, as can be seen in the calibration, the government finances 32% of total childcare expenditures. The rest is contributed by the parents. The NEW parents cover 56.58% and the HEW parents pay for 43.42%.

MEXT (2009b) shows the burden of childcare on household finances. Accordingly, the childcare expenditure to family income is approximately 10% (see Figure 4-2). Our model generates this pattern although we do not capture the ratio exactly (i.e., the ratio generated in our model is 8.5%). The reason for the difference is that MEXT (2009b) includes all relevant expenditures on childcare (e.g., school lunches as many kindergartens and child-care centers ask parents to prepare lunches – bento – for their children by themselves), while our model just covers tuition fees.

When we simulate policy experiments in the next section, we assume that the general government expenditures (excluding childcare subsidies, basic and

employment deductions, spousal and dependent deductions) are fixed at the level in the benchmark economy. Doing so and keeping the expenditures at the same level across the experiments, we can control for the budget balancing at the benchmark level and isolate the effect of each policy parameter.

6 Policy Experiments

In order to quantify the impact of the tax system and childcare on female's working decisions, we do three exercises. First, we do a tax reform experiment as we have done in previous chapter. Particularly, we investigate two reform proposals: (i) removing the spousal deduction policy, and (ii) completely removing all tax and social security thresholds, namely "All Tax Reform". Second, we explore a reform on the childcare system by increasing childcare subsidies. Lastly, we propose a reform on both the tax and childcare systems.

6.1 Tax reform

6.1.1 Removing the Spousal Deduction

Previously, in Chapter 3, we investigated how the tax and social security system distorts the Japanese women's working decisions. We find that by removing the spousal deduction policy, Japan could boost her aggregate labor supply and output by approximately 4.11%. In this study, for simplicity, we use a more simplified version of the current tax system. Particularly, we employ only one tax threshold level, the 1.03 million yen annual income, as this threshold has been confirmed as the most crucial threshold level.

As reported in table 4-4 (Column 2), removing the spousal deduction policy can help Japan add 0.61 percentage points to the economy's labor supply and output. However, cutting the deduction cannot encourage the NEW to work more as they still enjoy the tax threshold as can be seen on Figure 4-4, panel A. However, it allows the government to reduce the labor income tax rate.

Consequently, the HEW are also given more incentive to work (as shown in Figure 4-4, panel B). Our model shows that the HEW increase their labor supply by more than 4.34%. The required labor income tax for government balancing declines to 19.61% from 23.58%.

6.1.2 Completely Removing All Tax Thresholds

In Chapter 3, we do an experiment of removing all the tax and social security premium thresholds and treating both male and female workers the same in terms of tax and social security premium contributions. The experiment shows that Japan could increase the total labor supply and total output by up to 7.52%.

We repeat this experiment by adding childcare costs to the model to compare the impact of the tax and social security system on female employment and the economy. This time, our simulation shows that the reform by removing all income thresholds and equalizing males and females in contributing taxes and social security revenues could boost the economy's total output by 4.78% (See table 4-4, Column 3). The NEW will work 26.70% more than the benchmark level. In addition, due to the income effect, the HEW will also work longer by about 7.83%.

As both NEW and HEW increase their labor supply, the Japanese government runs a surplus budget. Thus, it enables the government to cut the labor income tax from 23.58% to 15.77%.

6.2 Childcare Reform

What is the role of childcare on determining the female labor supply in Japan? What are the economic consequences if Japanese government increases childcare subsidies? We attempt to answer these two key questions. For that purpose, starting from the benchmark's government subsidy share of 32%, we change the government subsidy share (ρ) gradually by 10 percentage points at

each step, up to 100% to see how the normal and high educated women respond to the changes.

Figure 4-3 (panel A) shows the responses of the two representative cohorts, the NEW and the HEW, to the changes in the government subsidy share (ρ). Two implications should be noticed. First, a higher subsidy on childcare is better for the economy. The improvement is mainly contributed by the high educated women cohort as they take the benefit of the subsidy and work more as the marginal gain from working one more unit is higher than the marginal childcare cost. However, the NEW still enjoy the subsidies; their labor supply is inelastic with the changes in the subsidy share (ρ) and are still stuck at the corner solution. Second, if the government uses the labor income tax to finance the increased spending on childcare subsidy, the tax rate will increase progressively and achieves its peak at 49.8% when the government subsidizes 100% of the childcare expenditures. Lastly, comparing with the benchmark, financing 50% of the childcare expenditures could yield return of only 0.62% in total output as shown in table 4-4, the third column).

6.3 Reform on Both Tax and Childcare System

We now go a further step to examine the role of childcare incorporated with a reform on the tax system in determining the female labor supply. We first do a reform on the tax system by removing all of the tax thresholds. Then, we gradually adjust the government subsidy share (ρ) from the benchmark level up to 100%. Figure 4-3 (panel B) shows the responses of the NEW and the HEW to the reforms on both the tax and childcare systems. Overall, the results in these experiments are much better than the previous experiment as explained below.

Firstly, the results once again, suggest that a higher subsidy on childcare expenditure is better for the economy. Unlike the reform only on childcare, both NEW and HEW respond positively to the changes in the government subsidy

policy. They both take advantage of the cheaper childcare services and adjust their labor supply immediately.

On the fiscal side, in order to finance the increase childcare spending, the government has to raise the labor income tax. However, in this experiment, the speed of increase of the labor income tax is lower compared with the previous experiment. At the starting point, the labor income tax rate is 15.8%; it gradually increases and achieves its peak at 41.3% when the government wants to apply a free childcare system. Compared with the previous scenario, this is a much lower tax rate. In addition, if the government covers 50% of the childcare expenditures, the national output will increase by about 8.84%, as can be seen in table 4-4, the last column.

7 Sensitivity Test

One crucial parameter in our study is childcare cost. Based on our calculation, we set the hourly cost of childcare equal to 31% of the male's hourly wage in the study. But the actual childcare costs could vary and depends on many aspects such as the type of childcare service, location, availability and quality, we do this sensitivity test to check how our findings could be affected by the childcare cost. We change the childcare cost to 20% and 40%, recalibrate the model and compare it with our findings from two of the above experiments' results: The "Completely Removing all Tax Thresholds" experiment in Section 6.1.2 and "Reform on both Tax and Social Security System" in Section 6.3. This comparisons will help us to see how the agents response to the change when the childcare cost is cheaper (Pc=20%) or more expensive (Pc=40%).

Table 4-5 compares the economic consequences of the tax reform and reform on both the tax and childcare systems under two cases of childcare cost: 20% (cheaper childcare cost), and 40% (more expensive childcare cost).

When we change the childcare cost to 20% or 40% of the wage rate, the aggregate labor and output will increase by 8.46% or 5.89% respectively while in the study, the same experiment returns about a 4.78% increase in the aggregate labor and output. The result suggests that the reform proposal is on the right track. It also highlights the importance of childcare costs in determining the female labor supply as indicated in many cited empirical studies.

When we change the subsidy parameter, we see that people respond quickly and better when the childcare cost is more expensive because the meaningfulness of the 20% additional subsidy is higher.

8 Concluding Remarks

This study aims to investigate the impact of childcare cost on female labor participation from the macroeconomic perspective. We extend the model in the previous chapter by adding childcare constraint to the married Japanese women's working decision. The model is designed to examine the impact of childcare costs on two representative women, who are differentiated by their education level, and their families. We then aggregate the impacts on the whole economy.

We calibrate the model to match the Japanese economy in 2004. The model enables us to do a number of experiments on government policies. Our findings are: (i) Removing the spousal deduction policy will increase Japan's national output by 0.61%; (ii) Removal of the spousal deduction, together with a further reform on the tax and social security system (i.e., completely removing all of the income tax thresholds), could boost the economy by 4.78%; (iii) Without any reform of the tax system, providing a greater subsidy on childcare expenditure has a limited impact on the economy; however, (iv) More subsidies on childcare expenditure, together with other reforms on the tax and social security systems (i.e., completely removing all of the income tax thresholds) could return a

significant improvement in Japan's aggregate labor and output; particularly, if the government covers 50% of the childcare expenditures, together with removing all tax thresholds, the national output will increase by about 8.84%.

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Tables

Table 4-1. The Early Childhood Education and Care System in Japan*

	Kindergarten	Day-Care Centers	ECEC Centers
Enrollment Policy	From age 3 to 5 ** Open to all*	From age 0 to 5 ** Eligibility to working parents*	From age 0 to 5 ** Open to all*
Childcare Time per day	4 hours	8 hours	Flexible (8hours)
Legal Foundation	Education Act	Child Welfare Act	ECEC Law
Governing Body	MEXT	MHLW	MEXT & MHLW
Number of Children	1,705,000	2,015,000	N/A
Public	338,000 (19.8%)	945,000 (46.9%)	N/A
Private	1,368,000 (80.2%)	1,071,000 (53.1%)	N/A
Number of Facilities	14,000	23,000	762[7]
Public	5,500 (39.3%)	12,000 (52.2%)	149 (19.6%)
Private	8,500 (60.7%)	11,000 (47.8%)	613 (81.4%)
Average Cost *(in yen/month)*[1,2]			
Public	7,000	22,000[3]	N/A
Private	30,000	60,000	N/A
Government Subsidy *(in yen/month/child)*			
Public	28,000[5]	88,000[6]	N/A
Private	17,000[5]	~40,000[6]	N/A
Non-licensed Center	N/A	50,000 ~ 100,000	N/A

Notes:

* Main data as of 2007, except for below notes.

ECEC: Early Childhood Education and Care.

MEXT: Ministry of Education, Culture, Sports, Science and Technology.

MHLW: Ministry of Health, Labour and Welfare.

[1] Pay-out by parents per child (rounded numbers). Actual cost depends on the family income, age of child and number of children.

[2] Zhou, Oishi and Ueda (2003).

[3] Oishi (2002).

[5] OECD (2011). Value was converted to monthly payment.

[6] The Author's calculation.

[7] As of 2011, taken from Saito *et al* (2013).

Source: MEXT (2009a). ECEC System in Japan

Table 4-2. The Model Parameters

Parameters	Description	Value	Sources
α	Preference Parameter	0.387	Matched with adjusted female labor supply, 24.2 hours/week.
β	Discount Factor	0.962	Matched K/Y ratio, 2.38.
ρ	Government subsidy share	0.3197	The author's calculation
pt	Childcare hourly cost	0.310	The author's calculation *(Percent of male's hourly wage rate)*

Table 4-3. Childcare Cost Calculation

	Kindergarten	Day-Care centers	Note/ Weighted Average Cost
Number of Children	45.83%	54.17%	100%
Public	19.8%	46.9%	
Private	80.2%	53.1%	
Monthly cost			
Public	35,000	100,000	
Private	37,500	100,000	
Hourly cost			
Public	438	625	
Private	469	625	
Weighted Average Cost	462[1]	625	550.30[2]
Male's monthly income			328,000.00
Male's hourly wage			1,778.36[3]
Childcare cost			31%[4]

Notes:

1. $P_{kindergarten} = 438 \times 19.8\% + 469 \times 80.2\%$
2. $P_{Childcare} = 462 \times 45.83\% + 625 \times 54.17\%$
3. $W_{male} = 328{,}000/(4 * 46.11)$ *(Male's working hours per week: 46.11)*
4. $P_c(relative) = 550.30/1{,}778.36$

Table 4-4. Benchmark and Experiment Results

Variables	Benchmark	Tax Reform		Childcare Subsidy Reform	Reform on Both
		Remove Spousal Deduction	Remove All Tax Thresholds		
Labor tax (τ_h)	23.58%	19.61%	15.77%	30.30%	21.36%
Childcare subsidy (ρ)	31.97%	31.97%	31.97%	***50%***	***50%***
Spousal Deduction?	Yes	No	No	Yes	No
Aggregate variables					
Consumption	59.92	+0.60%	+4.14%	+0.62%	+7.61%
Labor	63.84	+0.61%	+4.78%	+0.62%	+8.83%
Capital	247.90	+0.61%	+4.78%	+0.62%	+8.83%
Output	104.46	+0.61%	+4.79%	+0.62%	+8.84%
Normal Educated Women (NEW)					
Consumption	57.97	−0.45%	+3.20%	+0.55%	+7.54%
Labor	19.76	+0.00%	+26.70%	+0.00%	+50.86%
Capital	265.59	+0.70%	+5.29%	+2%	+12.78%
High Educated Women (HEW)					
Consumption	65.36	+3.19%	+6.47%	+0.78%	+7.80%
Labor	42.05	+4.34%	+7.83%	+4.46%	+12.96%
Capital	198.83	+0.26%	+2.86%	−4.74%	−5.82%

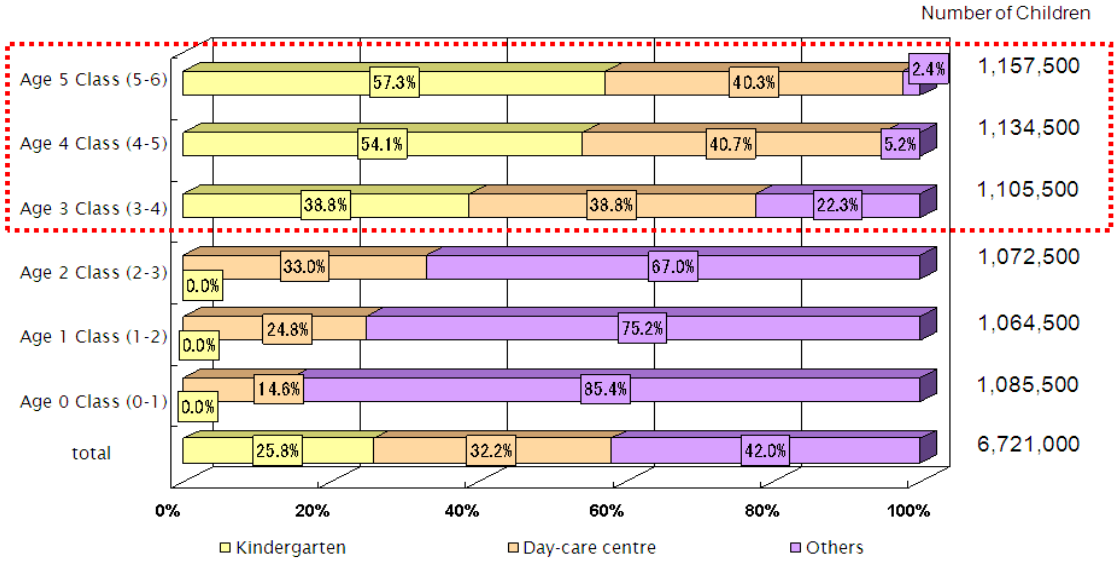
Table 4-5. Sensitivity Test with Different Childcare Cost

Variables	Cheaper Childcare Cost ($P_c = 20\%$)		More Expensive Childcare Cost ($P_c = 40\%$)	
	Tax Reform $\rho = 31.97\%$	*Reform on Both* $\rho = 50\%$	*Tax Reform* $\rho = 31.97\%$	*Reform on Both* $\rho = 50\%$
Labor tax (τ_h)	12.73%	16.70%	16.10%	24.04%
Aggregate variables				
Consumption	+8.44%	+10.17%	+4.36%	+8.81%
Labor	+8.46%	+10.21%	+5.89%	+12.15%
Capital	+8.46%	+10.21%	+5.89%	+12.14%
Output	+8.46%	+10.21%	+5.89%	+12.44%
Normal Educated Women				
Consumption	+8.93%	+10.42%	+3.98%	+8.98%
Labor	+51.86%	+64.36%	+35.72%	+81.66%
Capital	+12.86%	+10.30%	+10.90%	+16.31%
High Educated Women				
Consumption	+7.28%	+9.57%	+5.30%	+8.38%
Labor	+9.29%	+9.45%	+9.61%	+13.38%
Capital	−7.99%	+9.87%	−14.49%	−4.85%

Notes: P_c: Childcare (relative) cost (as the percent of wage rate)
ρ: Childcare subsidy

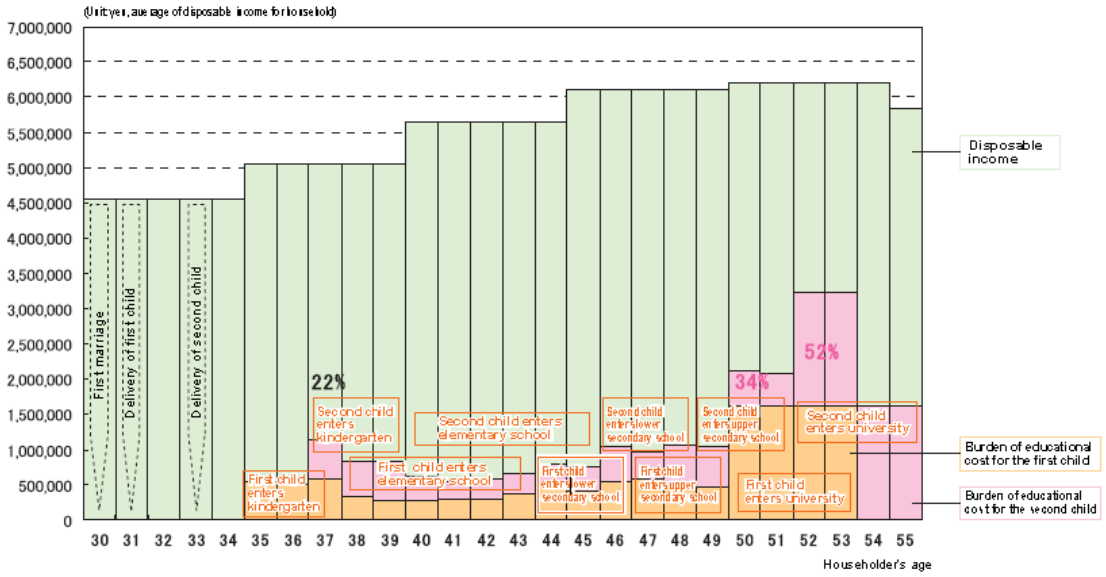
Figures

Figure 4-1. Childcare Arrangement in Japan (2007)



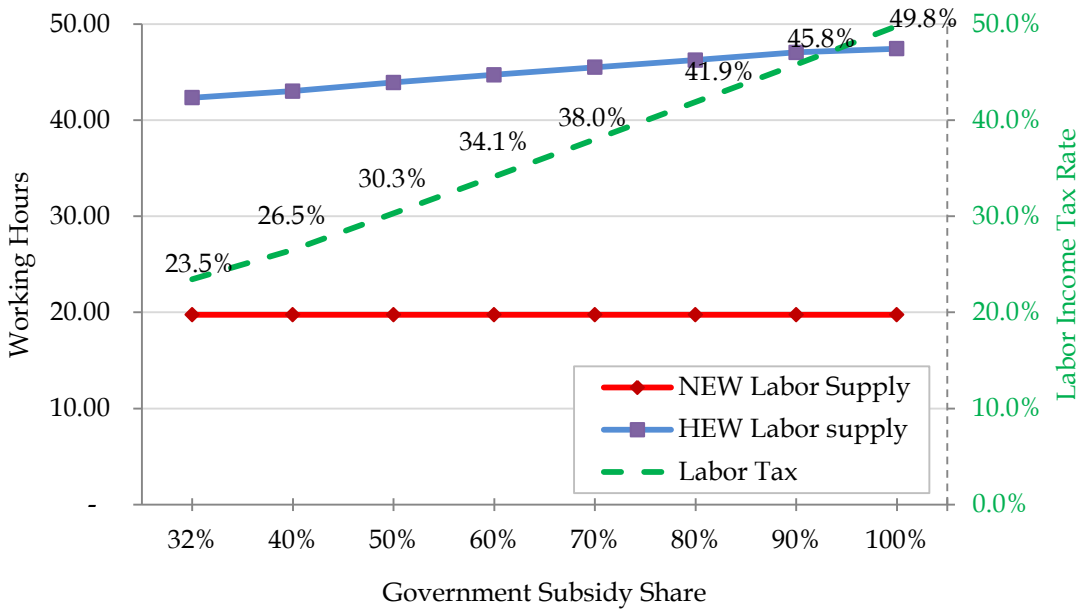
Source: MEXT (2009a). ECEC System in Japan

Figure 4-2. Household Income and Educational Expenses

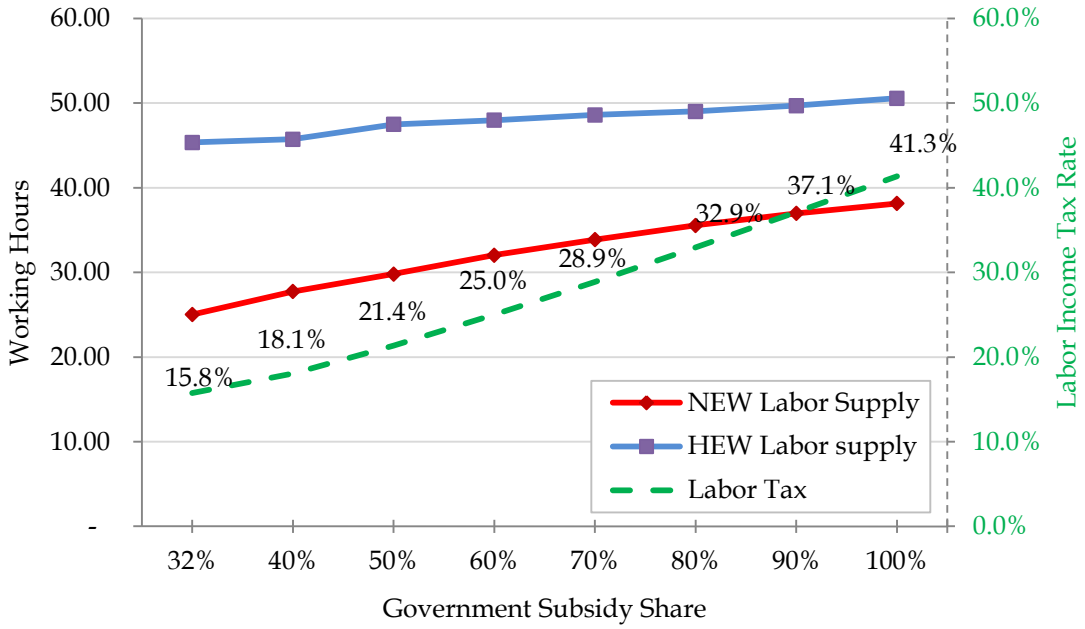


Source: MEXT (2009b). ECEC System in Japan

Figure 4-3. The Impact of Childcare Subsidies on Japanese Women's Working Decision



Panel A. Childcare Reform

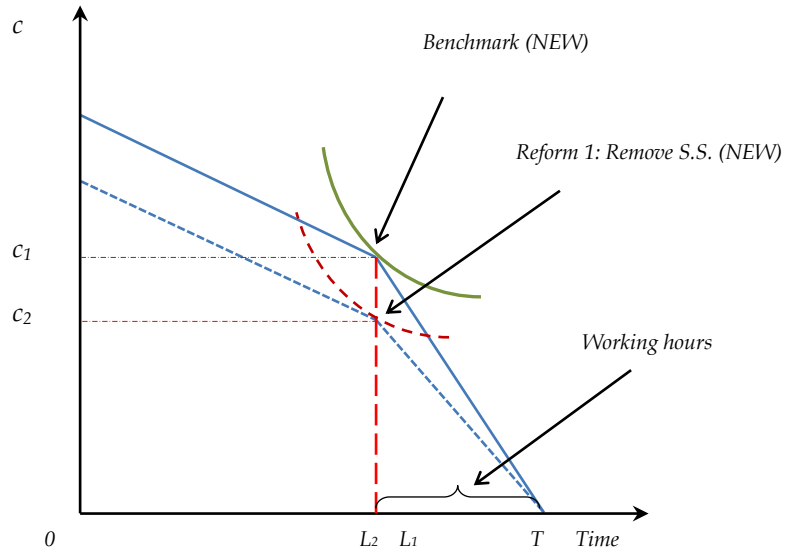


Panel B. Reform on Both Tax and Childcare System

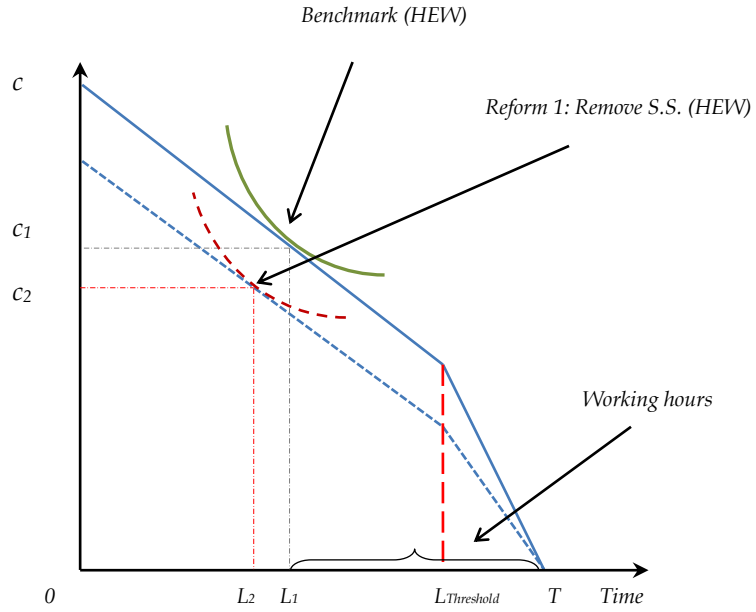
Notes: NEW: Normal Educated Women
HEW: High Educated Women.

Source: The author's simulation

Figure 4-4. Theoretical Choice of JMF.



Panel A: Normal Educated Woman



Panel B: High Educated Woman

CHAPTER 5 .
Conclusion and Policy Recommendations

1 Summary

This dissertation aims to tackle the Japanese government fiscal challenges. The study is timely and important as Japan has been facing many challenges in recent years such as an aging population, shrinking workforces, high public debt, persistent deflation and stagnation. After a brief overview of the current challenges in Chapter 1, we quantitatively investigate the impact of the predicted demographic changes in Japan on the public finance situation in Chapter 2. We found that financing public spending by raising taxes has many costs, and are highly challenging for Japan; to avoid a hike in tax rates, an alternative is to boost the Japanese female labor participation. The most important factors behind the low female participation are the tax and childcare systems. Thus, we quantify the impact of these factors on women's working decision as well as on the whole economy simultaneously in Chapter 3 and Chapter 4. In the last chapter, we conclude our study and provide some policy recommendations for the Japanese government.

2 Conclusion

The conclusions of our study include:

First, by using a heterogeneous agent model with stochastic aging and dying, we are able to calculate a sufficient tax rate to balance the Japanese government's budget in the future. We find that under the coming demographic shift, Japan has three options in 2050: (i) increase the labor income tax by 20 percentage points, (ii) increase the consumption tax rate from 5

percent to nearly 28 percent, or (iii) reduce the social security benefits from 50 percent of the wage rate recently to 5 percent.

Second, given the Japanese aging society, among several options for the tax reform, we suggest that financing by increasing the consumption tax is better than using labor income tax or cutting social security benefit as financing by the consumption tax has the lowest welfare cost for the society. This conclusion is based on our welfare comparison using the consumption equivalent variation method.

Third, by constructing a representative model and mimicking the Japanese tax system, we find that the current income tax system creates disincentives to work for Japanese married women. The impacts are different on cohorts with different levels of education. Reforms in the tax system can lead to an increase in the labor supply and output. In particular, removing the spousal deduction on the primary earner can boost the aggregate labor and output by 0.61%; furthermore, removing all of the income tax thresholds can boost the aggregate labor and output by 4.78%.

Fourth, without any reform on the tax and social security systems, providing a greater subsidy on childcare cost has a very limited impact on the economy;

Fifth, a reform of the tax system by removing all income tax thresholds, together with a higher childcare subsidy, could return a significant improvement in the Japanese labor supply and output. The key message from the study is that the effectiveness of a childcare subsidy is much higher if the Japanese government could reform its tax system. Thus, the first step to encouraging female labor participation should be dedicated to reforming the tax system.

3 Policy Recommendations

Based on this study, we would like to propose the following policy recommendations for the Japanese government.

First of all, as showed in the study, financing by the consumption tax is better for the social welfare in an aging society as it redistributes the tax burden among all agents in the society. We therefore recommend that a further reform of the consumption tax system should be considered in order to cope with the coming changes in the Japanese demographics.

Second, encouraging women to go to work would not only help Japan solve the shrinking workforce problem, but also lessen the pressure on the government finances. More effort should be dedicated to figure out the policies to encourage female labor participation. We suggest that the priority should be put on reforming the tax and social security systems, followed by a reform of childcare subsidies. These reforms together will be more efficient than reforms of only the childcare system.