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# Tax Policy in Aging Japan

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## Abstract

This paper investigates a desirable tax policy for Japan's coming aging society. Because the current Japanese public pension program is operated in a manner similar to a pay-as-you-go scheme, the declining percentage of the working population will have a harmful effect on economic welfare. Simulation results show in a quantitative way that a progressive expenditure tax is ultimately desirable, and that an inheritance tax stimulates capital accumulation following an expenditure tax. This paper suggests that the Japanese tax system should rely more on an inheritance tax, and that when considering a tax-combination policy, a combination of a progressive expenditure tax and an inheritance tax may be desirable in terms of efficiency and equity.

***Keywords***: Aging population, Progressive expenditure tax, Inheritance tax, Life-cycle general equilibrium model, Simulation analysis
***JEL classification numbers***: H31; J18

## 1. Introduction

Currently, the Japanese population is aging faster than any other in the world.[1] The percentage of the population aged 65 or over in Japan was 7.1% in 1970; however, just 30 years later, it had risen to 17.2%. A declining birth rate and a rising average life expectancy will continue to exacerbate this trend, causing serious problems for Japanese society. Under the current system, the aging population is placing a heavy burden of ever-increasing pension and medical care expenses on a shrinking working population. Hence, structural reforms, especially tax reforms, to accommodate this drastic demographic change have become an urgent policy issue.

In particular, the proper choice of tax bases is a significant question, with wide-ranging implications for the course of savings and economic growth, the level of economic efficiency, and the distribution of welfare across generations. In this paper, the life-cycle general equilibrium simulation model developed by Auerbach and Kotlikoff (1983a) is used to take account of the rapid aging of the Japanese population. The model is suitable as a basic theoretical framework to examine the impact of demographic changes on various social and economic variables.

The aim of this paper is to establish guidelines for structural tax reforms in Japan, using a numerical simulation approach. The paper investigates desirable combinations of four tax bases, namely, labor income, interest income, consumption and bequests, and searches for a

[1] Japan's population has the highest old-age dependency ratio. However, the Republic of Korea is currently the fastest-aging country among OECD members.

desirable tax-combination policy, with particular emphasis on inheritance tax. The macroeconomic and welfare effects of alternative tax regimes are evaluated in each of two steady states, one for the age structure of Japan in 2000 and the other for the age structure projected for 2025.

Nearly all studies based on a life-cycle general equilibrium model have analyzed the effects of an aging population on production and consumption, and thus on economic growth. When dealing with tax reforms, however, it is vital to evaluate not only efficiency but also equity. We employed an extended life-cycle model of overlapping generations with different earnings abilities, enabling us to examine equity issues as well as efficiency issues.[2]

This paper aims to contribute to the study of the selection of tax bases using a life-cycle model with an inheritance tax.[3] Numerous analyses have been conducted using this kind of model, including Auerbach and Kotlikoff (1983a, 1983b, 1987), Auerbach *et al*. (1989), Altig *et al*. (2001), Homma *et al*. (1987a), and Ihori *et al*. (2006). Nearly all, however, dealt with either a labor income tax, a consumption tax, or an interest income (i.e., capital income) tax. Empirical evidence, such as that reported by Kotlikoff and Summers (1981), suggests that bequests represent an important component of national wealth; thus, an analysis based on a model without bequests may lead to quite different results from those with a bequest motive. In a setting with significant intergenerational transfers, we evaluated the welfare effects of various tax policies.

As our analysis was based on a life-cycle model, a crucial question is whether this model is applicable to Japan. For example, Horioka *et al*. (2000) reported that bequest motives in Japan are weak both on an absolute scale and relative to those in the United States. Additionally, the majority of bequests in Japan are either unintended or strategic. The former are caused by uncertainty regarding the length of life, and our analysis will focus on this bequest motive. The latter signifies that parents accumulate their wealth (which change into bequests when they die) as a means of urging their children to look after them.

Horioka *et al*. also noted that many of the elderly in Japan finance their living expenses by dissaving, and that both parents and children are inclined to pursue selfish actions. These empirical results indicate that a life-cycle model is highly applicable to Japan, particularly as compared to the United States.

The rest of the paper is organized as follows. The next section identifies the basic model employed in the simulation analysis. Section 3 explains the method of simulation analysis and the assumptions adopted. Section 4 evaluates the simulation results and discusses policy implications, and Section 5 summarizes the analysis and concludes the paper.

## 2. Theoretical Framework

The life-cycle growth model employed in this paper is grounded in the microeconomics of intertemporal choice and the macroeconomics of savings and growth. Our simulation model has three features. First, aggregate assets of the economy in each period consist of the assets of different generations that maximize their lifetime utility. This allows us to rigorously analyze changes in the supply of assets caused by demographic changes. Second, assets in the

[2] Fullerton and Rogers (1993) and Altig *et al*. (2001) addressed differences in lifetime earnings ability by incorporating 12 lifetime-income groups into a life-cycle model. Miyazato and Kaneko (2001) also addressed the problem of intragenerational inequality and conducted an analysis on the public pension reform.

[3] Kato (1998) and Miyazato and Kaneko (2001) introduced an inheritance tax into a life-cycle general equilibrium model. These studies focused mainly on the analysis of public pension policies, and thus their aim was different from ours.

capital market, where aggregate assets appear as real capital, affect the production level. Third, it is possible to estimate realistic consumption-savings profiles for the elderly by incorporating uncertainty of life-length and unintended bequests into the model.[4]

We calibrated this simulation model of the Japanese economy by employing population data estimated by the Institute of Population Problems of the Ministry of Health and Welfare in 1997. This model has 75 different overlapping generations and considers three types of agents: households, firms, and government. The basic structure of households is as follows.

## 2.1. Household Behavior

Households are divided into three income classes: low, medium, and high.[5] Each income class is represented by a single household, and each household has the same mortality rate and the same utility function. Unequal labor endowments, however, create different income levels. Households appear in the economy as decision-making units from age 21 until the maximum age of 95.[6] Each household faces an age-dependent probability of death. Let $q_{j+1|j}$ be the conditional probability that a household at age $j$ lives up to $j+1$. Thus, the probability that a household at age 21 survives until the age $s$ can be expressed by

$$p_s = \prod_{j=21}^{s-1} q_{j+1|j} \tag{1}$$

The probability $q_{j+1|j}$ is calculated from the 1997 data from the Ministry of Health and Welfare.

The utility of each household depends only on the level of consumption, and there is no choice between leisure and labor supply.[7] Each household works from age 21 until $RE$, the retirement age. The labor supply is inelastic before retirement and zero after retirement. Households that maximize their expected lifetime utility make lifetime decisions concerning the allocation of wealth between consumption and savings at age 21. The utility function of a representative household in the income class $i$ is assumed to be time-separable, that is,

$$U^i = \frac{1}{1-\frac{1}{\gamma}} \sum_{s=21}^{95} p_s (1+\delta)^{-(s-21)} \left\{ C_s^i \right\}^{1-\frac{1}{\gamma}} \tag{2}$$

where $C_s^i$ represents consumption (or expenditure) at age $s$, $\delta$ the adjustment coefficient for discounting the future,[8] $\gamma$ is the intertemporal elasticity of substitution.

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[4] In a model without uncertainty regarding the length of life, the age profile of consumption is linear and has an upward slope. With the introduction of uncertainty of life-length, as in our model, the profile is no longer linear. The level of consumption at the final stages of old age is low, because weight on consumption diminishes. Since such consumption-savings behavior is realistic, economic variables such as aggregate consumption or capital stock in our simulation are also realistic.

[5] Okamoto (2005b) incorporates numerous representative households with continuous income distribution in each cohort.

[6] In the case of an overlapping generations model with 80-period life cycles, where households can live up to a maximum of 100, households' assets have negative values after 90. The reason for this is that the retired households obtain a fixed public pension benefit until they die. At the final stages of old age, survival probabilities decrease drastically, and thus the households that maximize their expected lifetime utility choose the low level of consumption. It is possible to rule out the unrealistic occurrence of negative assets after 90 by assuming a 75-period life-cycle model, as in our study.

[7] An elastic labor supply can be assumed by incorporating leisure into the utility function in addition to consumption, as in Auerbach and Kotlikoff (1987), Altig *et al*. (2001), and Okamoto (2007). Several recent investigations, however, showed that the labor supply *in Japan* is fairly inelastic for the after-tax wage rate. For instance, Asano and Fukushima (1994) reported that the estimated value of compensated elasticity of labor supply is 0.27. It should be noted that their study estimated only the size of the substitution effect. If the income effect were also estimated, a still smaller elasticity of labor supply for the after-tax wage rate would be obtained *for Japan*.

The superscript $i\,(=l,m,h)$ stands for low, medium and high-income classes, respectively.

The flow budget constraint equation for each household at age $s$ is

$$A_{s+1}^{i}=\{1+r(1-\tau_r)\}A_s^i+\{1-\tau_w(wx^ie_s)-\tau_p\}wx^ie_s+b_s^i+a_s^i-\{1+\tau_c(C_s^i)\}C_s^i \qquad (3)$$

where $A_s^i$ represents the amount of assets held by the household at the beginning of age $s$, $r$ is the interest rate, $w$ is the wage rate per efficiency unit of labor, and $e_s$ is the age profile of earnings ability for the household that belongs to the medium-income class.[9] Additionally, $b_s^i$ is the amount of public pension benefit, and $a_s^i$ is the amount of bequest to be inherited at age $s$. $\tau_w(wx^ie_s)$ is the tax rate on labor income, $\tau_c(C_s^i)$ is that on consumption, $\tau_r$ is that on interest income, and $\tau_p$ is the contribution rate to the public pension scheme. $x^i$ is the weight coefficient corresponding to the different levels of labor endowments among the three income classes. The medium-income class is used as a benchmark; thus $x^m=1$. $x^l$ and $x^h$ reflect the realistic differences in earnings ability across the three income classes.

The tax system consists of labor income, interest income, consumption, and inheritance taxes. Labor income or consumption (i.e., expenditure) is progressively taxed in several simulation cases. The progressive tax schedule is incorporated in the same manner as in Auerbach and Kotlikoff (1983a, 1987). If the tax base is $z$, we use two parameters, $\alpha$ and $\beta$, and set the average tax rate ($\tau_w$ or $\tau_c$) equal to $\alpha+0.5\beta z$ for all values of $z$. The corresponding marginal tax rate ($\overline{\tau_w}$ or $\overline{\tau_c}$) is $\alpha+\beta z$. Setting $\beta=0$ amounts to proportional taxation. One may make the tax system more progressive, holding the revenue constant, by simultaneously increasing $\beta$ and decreasing $\alpha$.

In the case of a progressive labor income tax, the tax base, $z$, is equal to the gross wage rate, $wx^ie_s$. If a progressive expenditure (or consumption) tax is introduced, $z$ is equal to the level of expenditure (or consumption), $C_s^i$.[10] In other words, progressive taxation is adopted for the gross wage rate or level of consumption on an annual basis for households. The symbols, $\tau_w(wx^ie_s)$ and $\tau_c(C_s^i)$, in equation (3) express $\tau_w$ and $\tau_c$ as functions of $wx^ie_s$ and $C_s^i$, respectively. The tax system on interest income is based on proportional taxation.

Variables related to the public pension program in a pay-as-you-go system are represented by

$$\begin{cases} b_s^i=\theta H^i & (s\geq ST)\\ b_s^i=0 & (s<ST)\end{cases} \qquad (4)$$

[8] The subjective discount rate at age $s$ can be calculated by considering each survival probability, $p_s$, in addition to the constant adjustment coefficient, $\delta$. It is verified that the subjective discount rates have positive values.

[9] To estimate the age profile of earnings ability, $e_s$, the following equation is employed:

$Q=a_0+a_1A+a_2A^2+a_3L+a_4L^2,$

where $Q$ denotes the average monthly cash earnings, $A$ the age, and $L$ is the length of service for male workers. Table 7 presents the parameter values estimated using data from the Ministry of Labor (2000). Because bonuses account for a large part of earnings in Japan, monthly cash earnings used herein contain bonuses.

[10] See Seidman (1997) or Okamoto (2004, 2005a) for the details of a progressive consumption (expenditure) tax.

**Table 7. Estimation of the age profile of earnings ability**

| $a_0$ | $a_1$ | $a_2$ | $a_3$ | $a_4$ |
|---|---|---|---|---|
| -0.680796 | 0.111582 | -0.0013685 | 0.104218 | -0.0008368 |
| (-1.73253) | (4.04878) | (-5.32310) | (2.93608) | (-0.91418) |

$$\begin{cases} S.E.=0.0534\\ R^2=0.9975\end{cases}$$

where the age at which each household starts to receive public pension benefits is $ST$,[11] the average annual remuneration is $H^i \left( = \frac{1}{RE-20} \sum_{s=21}^{RE} wx^i e_s \right)$ and the replacement ratio is $\theta$. Thus, $b_s^i$ rigorously reflects different earnings abilities across the three income classes.

Unintended bequests are caused by uncertainty over the length of life. Bequests, held as assets by deceased households, are handed over to surviving households at age 50.[12] Therefore, $a_s^i$ is positive if and only if $s = 50$, and are otherwise zero. The inheritance is transferred within the households that belong to the same income class. When $BQ_t^i$ is the sum of the bequests inherited by 50-year-old households at period $t$, $a_{50}^i$ is defined by

$$a_{50}^i = \frac{(1-\tau_h)BQ_t^i}{N_t p_{50}(1+n)^{-29}} \tag{5}$$

where

$$BQ_t^i = N_t \sum_{s=21}^{95} (p_s - p_{s+1})(1+n)^{-(s-21)} A_{s+1}^i \tag{6}$$

$N_t$ is the number of new households entering into the economy at period $t$ as decision-making units, $n$ is the common growth rate of successive cohorts,[13] and $\tau_h$ is the tax rate on inheritances of bequests.[14] In the steady state of a life-cycle growth model, the amount of inheritances received is linked to the age profile of assets chosen by individuals.

Let us consider a case in which each household maximizes the lifetime utility under a budget constraint by maximizing equation (2) subject to equation (3) (see Okamoto (2004) for further details). Using the utility maximization problem, the time path of consumption for each household is characterized by

$$C_{s+1}^i = \left[ \left( \frac{p_{s+1}}{p_s} \right) \left\{ \frac{1 + r(1-\tau_r)}{1+\delta} \right\} \left( \frac{1 + \overline{\tau_c}(C_s^i)}{1 + \overline{\tau_c}(C_{s+1}^i)} \right) \right]^{\gamma} C_s^i \tag{7}$$

Once the initial consumption level, $C_{21}^i$, is specified, the optimal consumption behavior of all ages can be derived from equation (7). The amount of assets held by each household at each age can be obtained from equation (3). The expected lifetime utility of each household is derived from equation (2).

The social welfare function, which takes into account different earnings abilities, thus providing different levels of consumption, is given by

$$SW = q^l U^l + q^m U^m + q^h U^h \tag{8}$$

where $q^i$ $(i=l,m,h)$ is the weight coefficient corresponding to the population ratio of each income class. This function is derived from the sum of the expected lifetime utilities at age 21 for the three income classes. When comparing steady states, it is not necessary to take account of the

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[11] The retirement age, $RE$, and the age at which the public pension benefits start, $ST$, are exogenously given in the simulation at 60 and 65, respectively.

[12] There are two methods for dealing with uncertainty regarding the length of life. One is to consider the unintended bequests and to transfer them between the different generations; our model followed this approach. The setting of a bequest motive in this paper is the same as that considered in Iwamoto (1990). The other method is to take account of annuity markets, as in Iwamoto *et al*. (1993), which accounted for a private pension market consistent with life-length uncertainty.

[13] The rate of $n$ in our model is the gross size rate, defined as the simple ratio of the size between successive cohorts without accounting for survival probabilities, $p_s$.

[14] For simplicity, our model assumes a proportional tax rate on inheritances, although it is actually progressive. The rate was set to 10%, which was estimated using data from the National Tax Administration Agency (2000). Kato (1998) also assumed a 10% tax rate on inheritances.

utilities of all overlapping generations existing at period $t$. A comparison of the lifetime utility of a single cohort is sufficient, because our aim is to compare the welfare level among simulation cases under alternative tax regimes. The social welfare function is of the “Benthamite type,” but depends mainly on the utility of the low-income class, as in the “Rawlsian type.” [15] This function is maximized if all income classes have the same level of consumption.

With regard to the basic structure of firms, a single production sector is assumed to behave competitively, employing capital and labor, subject to constant-returns-to-scale technology (see Okamoto (2004) for the basic structures of firms and the government, and market equilibrium conditions).

## 3. Simulation Analysis

### 3.1. Method of Simulation

The simulation model presented in the previous section is solved under the hypothesis of perfect foresight by households that correctly anticipate the interest, wage, tax, and contribution rates. Once the tax and public pension systems are determined, the model can be solved by the Gauss-Seidel method (see Auerbach and Kotlikoff (1987) for the computation process).

### 3.2. Cases of Simulation

The percentage of the population aged 65 or over in Japan will continue to increase, and the trend of an aging population will be further enhanced with the declining birth rate and rising average life expectancy. In comparison with the year 2000, the population aged 65 or over is set to increase drastically by 2025. We thus considered two demographic regimes: the steady state of 2000 and the aged steady state of 2025. Case A is the 2000 current benchmark of Japan, and Case B is the benchmark of aged Japan projected for 2025; the cases differ in terms of population structure. Different survival probabilities ( $p_s$ ) and different growth rates of successive cohorts ( $n$ ) create different age structures of the population between the two demographic regimes (see Table 1 for the parameter values characterizing the two steady states).

**Table 1. Parameter values characterizing the two steady states**

| Parameter | Current steady state (Case A) | Aged steady state (Cases B and C) |
|---|---|---|
| Survival probabilities, $p_s$ (year) | 2000 | 2025 |
| Growth rate of successive cohorts, $n$ | 0.01056 | -0.00515 |
| New entrants in period $t$, $N_t$ | 1.5 | 0.9154 |
| Labor supply, [a] $L_t$ | 153.22 | 132.51 |
| Contribution rate, $\tau_p$ | 17.35% | 30.82% |

[a] Measured per effective labor unit.

[15] Our model employs a simple utilitarian social welfare function based on the steady state utility for a single generation. This function is most sensitive to income changes for the low-income class due to the concavity of the underlying utility function. As the parameter of the intertemporal elasticity of substitution, $\gamma$, is decreases, it becomes more dependent on the utility of the low-income class, becoming Rawlsian if both $q^m$ and $q^h$ are zero.

Under the aged steady state condition, Japan will face a decline in the proportion of its working population, with a subsequent decrease in aggregate output ($Y_t$) ; hence, the ratio of total tax revenue ($T_t$) to aggregate output ($Y_t$) increases under tax revenue neutrality, representing a substantial increase in the tax burden on an aging society. In other words, there is an increase in the tax burden caused by the aging population from Case A to B.[16] There is the political possibility that a tax rate on consumption can be raised in present-day Japan. Therefore, a consumption tax is used to finance the extra tax burden caused by the transition from the current to the aged state in this paper.

In Case B-1, a progressive expenditure tax covers overall tax revenue. Cases B-2 and B-3 are tax-combination cases, in which there is an inheritance tax in addition to a progressive expenditure tax. The Case-C simulations (which are based on a proportional tax system) are also considered in the aged situation to ascertain the apparent effects of alternative tax regimes on capital accumulation.

The simulation cases employed in this paper are as follows (see Tables 2 and 3 for simulation cases and results):

**Table 2. Benchmark cases and simulation results caused by alternative tax policies in the 2025 aged steady state**

| | Case A (Benchmark; current state) | Case B (Benchmark; aged state) | Case B-1 (Progressive expenditure tax) | Case B-2 (Tax-combination; 50% inheritance tax) | Case B-3 (Tax-combination; 100% inheritance tax) |
|---|---|---|---|---|---|
| Tax rate on labor income $\tau_w(wx^ie_s)$ | $*\begin{cases}\alpha=-0.040\\ \beta=0.0540\end{cases}$ | $*\begin{cases}\alpha=-0.040\\ \beta=0.0540\end{cases}$ | *0 | *0 | *0 |
| Tax rate on consumption $\tau_c(C_s^i)$ | $*\begin{cases}\alpha=0.05\\ \beta=0\end{cases}$ | $*\begin{cases}\alpha=0.0677\\ \beta=0\end{cases}$ | $*\begin{cases}\alpha=0.0596\\ \beta=0.0889\end{cases}$ | $*\begin{cases}\alpha=0.0324\\ \beta=0.0856\end{cases}$ | $*\begin{cases}\alpha=0.0087\\ \beta=0.0828\end{cases}$ |
| Tax rate on interest income $\tau_r$ | 20.00% | 20.00% | 0.00% | 0.00% | 0.00% |
| Tax rate on inheritances $\tau_h$ | *10% | *10% | *0% | *50% | *100% |
| Capital-labor ratio $K/L$ | 3.100 | 2.962 | 3.830 | 3.716 | 3.624 |
| Interest rate $r$ | 3.78% | 4.05% | 2.75% | 2.88% | 2.99% |
| Wage rate $w$ | 0.9970 | 0.9890 | 1.0324 | 1.0275 | 1.0235 |
| (Low) Bequests $BQ^l$ | 5.843 | 5.541 | 6.010 | 5.572 | 5.195 |
| (High) Bequests $BQ^h$ | 9.642 | 8.119 | 12.457 | 11.543 | 10.755 |
| (Low) Utility $U^l$ | -5.122 | -10.233 | -9.435 | -9.657 | -9.852 |
| (High) Utility $U^h$ | -0.423 | -0.901 | -0.706 | -0.723 | -0.738 |
| Social welfare $SW$ | -2.343 | -4.723 | -4.262 | -4.363 | -4.452 |

Asterisks (*) before the rate show that the variable is exogenous.

[16] Alternatives to tax increases, such as decreases in retirement benefits or increases in government debt, might cover public pension benefits or an increased burden; however, this paper assumes that they are not politically feasible.

**Table 3. Effects of alternative tax regimes on capital accumulation under proportional taxation in the 2025 aged steady state**

| | Case C (Benchmark; proportional tax) | Case C-1 (Inheritance tax vs. consumption tax) | Case C-2 (Inheritance tax vs. labor income tax) | Case C-3 (Inheritance tax vs. interest income tax) | Case C-4 (Interest income tax vs. labor income tax) |
|---|---|---|---|---|---|
| Tax rate on labor income, $\tau_w$ | 6.30% | *6.30% | 4.14% | *6.30% | 3.79% |
| Tax rate on consumption, $\tau_c$ | *6.77% | 4.70% | *6.77% | *6.77% | *6.77% |
| Tax rate on interest income, $\tau_r$ | *20.00% | *20.00% | *20.00% | 0.57% | *40.00% |
| Tax rate on inheritances, $\tau_h$ | *10% | *50% | *50% | *50% | *10% |
| Capital-labor ratio, $K/L$ | 2.751 | 2.706 | 2.891 | 2.927 | 2.705 |
| Interest rate, $r$ | 4.52% | 4.63% | 4.20% | 4.12% | 4.63% |
| Wage rate, $w$ | 0.9756 | 0.9726 | 0.9846 | 0.9869 | 0.9725 |
| (Low) Bequests, $BQ^l$ | 4.844 | 4.567 | 4.731 | 5.103 | 4.395 |
| (High) Bequests, $BQ^h$ | 9.687 | 9.135 | 9.462 | 10.206 | 8.790 |
| (Low) Utility, $U^l$ | -13.364 | -13.599 | -12.715 | -13.501 | -12.664 |
| (High) Utility, $U^h$ | -0.835 | -0.850 | -0.795 | -0.844 | -0.792 |
| Social welfare, $SW$ | -5.893 | -5.996 | -5.606 | -5.953 | -5.584 |

Asterisks (*) before the rate show that the variable is exogenous.

1 ***Case A** (Benchmark of the 2000 current state)*
The tax system on labor income has a realistic progressiveness. The tax rate on consumption is 5%, that on interest income is 20%, and that on inheritances of bequests is 10%.

2 ***Case B** (Benchmark of the 2025 aged state)*
A consumption tax covers the extra tax burden caused by the transition to an aging society. Other tax regimes remain the same as in Case A.

3 ***Case B-1** (Progressive expenditure tax)*
In Case B, a progressive expenditure tax is introduced. The tax covers overall tax revenue. Labor and interest incomes and inheritances are not taxed.

4 ***Case B-2** (Tax-combination policy with a 50% inheritance tax)*
In Case B-1, a 50% inheritance tax is introduced. The tax and a progressive expenditure tax cover overall tax revenue. Labor income and interest income are not taxed.

5 ***Case B-3** (Tax-combination policy with a 100% inheritance tax)*
In Case B-1, a 100% inheritance tax is introduced. The tax and a progressive expenditure tax cover overall tax revenue. Labor income and interest income are not taxed.

6 ***Case C** (Benchmark under a fully proportional tax system)*
In Case B, a proportional labor income tax replaces a progressive one. Thus, the whole tax system is completely proportional.

7 ***Case C-1** (Inheritance tax versus consumption tax)*

In Case C, the tax rate on inheritances is raised to 50%, and that on consumption is reduced under revenue neutrality. Tax rates on labor income and interest income remain the same as in Case C.

8 ***Case C-2*** *(Inheritance tax versus labor income tax)*
In Case C, the tax rate on inheritances is raised to 50%, and that on labor income is reduced under revenue neutrality. Tax rates on consumption and interest income remain the same as in Case C.

9 ***Case C-3*** *(Inheritance tax versus interest income tax)*
In Case C, the tax rate on inheritances is raised to 50%, and that on interest income is reduced under revenue neutrality. Tax rates on labor income and consumption remain the same as in Case C.

10 ***Case C-4*** *(Interest income tax versus labor income tax)*
In Case C, the tax rate on interest income is raised to 40%, and that on labor income is reduced under revenue neutrality. Tax rates on consumption and inheritances remain the same as in Case C.

Across simulation cases with the different tax structures, it is difficult to make the degree of tax progressivity identical. With regard to the parameter values that determine tax progressivity on expenditure, namely, $\alpha$ and $\beta$, in Cases B-1, B-2 and B-3, we decided to assign the parameter values so that the overall tax revenue (which is generated by the four types of tax regimes) for each income class is close to that in Case B.

### 3.3. Specification of Parameters

Table 4 presents the parameter values used in the simulation. As this paper examines the implications of several tax policies for the Japanese economy under the condition of an aging society, we choose parameter values that are realistic for the economy.[17] In benchmark Case A,

**Table 4. Parameter values used in simulation analysis**

| Parameter description | Parameter values |
|---|---|
| Adjustment coefficient for discounting the future | $\delta = -0.022$ |
| Intertemporal elasticity of substitution | $\gamma = 0.2$ |
| Elasticity of substitution in production | $\sigma = 0.6$ |
| Weight parameter in production | $\varepsilon = 0.2$ |
| Scale parameter in production | $B = 0.942$ |
| Government expenditure for each cohort | $g = 0.3111$ |
| Retirement age | $RE = 60$ |
| Starting age for receiving public pension benefits | $ST = 65$ |
| Replacement ratio for public pension | $\theta = 0.5512$ |

[17] Parameter values are assigned with reference to earlier research such as Homma *et al*. (1987b), in which the values are estimated from Japanese data. Thus, we chose realistic parameter values.

the variables, such as the ratio of capital to income (K/Y) or that of capital to labor (K/L), were close to the actual values for 2000.

First, survival probabilities ( $p_s$ ) were calculated from data provided by the Institute of Population Problems of the Ministry of Health and Welfare (1997). Our model makes no distinctions by sex, and thus this analysis uses male–female average values for 2000 and 2025. Based on this data, the percentages of the aged population (65 or over) to the total population (21 or over) in 2000 and 2025 are 22.04% and 33.86%, respectively. Common growth rates of successive cohorts ( $n$ ) are chosen so that the percentages in the simulation under two demographic regimes are the same as the estimated values.

Next, the method of assigning the weight given to labor endowments for the three income classes is described. Table 5 is comprised of data from the Ministry of Finance (2001), showing the effective tax rates of wage-workers on a national income tax and a residence tax, with regard to a couple with two children. In our model, the three representative households, namely, low, medium and high-income classes, have different earnings abilities. Table 5 indicates that the income classes, each of which accounts for one-third of the total population, correspond to representative household earnings of 5, 7 or 10 million yen, respectively, on an annual base. The weight on labor endowments for each income class corresponds to the ratio of its amount of earned income. The medium-income class is used as a benchmark, that is, $x^m$ =1; $x^l$ and $x^h$ are assigned to reflect different earnings abilities across the three income classes.

**Table 5. Effective tax rates for national income tax and residence tax of wageworkers**

| Income class | Total amount of annual income (million yen) | Weight on labor endowments | Total amount of annual taxes: national income tax and residence tax (thousand yen) | Effective tax rates (%) | Population ratio of the income class |
|---|---|---|---|---|---|
| Low | 5 | $x^l = 0.7143$ | 115 | 2.30 | $q^l = 0.3333$ |
| Medium | 7 | $x^m = 1$ | 319 | 4.56 | $q^m = 0.3333$ |
| High | 10 | $x^h = 1.4286$ | 859 | 8.59 | $q^h = 0.3333$ |

Data given are for a couple with two children.
Source: Ministry of Finance (2001).

Third, the method of assigning the parameter values that determine tax progressivity on labor income, namely, $\alpha$ and $\beta$ , is described. Table 5 presents the effective tax rate calculated from a national income tax and a residence tax for each income class. The parameter values on labor income in benchmark Case A are assigned so that the effective tax rate for each income class in the simulation is close to the value shown in Table 5.

Finally, with regard to the public pension system, the replacement ratio of pension benefits ( $\theta$ ) in Case A was chosen so that the contribution rate ( $\tau_p$ ) equals the actual value of 17.35% for employee pension plans (*kosei nenkin*) in 2000.

## 4. Simulation Results

The aged-state simulations for 2025 are the main focus of the discussion below, because we are interested in the effect of tax reforms on the future Japanese economy. Tables 2 and 3 present the simulation results for the current and aged steady states. In this paper, the influence on capital accumulation is used as an indicator of efficiency. This is because under the assumption of inelastic labor supply, the total level of output depends solely on the level of capital stock. The social welfare function represented by equation (8) includes aspects of both efficiency and equity.

### 4.1. Results and Policy Implications

*1. Changes in capital accumulation during the transition from the current state to the aged state*

First, we focus on the difference in the capital-labor ratio (K/L) between the current and aged state cases. Table 2 shows that the ratio is 3.10 in the 2000 benchmark Case A, but decreases to 2.96 in benchmark Case B projected for 2025. A possible reason for this is that, in an aging society, there are many cohorts that dissave their assets based on a life-cycle motive. Therefore, tax policies that stimulate capital accumulation may be required in an aging society. In addition, the results in Table 1 suggests that the payroll tax (i.e., contribution rate) rises sharply from 17.35% to 30.82% under the constant benefit-to-earnings replacement rate because the demographic ratio of retirees to workers increases drastically. Both capital accumulation and the working population will decrease in an aging Japanese society, and thus national income may also decline substantially.

*2. Effects of the four proportional tax regimes on capital accumulation*

In the simulations projected for 2025 (see Table 3), we compared labor income tax, consumption tax, interest income tax and inheritance tax to examine alternative proportional tax regimes. Case C-3 attains the highest K/L ratio (2.93), while Case C-4 has the lowest K/L ratio (2.71). A possible reason for this is that the tax rate on interest income decreases in Case C-3 but increases in Case C-4. This result suggests that an interest income tax is a relative hindrance to capital accumulation.

Our model assumes only accidental bequests, which are exogenous to households. In a perfect foresight model, the inheritance tax employed in this paper is analogous to the age-specific wage tax under the assumption of an inelastic labor supply. The inheritance tax is inferior to the consumption tax with regard to efficiency, which is confirmed by a comparison of the K/L ratio among Cases C (2.75), C-1 (2.71), and C-2 (2.89). The results indicate that the inheritance tax enhances capital formation more than the labor income tax but less than the consumption tax.

If the consumption tax covers more of the total tax revenue, the capital accumulation is promoted, thus improving social welfare. It is desirable that the consumption tax covers a greater part of the revenue. If the promotion of capital formation is necessary in Japan, then the first consideration may be the replacing the interest income tax, which is a relative hindrance to capital accumulation, with the consumption tax. Because the inheritance tax is the strong enhancer of capital accumulation, after consumption tax, a tax-combination policy with an inheritance tax should be considered when there are difficulties, such as political obstacles, in raising the tax rate on consumption.

Auerbach and Kotlikoff (1987) report that the K/L ratio is the highest under the consumption tax, followed by the labor income tax, and finally the capital income tax (i.e., the interest income tax). Our simulation obtained the same qualitative result.

*3. Progressive expenditure taxation*

Tax policies that stimulate capital formation may be required in the aging society of

Japan. In Cases B-1, B-2 and B-3, we considered several tax policies aimed at enhancing capital accumulation. In Case B-1, the consumption tax, which has the highest promotion of capital formation, covered overall tax revenue. Because taxation on consumption exists continuously even after retirement, the consumption tax requires more assets to cover the tax burden after retirement than the labor income tax. In Cases B-2 and B-3, an inheritance tax, the second-most effective enhancer of capital accumulation, was introduced in addition to the consumption tax.

In switching from Case B (i.e., the benchmark in an aged society) to B-1 (overall tax revenue covered by progressive expenditure tax), the K/L ratio rises dramatically from 2.96 to 3.83, while social welfare improves from -4.723 to -4.262. This result shows that the expenditure tax (or the consumption tax) is a relative promoter of capital accumulation, and that incorporating progressivity into the expenditure tax system efficiently reduces dispersion in lifetime income distribution. In present-day Japan, saving rates tend to decline, and the disparity of within-cohort inequality is likely to increase. Hence, we recommend a progressive expenditure tax as the nucleus of a tax scheme for an aging Japan.

Ohtake and Saito (1998) suggest that the younger generations in Japan have recently started to face high consumption inequality from the beginning of their life cycle, because within-cohort inequality may be transmitted from the older generations to the younger ones through intergenerational transfers. This is known as the “cohort effect.” In a society under a high rate of economic growth, such as Japan in the high-growth era, the difference in labor income creates within-cohort inequality. However, once a society shifts to the stable-growth phase, as typified by the current Japanese economy, inheritances of bequests play a more important role, resulting in higher cohort effects. Thus, significant cohort effects are found not in income inequality but consumption inequality, indicating that consumption, rather than labor income, is an appropriate tax base for achieving income redistribution.[18]

*4. Changes in the size of the four tax bases in the transition to an aging society*

Miyajima (1986) proposed a tax-combination policy, namely, a combination of *several* tax bases. The reason is that no *single* tax base can perfectly satisfy all the conditions required for the whole tax system, which, in reality, has significant defects, both functionally and administratively. Therefore, even if a progressive expenditure tax is suitable for the nucleus of a tax scheme, we should consider a tax-combination instead of a *single* tax base as actual policy.[19]

As population aging prevails, Japan will face a decline in the proportion of its working population, resulting in a drastic decrease in aggregate labor income. Hence, consumption, savings and bequests will also decline because they arise from labor income. In order to elucidate a desirable tax-combination policy, we investigated changes in the size of tax bases. Table 6 shows that the size of four tax bases (namely, labor income, interest income, consumption, and bequests) will decline in the transition to an aging society. The largest decrease emerges in labor income (-14.21%), followed by interest income (-11.56%), and then consumption (-11.47%). It should be noted that the smallest decrease is associated with accidental bequests (-10.82%). Therefore, taxation on inheritances may become increasingly significant in an aging Japan.

[18] If we consider human capital accumulation in the form of educational investment, this statement may not hold true. If the rich can give their children a higher level of education, it will perpetuate both income and consumption inequalities across cohorts. This intergenerational inequality in education could be more influenced by income taxes than consumption taxes.

[19] This paper basically accepts the view that a tax-combination policy is preferable to a single-tax policy, based on Miyajima (1986). However, the justification for this proposal needs to be discussed further, because it is potentially controversial.

**Table 6. Changes in the size of four tax bases in a transition from the 2000 current steady state to the 2025 aged steady state**

| *Tax base* | Current benchmark Case A (2000) | Aged benchmark Case B (2025) | Rate of change (%) |
|---|---|---|---|
| Labor income, $wL$ | 152.76 | 131.05 | -14.21 |
| Interest income, $rK$ | 17.96 | 15.89 | -11.56 |
| Consumption, $AC$ | 144.85 | 128.23 | -11.47 |
| Bequests, $BQ$ | 7.702 | 6.869 | -10.82 |
| Interest rate, $r$ | 0.0378 | 0.0405 | 7.02 |
| Capital stock, $K$ | 474.94 | 392.46 | -17.36 |

*5. Necessity of strengthening an inheritance tax*

Cases B-2 and B-3 consider the combination tax with a progressive expenditure tax and an inheritance tax. B-2 shows a case with a 50% inheritance tax, and Case B-3 with a 100% inheritance tax. The K/L ratios in Cases B-2 and B-3 are 3.72 and 3.62, and the social welfare indicators are -4.363 and -4.452, respectively. As the progressive expenditure tax accounts for a greater part of the total tax revenue, it produces a higher K/L ratio and thus improves social welfare. Because inheritance tax stimulates capital accumulation following expenditure tax, a combination of progressive expenditure tax and inheritance tax may be desirable as a tax-combination policy.

Households allocate their income into consumption (i.e., expenditure) and savings. Under an expenditure tax, the part of income allocated to savings is not taxed at that time, but will be taxed in the future, especially when households start to dissave. However, the bequest, which eventually becomes part of the wealth that is not consumed, is ultimately not taxed. Therefore, intergenerational transfers, namely, inheritances of bequests, should be more strongly taxed to mitigate within-cohort inequality, especially when an expenditure tax is adopted as the nucleus of a tax scheme. Ohtake and Saito (1998) also propose that strengthening the redistribution system and raising the inheritance tax rate may enable the Japanese economy to avoid further increases in inequality.

*6. Substitution between an interest income tax and an inheritance tax (or a labor income tax)*

In order to identify the optimal combination between an interest income tax and an inheritance tax (or a labor income tax), we compared the simulation results in Cases C, C-3, and C-4 (see Table 3). The tax rate on interest income is 20% in Case C, and increases to 40% in Case C-4. Although the K/L ratio in Case C-4 (2.71) is lower than that in Case C (2.75), the social welfare indicator in Case C-4 (-5.584) is higher than that in Case C (-5.893). This observation suggests that the substitution of the interest income tax for the inheritance tax (or the labor income tax) may improve social welfare despite a lower volume of capital stock. This signifies that a low K/L ratio does not necessarily lead to a low level of social welfare. Hence, for the improvement of social welfare, these substitutions may be desirable under certain circumstances.

### 4.2. Comments

The following five points should be considered when interpreting our simulation results. First, the simulation results show that the higher the tax progressivity, the greater the capital accumulation. This is because our model assumes an *inelastic* labor supply, and thus tax progressivity has no impact on the labor supply. If the model incorporated a tax-induced disincentive effect, high tax progressivity would not always result in favorable outcomes with regard to efficiency. Assuming an *inelastic* labor supply, an increase in progressiveness could reduce the dispersion of after-tax income distribution without a decrease in the labor supply. However, if the labor supply in our model is *elastic*, the disincentive effect of progressive taxation will be damaging to social welfare (see Okamoto (2007) for an analysis of a life-cycle model with an *elastic* labor supply).

Second, the effects of demographics are explained by comparing the two steady states, namely, the current and aged states. Thus, our analysis lacks consideration of the transitional path. A change from a labor income tax to a consumption tax creates income transfers among generations during the transition. At the onset of policy reform, elderly citizens who have already paid their labor income tax will have to pay an additional consumption tax. Because this generation would suffer from a double burden, transition to the consumption tax is not Pareto improving. Thus, any conclusion recommending a consumption tax will be required to provide further justification, that is, to suggest measures to avoid a double burden during transition.

Third, with regard to the performance of inheritance tax, this paper does not sufficiently account for the economic mechanisms underlying the simulation results, for example, the reason why inheritance tax considerably stimulates capital accumulation.[20] Thus, the effects of inheritance tax need to be discussed more carefully. Furthermore, the inheritance tax introduced in our model is based only on accidental bequests. This begs the question of whether the simulation results would hold irrespective of bequest motives, including altruistic, strategic, or bequest-as-consumption. We should thus examine the robustness of our results obtained from the case of inheritance tax for different bequest motives.

Fourth, our simulation model deals only with the unintended bequests consistent with uncertainty regarding the length of individual life. Horioka *et al*. (2000) suggested that unintended or strategic bequest motives give a sufficient account for the majority of bequests in Japan. Therefore, the strategic bequest motive, which is one of the intended bequest motives, should also be included in the model. If the intended bequests are taken into account, then the tax elasticity of intended bequests would play an important role.

Finally, because the simulation results are dependent on the given parameters, we must be careful about the effects of any parameter changes. In particular, a slight change in the parameter of the intertemporal elasticity of substitution, $\gamma$, has a great effect on capital formation.

## 5. Conclusions

In this paper, we developed, calibrated and simulated a life-cycle general equilibrium model of overlapping generations with different earnings abilities to clarify the guidelines for possible structural tax reforms. We have focused on the taxation on intergenerational transfers by introducing the unintended bequest motives into the model, and evaluated the macroeco-

[20] In terms of the "postponement effect," Seidman (1983) addressed the effect of inheritance tax, suggesting that the age at which a tax is paid is crucial for the capital-labor ratio (K/L): the later one pays, the higher the ratio.

nomic and welfare effects of alternative tax regimes in an aging Japan.

Our simulation results suggest in a quantitative way that capital stock diminishes in the transition to the aging society. The results also show that a consumption tax substantially stimulates capital accumulation and offsets some of the dissavings that take place in an aging population, and that a progressive expenditure tax efficiently reduces the dispersion of lifetime income distribution and enhances overall welfare. Therefore, in an aging Japan, a progressive expenditure tax is more desirable than the progressive labor income tax on which the current Japanese system mainly relies.

When a progressive expenditure tax is introduced as the nucleus of a tax scheme, an inheritance tax is suitable for a complement tax. This is because an inheritance tax promotes capital formation following a consumption tax, and may also restrain the recent tendency for the younger generations in Japan to face high consumption inequality from the beginning of their life cycle. The combination of progressive expenditure tax and inheritance tax may be desirable as a tax-combination policy in an aging Japan with regard to efficiency and equity.

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