Chapter 2

Generational Gap in Public Benefits and Burdens
Under the Integrated Reform of Expenditures and Revenues 2006 in Japan

Satoko MAEKAWA, Kansai University
Masahiro HIDAKA, Osaka Gakuin University

1. Introduction

In Chapter 1, we investigated the effects of the “Integrated Reform of Expenditures and Revenues” on the future stream of primary balances, which gives us useful information to verify whether a policy can satisfy the sustainability condition.

It is important not only to verify those effects on future fiscal conditions, but also to clarify how much of a burden people should bear. In particular, the government would be faced with increasing social security demand because it should repay debt. Therefore, given a declining and aging population, additional burdens that emerge from fiscal reforms could create a serious difference in public burdens among generations. The government is required more than ever to exercise fiscal management considering such generational gaps.

Generally, if there are some policies that satisfy sustainability, we should examine their superiority by conducting further welfare analyses. Two approaches are used in welfare analysis studies on policy reform over the long term. One is generational accounting, which was introduced by Auerbach, Gokhale, and Kotlikoff (1991). It has been used in many
countries to evaluate policies from the viewpoint of intergenerational imbalances of lifetime net burden. The other is dynamic general equilibrium welfare analysis. It reflects consumers’ reactions toward policy changes, and enables us to evaluate policy in terms of level of utility.

Although the latter approach is superior for endogenously determining growth rate and interest rate within the same framework, it might not be consistent with the assumptions of growth rate and interest rate in Chapter 1. The projection in Chapter 1 suitable for modifying the generational accounting method, which also assumes constant growth and interest rates.

This paper investigates how the “Integrated Reform of Expenditures and Revenues” would change differences in public benefits and burdens among generations in Japan. The main feature of the paper is that we consider each generation’s burden of fiscal deficit. Although we often pay attention to the potential national burden, which is the sum of the national burden and the ratio of fiscal deficit to national income, there have been few papers that estimate potential public burdens of generations. While some analyses of generational accounting have estimated the burden of a future generation, they have focused only on a representative future generation, who would bear all of the government debt. On the other hand, this paper estimates the potential burdens of both present and future generations by distributing the annual fiscal deficit to all generations living in that year.

The next section explains our concept of generational potential burdens, and Section 3 explains our estimation methodology and data. Section 4 presents the results, and Section 5 presents our conclusions.
2. Relation between Government Debt and Primary Balance

In this section, we describe the relation between government debt evaluated at the end of the fiscal year and the primary balance of that fiscal year. Denoting \(D_t\), government debt at the end of fiscal year \(t\), and \(PB_t\), the primary balance of fiscal year \(t\), \(D_t\) is defined as

\[
D_t = (1+r)D_{t-1} - PB_t. \tag{1}
\]

The increment of debt for year \(t\) is the sum of interest payments of debt and the deficit of the primary balance. Then, we can rewrite (1) as

\[
D_t = (1+r)^tD_0 - \left\{ (1+r)^{-1}PB_1 + (1+r)^{t-2}PB_2 + \cdots + PB_t \right\}. \tag{2}
\]

This means that \(D_t\) is calculated using the initial value of debt and the stream of primary balances from year 1 to year \(t\). We can project the debt balance at a time in the future by estimating future PB.

Keeping \(D_t\) at a certain level in the future is required for the sustainability of the government’s budget. The stream of PB in the future is constrained to satisfy the sustainability condition because government debt is determined by PB as shown in (2). To describe this constraint, we define the sustainability condition. We assume that government expenditures and revenues in the future will increase at the same rate as the GDP growth rate, which is assumed to be constant. Therefore, the PB GDP ratio is assumed to be constant in the future.

Under these assumptions, we have a ratio of government debt to GDP of

\[
\frac{D_t}{Y_t} = \left( \frac{1+r}{1+g} \right)^t \frac{D_0}{Y_0} - \left( \frac{1+r}{1+g} \right)^{t-1} \frac{PB_1}{Y_1} - \left( \frac{1+r}{1+g} \right)^{t-2} \frac{PB_2}{Y_2} - \cdots - \frac{PB_t}{Y_t}.
\]
or

$$\hat{\beta}_t = \left(\frac{1 + r}{1 + g}\right)^t \hat{\beta}_0 - \alpha \left(\frac{1 + r}{1 + g}\right)^{t-1} + \left(\frac{1 + r}{1 + g}\right)^{t-2} + \cdots + 1 \right), \quad (3)$$

where $\hat{\beta}_0 = \frac{D_t}{Y_t}$, and $\alpha = \frac{PB_t}{Y_t}$ for all $i$ from 1 to $t$. We can calculate $\alpha$ such that $\hat{\beta}$ is not infinite.

**Reducing Debt GDP ratio**

Given the initial ratio of debt to GDP $\hat{\beta}_0$, we can calculate the required ratio of the PB surplus to GDP $\hat{\alpha}$ to obtain $\hat{\beta}_t$ which we exogenously set as the target level of the target year using (3).

$$\hat{\alpha} = \frac{r - g}{\left(\frac{1 + r}{1 + g}\right)^t - \left(\frac{1 + r}{1 + g}\right)^{t-1}} \left(\frac{1 + r}{1 + g}\right)^t \hat{\beta}_0 - \left(\frac{1 + r}{1 + g}\right)^{t-1} \hat{\beta}_t \right), \quad r \neq g \quad (4)$$

$$\hat{\alpha} = \frac{1}{t} \left(\hat{\beta}_0 - \hat{\beta}_t \right), \quad r = g \quad (4')$$

Equation (4) shows that PB surplus $\hat{\alpha}$ depends on the set of interest rate ($r$), growth rate ($g$), targeted debt balance ($\hat{\beta}_t$), and initial debt balance ($\hat{\beta}_0$).

**Holding Debt GDP Ratio Constant**

The level of government debt to GDP in the long run must not be zero for sustainability.

After achieving a certain level $\hat{\beta}_t$, it might be sufficient to keep that level constant. This condition must satisfy $\hat{\beta}_{t+1} - \hat{\beta}_t = 0$. From (3), we can obtain $\hat{\alpha}$ that keeps $\hat{\beta}$ constant,

$$\hat{\alpha} = \frac{r - g}{1 + g} \hat{\beta}_t \quad (5)$$
If \( r > g \), \( \bar{\alpha} \) must be positive. That means a primary balance surplus is needed to keep the ratio of government debt to GDP constant in the future if \( r > g \).

3. Methodology and Data

We estimate both annual public burdens and benefits that each generation would receive during a lifetime. By summing up those present values, we calculate lifetime public burdens and benefits\(^1\). We estimate lifetime benefits and burdens in the case of no reform, and under the “Integrated Reform of Expenditures and Revenues” respectively. So, we reveal how the reform would change differences in public benefits and burdens among generations by comparing generational differences under the two cases.

This section explains how we calculate public burdens and benefits, and which data we employ in the estimation. First, we explain our assumptions for generations, and then present ways to calculate public burdens and benefits.

Assumptions for generations

This paper assumes a head of a representative household of each generation. He (or she) is considered to be an employee, and begins to work at 23 years old, retires at 60, and dies at 80. The estimations in the paper focus on seven generations: those born in 1930, 1940, 1950, 1960, 1970, 1980, and 1990.

\(^1\) When we calculate the present values of public benefits and burdens, we evaluate them at constant prices in 2006. We use nominal long-term interest rate as the discount rate, which is assumed to be 4%.
(1) Estimation of public burdens (No reform)

The public burdens a household bears are taxes, social insurance contributions, and potential burdens that would be required for the repayment of government debt. Therefore, we calculate those burdens of each generation respectively. We estimate the generational burdens of income tax, residence tax, and social security premiums based on each generation’s lifetime income, and we also estimate the generational burden of consumption tax by considering each generation’s lifetime consumption. The other tax burdens, for example corporate tax, are calculated by dividing the other revenues by total population.

Estimation of potential burdens

The potential burdens of government debt are calculated based on the concept presented in the previous section. First, we calculate the required level of the primary balance of the central and local government combined in order to reduce the ratio of government debt to GDP. We assume reducing the ratio of government debt to GDP to 60% from 2012 until 2050. Second, we estimate additional revenues that would be necessary to achieve the required primary balance. In this paper we consider that such additional revenues would be covered by increasing taxes. Third, we estimate how much we should increase a tax. When we estimate it, we set up two cases. One case is to increase poll tax, and the other is to increase consumption tax.

In the case of poll tax, we calculate the additional tax burden by dividing the amount of additional revenues by total population. In the case of consumption tax, we calculate how
much we need to increase the tax rate in 2012 to finance the total amount of additional revenues in the future.

Data on each generation’s Lifetime income

We use cohort data for the estimation\(^2\). Cohort data represents the yearly average of income per worker’s household by age of household head. It is based on “Annual Report on the Family Income and Expenditure Survey” in Japan from 1953 to 2000. The data after 2001 are calculated by multiplying the data for 2000 by a nominal growth rate.

Data on each generation’s lifetime consumption

To estimate the lifetime consumption of each generation, this paper establishes a life-cycle model in which a head of a representative household maximize lifetime utility.

The head of a generation-\(t\) household consumes private goods (\(c\)) in each year from the age of 23 to 80 years. The head of household also derives utility from social security (\(s\)) and public goods (\(g\)) provided equally by the government except social security. Therefore, the lifetime utility of the head of a generation-\(t\) household is written as

\[
U^t = U^t \left( c_{23}^t, c_{24}^t, \ldots, c_{80}^t, s_{23}^t, s_{24}^t, \ldots, s_{80}^t, \bar{g}_{23}^t, \bar{g}_{24}^t, \ldots, \bar{g}_{80}^t \right) \quad (6)
\]

, where \(c_{23}^t, c_{24}^t, \ldots, s_{23}^t, s_{24}^t, \ldots, \bar{g}_{23}^t, \bar{g}_{24}^t\) represent consumption, social security, and public good at each age (23 - 80) of the generation-\(t\) household\(^3\).

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\(^2\) The existing analysis based on cohort data in Japan are Hashimoto et al. (1991), and Homma et al.(1989).

\(^3\) The following utility function is used in the analysis.
The budget constraint for a representative household of generation $t$ is given by

$$
(1 - t_{c25})p_{23}c_{23} + \frac{(1 - t_{c24})p_{24}c_{24}}{(1 + (1 - T_{r24}))r_{24}} + \cdots + \frac{(1 - t_{c89})p_{89}c_{89}}{(1 + (1 - T_{r89}))r_{89}} \right)^{\gamma} \\
= \text{income}_{23} - PE_{23} + \frac{\text{income}_{24} - PE_{24}}{(1 + (1 - T_{r24}))r_{24}} + \cdots + \frac{\text{income}_{63} - PE_{63}}{(1 + (1 - T_{r63}))r_{63}} \right)^{\gamma} + \cdots + \frac{\text{income}_{96} - PE_{96}}{(1 + (1 - T_{r96}))r_{96}} \right)^{\gamma} 
$$

(7)

where $p_i$ is the price of private goods, $r_i$ is interest rate, $T_{ri}$ is tax rate on interest, income is annual income, $PB_i$ is public burden including income tax, residence tax, and social security contribution (health insurance contribution and pension premium) and $pen_i$ is pension at $i$-years old.

Based on the model explained above, we calculate the lifetime consumption that maximizes utility (6) under the lifetime income (7).

Data on population

When we calculate per-capita burdens, we use “Population Estimation of Japan 1920-2000”

$$
U = \beta \sum_{i=1}^{T} \left( 1 + \delta \right)^{-(t-i+1)} \frac{C_i^{1-\gamma}}{1-\frac{1}{\gamma}} + (1 - \beta )\left( 1 + \delta \right)^{-(T-i+1)} \frac{K^{1-\gamma}}{1-\frac{1}{\gamma}}
$$

where $\delta$ is the ratio of time preference, $\gamma$ is the elasticity of substitution between the present and the future, $C_i$ is the level of consumption per person at time $t$, $K$ is the amount of inheritance, $\beta$ is a weight parameter of inheritance, $T$ is the age of death (80 years old). It is assumed that $\delta = 0.01$ and $\gamma = 0.3$, which are based on Homma et al. (1987) and that $\beta = 0.000001$, which is based on Hashimoto(1998). We can get the following Euler equation by solving the maximization of the utility function above subject to the life-time income constraint (equation (7)). Using this Euler equation, we calculate the lifetime consumption of a representative household.

$$
C'_t = \left( 1 + (1 - t_{r}r_{r})^{-\gamma} \frac{\nu}{1 + \delta} \right)^{\gamma} C_{t-1} \left( \frac{\nu_{t-1}}{\nu_t} \right)^{\gamma} \phi_t
$$

where $t_r$ is tax rate on interest income, $\nu = (1 + (1 - r) r)^{-\gamma} \phi_r$, and $\phi$ is a lagrange multiplier.

(2) Estimation of public benefits: 1953-2004

We regard public expenditures for administrative services, public investment, and social security (pension, medical care, and nursing care for the elderly) as public benefits.

We use the generational government data in the System of National Accounts (SNA). ‘Final consumption expenditure’ of the general government in SNA is used for representing administrative services, ‘public capital formation’ is used for public investment, and ‘Social security transfers’ is used for social securities benefits. A summary of the estimation is as follows.

Final Consumption Expenditure

We consider the “final consumption expenditure” of the general government as one of the public benefits. We calculate per-capita benefit by dividing the total amount of “final consumption expenditure” by the total population.

Public Investment

We use “gross public fixed investment” in the National Account for representing the benefit of public investment.\(^4\) Its per-capita benefit is calculated by dividing total annual

\(^4\) Although it is important to estimate the benefit of social capital (stock) as well as public investment (flow), this paper focuses on the benefit of public investment.
“gross public fixed investment” by the total population in Japan in the same year. Gross investment, not net investment data, is used in the estimation because depreciation can be considered as repair expenses paid for by the government.

Social Security Benefits

Social security benefits in this analysis consist of public pension, medical care, nursing care for the elderly, and other social security transfers. A summary of the estimation of each social security benefit as follows.

(Pension)

The benefit of pension is calculated using the income of each generation derived from cohort data, because the pension in Japan, especially Employee’s Pension Insurance, depends basically on average annual income during the insured period.

(Medical care)

The generational benefit of medical care is estimated by dividing the total transfer by the number of people who receive it. The data on medical care are been divided into two groups since 1982: general medical care and medical care for the elderly. So, the estimation of per-capita general medical care is calculated by dividing the amount of general medical care expenditure by the number of people who are less than 70 years old. The per-capita medical care for the elderly is calculated by dividing the total amount of care by the number of people who are more than 70 years old.

(Nursing care for the elderly)
The generational benefit of nursing care for the elderly is estimated in the same way as
the benefit of medical care for the elderly. That is, it is calculated by dividing the total amount
of care by the number of people who receive it. In the case of nursing care, the people who
receive it are more than 65 years old.

(Other social security benefits)

The generational benefits of other social security transfers except pension, medical care,
and nursing care are calculated by dividing the total amount of those transfers by the total
population.

(3) Estimation of future public benefits: 2004-2070 (No reform)

To estimate generational lifetime public benefits, we need data from 1953, when the
generation born in 1930 became 23 years old, until 2070, when the generation born in 1990 is
assumed to die at 80 years old. But, the available data of the National Account is from 1953 to

The forecast of future benefits depends on economic circumstances: economic growth
rate, price index, interest rate, population, etc. Table 1 presents the assumptions used in the
analysis. These assumptions are the same as those in the of the Cabinet report “Basic Policies
for Economic and Fiscal Management and Structural Reform 2006,” which presents details of
the “Integrated Reform of Expenditures and Revenues.”

Table 1  Assumptions for Future Economic Circumstances in Japan
The future amounts of administrative services, public investment, and other social transfers except for pension, medical care, and nursing care are estimated by increasing the total amount of each transfer and service in 2004 by the annual growth rate in Table 1. The generational future benefits of those benefits are calculated by dividing the future amount of those benefits by the future total population\(^5\).

Future social security benefits such as pension, medical care, and nursing care are estimated as we can get the same results as those presented in reports of Ministry of Health, Labor, and Welfare in Japan. These reports are “The 1999 Actuarial Valuation of the Employees’ Pension Insurance and the National Pension,” and “Review of the future social security benefits and burdens–Revised May 2006–,” which are the basic reports used when the Japanese government decides the budget for social security and reforms social security systems\(^6\).

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\(^5\) The data on future population are based on “Population Projection for Japan: 2001-2050” of the National Institute of Population and Social Security Research (January, 2004).

\(^6\) The detailed estimation methods are not announced officially. Therefore, the estimated benefits are the same as those in the ministry reports although the estimation methods might differ.

We use the estimation results of the total of revenues and expenditures presented in Chapter 1. As in Chapter 1 we consider two cases of reform: Reform A and Reform B. Regarding future burdens of taxes under the “Integrated Reform of Expenditures and Revenues,” we apply the consumption tax rates in the case of Reform A and Reform B in Chapter 1, respectively\(^7\). In the same way, regarding future benefits under the reform, we provide the amount of expenditures of Reform A and Reform B in Chapter 1 to all generations.

The generational potential burdens are also calculated by the same methodology explained above. The goal of reducing government debt is the same, which would be 60% by 2050. But, the revenues required for financing the additional surplus of the primary balance are changed because the reform (Reform A and Reform B) would change the fiscal situation in 2012, when we start to reduce the ratio of government debt.

Table 2 shows that the primary balance surpluses required to reduce the ratio of government debt to 50% from 2012 by 2050 in all cases. Table 3 presents the additional consumption tax rates for all cases.

<table>
<thead>
<tr>
<th></th>
<th>No Reform</th>
<th>Reform A</th>
<th>Reform B</th>
</tr>
</thead>
<tbody>
<tr>
<td>60% until FY 2050</td>
<td>3.45%</td>
<td>3.19%</td>
<td>3.19%</td>
</tr>
</tbody>
</table>

\(^7\) Reform A is a plan to reduce expenditures by 14.3 trillion yen and increase revenues by 2.2. Reform B is a plan to reduce expenditures by 11.5 trillion yen and increase revenues by 5.1.
<table>
<thead>
<tr>
<th>After FY 2050</th>
<th>1.48%</th>
<th>1.40%</th>
<th>1.40%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio of the Government Debt at the end of FY 2011</td>
<td>153%</td>
<td>144%</td>
<td>144%</td>
</tr>
</tbody>
</table>

**Table 3 Required Rate of Consumption tax**

<table>
<thead>
<tr>
<th>For achieving 60% of the Government Debt to GDP until FY 2050</th>
<th>No Reform</th>
<th>Reform A</th>
<th>Reform B</th>
</tr>
</thead>
<tbody>
<tr>
<td>(FY 2012-2096)</td>
<td>+10.30%</td>
<td>+4.38%</td>
<td>+4.39%</td>
</tr>
<tr>
<td>15.30%</td>
<td>10%</td>
<td>10.99%</td>
<td></td>
</tr>
</tbody>
</table>

4. Estimation Results

Figure 1 shows the estimation results in the case of a reduction of government debt by imposing an additional poll tax. And, Figure 2 shows the results for the case of increasing consumption tax to reduce government debt by 2050. In both cases we compare the differences among lifetime public benefits and burdens (= life-time benefits – burdens) of seven generations among the cases: “No Reform,” “Reform A,” and “Reform B.”

The results in the case of “No Reform” mean how the generational gap would be changed if no expenditure reforms are made, and only tax increases are implemented to promote fiscal consolidation.

We can point out two findings based on these two figures. First, the generational gap would not depend on Reforms A and B. This means that if the total amount of the sum of expenditure cuts and revenue increases are the same, the combination of expenditure reform
and revenue reform would hardly affect the generational gap.

Second, both figures suggest that the generational gap in the case of “No Reform” would be better than the gaps in the case of Reforms A and B. This result indicates that a fiscal reform implemented only by increasing tax would narrow the difference between lifetime benefits and burdens on the younger generations more than a fiscal reform that reduces both future public services and increases their future burdens.

Figure 1 Differences Between Lifetime Public Benefits and Burdens by Generations
(Including Potential Burden by Poll Tax)
5. Concluding Remarks

As the declining and aging of the population has been advancing, it has become more important to consider differences in public benefits and burdens among generations. This paper aims to reveal how differences in public benefits and burdens among generations change with the “integrated reform of expenditures and revenues” the Japanese government has decided to implement during the next five years. In particular, we put weight on estimating the generational potential burdens that would be required for reducing the ratio of the government debt to GDP in the future.

The findings of our estimation are as follows. First, the generational gap would not
depend on the combination of expenditure reform and revenue reform. Second, a fiscal reform that would be implemented only by increasing tax would improve the generational gap more than a fiscal reform that would involve expenditure cut and tax increase.

These results would be derived mostly from the generational potential burdens defined in this paper. This enables us to compare three fiscal reforms under the same sustainability condition. Table 2 and Table 3 show that required surpluses of the primary balance and required rates of consumption tax differ among the three reforms plans. The additional tax rates calculated in this paper would not be achieved under the actual scenarios of reforms.

It seems to be more difficult to imagine the policy every year under the assumption of generational accounting, by which benefits and burdens of living generations do not change throughout their lives, and all debts under these policies are levied on future generations as additional burdens. In this sense, potential generational burdens could improve in reality, shown in policy every year as additional tax.

Nevertheless, there is still room for improvement. For example, we estimate the additional tax rate using the given growth rate and interest rate. The interest rate would affect not only government debt in the future but also the discount rate used when calculating lifetime benefits and burdens. It is more important to clarify the relation between these assumptions and lifetime burdens when examining an alternative policy in terms of potential generational burdens. Further, fiscal reforms would affect growth rate generally. To include this effect in the analysis, we need to extend the study to a general equilibrium model.
References


