# Re-examination of the Generational Accounting in Japan

—A Perspective of Lifetime Consumption Inequality among Generations

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## 1. Economic growth, social security enhancement, population aging

Japan's social security system has expanded as a result of the establishment of a universal health insurance system in 1961, the first year of welfare in 1973, and the establishment of long-term care insurance in 2000. As society became more prosperous and the population aged, its need increased for such services, which developed accordingly.

These social security systems are mainly operated by the public social insurance system, and most are financed by insurance premiums and tax revenues. Social insurance premiums are linked to medical expenses for the elderly and the income, including wages, of the insured population. Tax revenue depends on the income earned from work, so the burden on households has increased as the social security system has expanded. As the birthrate declines and the population ages, the increasing burden on the younger generation and the insurance system sustainability have become major social concerns. According to many generational accounting studies, the lifetime net benefits (receipts minus burdens) for the current elderly generation are positive, whereas those for the younger working generation are significantly negative. Later generations will have net burdens (negative net benefits). This may lead to a significant disparity.

Generational accounting focusing on social security finance cannot comprehensively measure changes in total benefits and burdens caused by changes in the economic and social environment, such as economic growth. Therefore, even if later generations become economically wealthy and can afford to pay part of the social services cost for previous generations, this will still appear as a generational gap because generational accounting only measures the burden and social services received by one generation. However, as long as we consider each generation's living standards and if the later generations' living standards are not worse than those of the earlier ones, sharing the social services of later generations should not be particularly problematic from the perspective of equity.

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To understand intergenerational benefits and burdens, we must capture not only social security finances but also household finances, with their social changes, and the macroeconomy. Social services are a necessary social support, and if they are not provided by the government, households will provide them themselves. In fact, long-term care services, which are now widely provided through social insurance, were once part of households' private expenditure, so they do not appear in social security finances and are not reflected in generational accounts. In addition, the later generation has benefited from economic growth and a technologically advanced society and is expected to earn a higher average income and live longer than the generation born immediately after the war. However, this is not reflected in generational accounting. From this perspective, it is necessary to consider the framework of household income-expenditure accounts in the System of National Accounts.

This study attempts to evaluate intergenerational equity using the expected value of the discounted present value of market goods and services and social services that would be consumed over a lifetime, following Saruyama et al. (2018) as the macroeconomic assumption.

In the next section, we examine intergenerational equity and explain the evaluations used in this study. Section 3 explains the macroeconomic assumptions of the calculations and the concept of benefits and burdens for each age group. Section 4 assesses the scale of the real final consumption expenditure (and/or actual final consumption) over the lifetime of each generation. Finally, we discuss the economic environment that will allow future generations to reap more benefits, especially due to a longer expected lifespan and economic growth.

## 2. Rethinking the standards of intergenerational equity

After a period of economic growth and enhanced social security, the nation's health has improved beyond expectations at the time the system was launched, and the expected lifespan of Japan's society is one of the highest worldwide. As the birth rate declines and the population ages, a large government budget and insurance premium income are required to maintain a system that provides a full range of social services. Auerbach et al. (1991), followed by other authors, have developed generational accounting as an analytical method that quantifies the sustainability of social security and social benefits and burdens. This study clarifies the balance between the benefits and burdens related to taxes and social security by generation.

The discounted present value of government benefits of the generation $i$ in the period $t$ ($B_{i,t}$) such as pensions, other cash benefits, medical care, and nursing care, and the burden of taxes and social insurance premiums paid by households ($T_{i,t}$) must be balanced. $s_{i,t}$ is the survival rate of the generation $i$ in the period $t$, $\beta$ is the discount factor, and equals $\beta=1/(1+r)$ where $r$ is the market interest rate. In addition, $W_t^g$ is the wealth held by the government in the same period and $N_{i,t}$ is the population of each generation.

$$\sum_{i=t}^{\infty} s_{i,t}\beta^{t-1}T_{i,t}N_{i,t}+W_t^g=\sum_{i=t}^{\infty} s_{i,t}\beta^{t-1}B_{i,t}N_{i,t} \tag{1}$$

Lifetime net income (generational accounting) $\hat{G}_{i,t}$ of individuals (households) in each generation $i$ (assuming the possibility of survival to age Z) can be estimated as follows:

$$\hat{G}_{i,t}=\sum_{i=t}^{i+Z} s_{i,t}\beta^{t-1}(B_{i,t}-T_{i,t}) \tag{2}$$

In particular, concerns over intergenerational fairness have been expressed in response to stagnating economic growth, rapid population aging, and deteriorating public finances. This is a matter of fairness between generations; the elderly can receive benefits from the current system despite having low premiums in the past while the younger generations cannot expect sufficient benefits in the future despite paying high premiums in the present.

In traditional generational accounting, the youngest generation is treated as the 0-year-old generation and the generations born in the future are collectively treated as the future generations. The future generations will eventually provide financial resources to fully pay off the existing government debt. Among the countries where generational accounting research has been conducted, Japan has the greatest burden on future generations (Auerbach et al., 2009).

Some research, including Suzuki et al. (2012), applied the generational accounting method to Japanese social security (pensions, medical care, and long-term care), focusing on differences in burdens both among the present as well as the future generations. They concluded that the burden rate[1)] in later generations would be higher.

However, this study suggests that the traditional generational accounting view is insufficient for thoroughly analyzing the issue of intergenerational fairness because the subject of analysis is limited to the social security system. To evaluate intergenerational equity, the expected present value of consumption over the lifetime should be examined. Thus, evaluating only the social security field as the social benefit received over a lifetime is insufficient.

Before the social security system was fully developed, income compensation for old age, childcare and nursing care services, which correspond to social services, were borne by households. They were not covered by traditional generational accounting, which is calculated based on receipts and payments between the government and households. With the increasing number of nuclear families, we must consider housework services, given that women have been restrained from working and have to take care of children if nursery schools and other facilities are inadequate. However, this study does not address this issue.

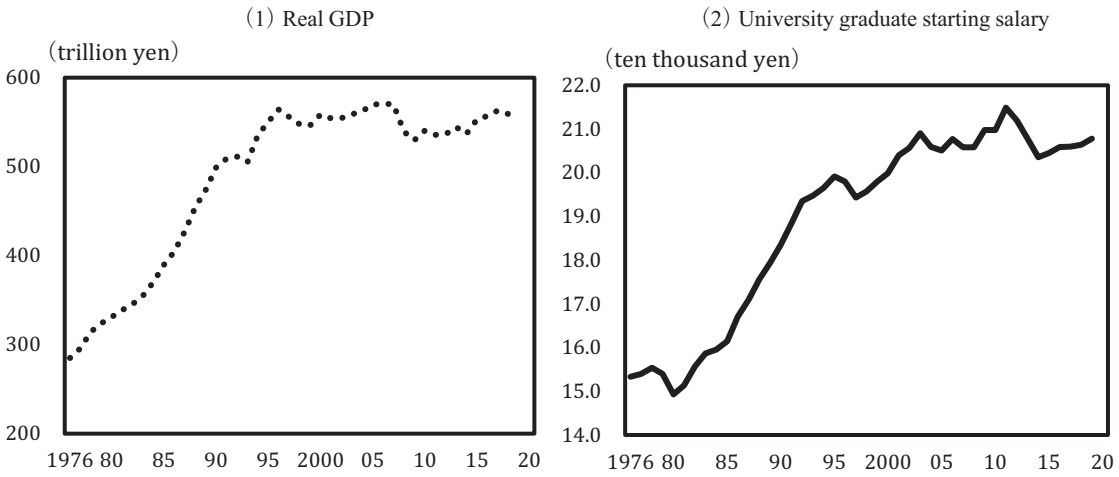
This study considers the benefits which later generations receive apart from social security, such as a higher starting salary for college graduates than that of the previous generation (Figure 1). Why is there such a difference despite both groups having the same educational background and both having not made any contributions to society yet? The main reason is that they started working under a high capital equipment ratio as a result of their past generations' investments. Later generations find themselves in a privileged environment where they can be more productive, earn higher income, and consume more than previous generations. The above-mentioned points indicate that generational accounting is inadequate for evaluating generational gaps.

What is the appropriate term for "consumption" when comparing generations? Each individual's utility is derived from the purchasable market goods and social services provided through the social security system. Therefore, it is more appropriate to use "actual final consumption," which is the sum of "final consumption expenditure" and "benefits in kind" based on the income and outlay accounts of the SNA. This research calculates the discounted present value of the actual final consumption over the lifetime of each generation using equation (3):

$$W_i = \sum_{t=1}^{Z} s_{i,t} \beta^{t-1} (C_{i,t} + E_{i,t}) \qquad (3)$$

$W_i$：Lifetime actual final consumption for generation $i$ (real, discounted present value at the birth year. $s_{i,t}$ and

Figure 1. Real GDP and Starting Salaries for University Graduates




(Note) Cabinet Office “National Accounts,” Ministry of Health, Labor, and Welfare “Wage Structure Basic Survey,” Ministry of Internal Affairs and Communications “Consumer Price Index.” University graduate starting salary is the average monthly salary of university graduate workers in all industries at the starting year of work, derived by CPI (excluding imputed rent).

$\beta$ are described in equation (2)).

$C_{i,t}$：Final consumption expenditure (market goods) per capita for generation $i$ in period $t$.

$E_{i,t}$：Benefit in kind (benefits for health, education, etc.) per capita for generation $i$ in period $t$.

The estimates of equations (2) and (3) are future macroeconomic projections and settings related to tax and social security systems, estimates of income expenditure accounts by age group, and government sector accounts that act as the social service supply side. They will be explained further in the next section.

## 3. Data and settings

（1）Future macroeconomic assumptions:

This research includes three generations; the first born in 1950 (70 years old as of 2020, referred to as the parent generation), the second born in 1980 (40 years old, referred to as the child generation), and the third born in 2010 (10 years old as of 2020, referred to as the grandchild's generation). The first is older than the second and the second is older than the third by 30 years. The calculation period is from 1950, when the parent's generation was born, to 2110, when the grandchild's generation turns 100 years old.

The data up to 2015 are actual values, and the data after 2020 are estimates based on macro assumptions. Specifically, it is based on the medium-term forecast up to 2030 by the Japan Center for Economic Research (2018). We calculated real GDP as the product of per capita labor productivity and the number of workers. We assumed that per capita labor productivity and real wages will grow at an annual rate of 1%, prices (consumption deflator) will rise at an annual rate of 0.5%, and long-term interest rates (10-year government bond yields) will remain at 1%[2)]. It is assumed that the currently implemented benefits plans will not be changed in terms of the system and that only the number of recipients and price increases will be reflected[3)]. The discount rate is set at 3%[4)].

Regarding future demographic changes, we apply data on life expectancy and mortality provided by the National Institute of Population and Social Security Research and assume that later generations will live longer.

（2）Income and outlay accounts by age group

Income and burden by age group were estimated using the household distribution accounts[5] of Yamazaki and Sakamaki (2018), the National Survey of Family Income and Expenditure (NSFIE), and various statistics on medical care, nursing care, and education. We estimated the individual equivalent income and expenditure data by converting the estimates of income and expenditure per household provided by Yamazaki and Sakamaki (2018).

Final consumption expenditure at age t of generation $i$ ($C_{i,t}$) depends on various attributes, such as income and family structure, and systems, such as taxes and social security. We assume that final consumption expenditure is determined by disposable income ($YD_{i,t}$) and consumption propensity ($PC_{i,t.}$)[6].

Wage income ($I_{i,t}$) and other property income are not considered for the sake of simplification. As for the burden, $TD_{i,t}$ is income tax, $TP_{i,t}$ is pension fee, and $TM_{i,t}$ is medical and long-term care insurance premium. From 2020 onwards, the 2015 tax[7] and social insurance rates will apply. For benefits, $BP_{i,t}$ and $BC_{i,t}$ are pension benefits and other cash benefits, respectively.

The average (wage) income $I_{i,t}$ of generation $i$ is determined by the wage level $\bar{I}_{i,t}$, determined by labor productivity and the labor force participation rate $RLF_{i,t}$[8] for each age group set exogenously.

$$I_{i,t}=\bar{I}_{i,t}\cdot RLF_{i,t}$$

The benefits in kind in the generation $i$ at period $t$, $E_{i,t}$, are divided into medical/nursing care benefits $BM_{i,t}$ and childcare/educational benefits $BE_{i,t}$. Adjusted disposable income $\widetilde{YD}_{i,t}$ and actual final consumption $\tilde{C}_{i,t}$ are as follows:

$$\widetilde{YD}_{i,t}=YD_{i,t}+BM_{i,t}+BE_{i,t}$$
$$\tilde{C}_{i,t}=C_{i,t}+BM_{i,t}+BE_{i,t}$$

（3）Government sector

Social services, as part of household consumption, are provided by the government. The benefits provided by the government to generation $i$ in period $t$ and the tax and premium income received by the government are expressed as:

$$B_{i,t}=BP_{i,t}+BC_{i,t}+BM_{i,t}+BE_{i,t}$$
$$T_{i,t}=TP_{i,t}+TM_{i,t}+TD_{i,t}+TC_{i,t}$$

Cash benefits include $BP_{i,t}$ (pension benefits) and $BC_{i,t}$ (other cash benefits), whereas benefits in kind include $BM_{i,t}$(medical and nursing care) and $BE_{i,t}$ (childcare and education). $TC_{i,t}$ represents the consumption tax burden levied on the final consumption expenditure $C_{i,t}$. As the benefits in kind related to childcare and education are covered by taxes, the burden of these measures does not appear separately. Out-of-pocket expenses for medical care, nursing care, childcare, and education were considered a part of the final consumption expenditure. The

government's fiscal balance $F_t$ is defined as:

$$F_t=\sum_i(T_{i,t}-B_{i,t})N_{i,t}-r_tD_t+OT_t$$

The government's tax and social security balance at each period is the total of the difference between payments and receipts of households multiplied by each generation's population at period t. Interest payments $r_t$ are made on outstanding government debt $D_t$. $OT_t$ represents other fiscal surpluses, including tax revenues, such as corporate tax and property tax, and expenditures, including general administration and public investment[9]. The debt balance at $t+1$ decreases with the fiscal balance (surplus) in period $t$:

$$D_{t+1}=D_t-F_t$$

Government's debt will be maintained at a certain level of GDP (approximately 250%) in the future. Specifically, if it exceeds this, $TM_{i,t}$ (medical and long-term care insurance premiums) and $TC_{it}$ (consumption tax)[10] will be adjusted.

## 4. Calculation results

In this section, following the changes in benefits and burdens estimated previously, we perform calculations using equation (2) and (3) for the three generations of interest and compare the results. First, after reproducing the results of traditional generational accounting based on equation (2), we examine the calculation results based on the discounted present value of lifetime consumption proposed in this study, using equation (3).

### （1）Discounted Present Value of Benefits and Burdens: Replicating the Results of Traditional Generational Accounting

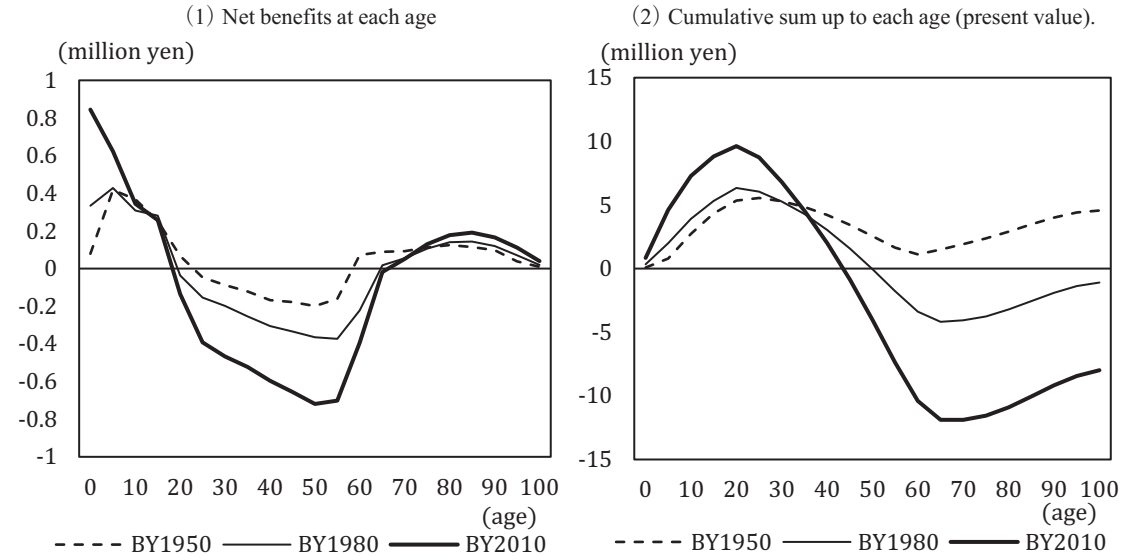
First, we performed a trial calculation of Equation (2). Figure 2 (1) shows the expected value of the net benefit, considering the survival rate at each age for each generation. For each generation, net benefits are positive until their 20s, then turn negative, reaching the lowest value in their late 50s (when the burden of income tax, etc., becomes heavier) and turn positive in their 60s.

In addition, the cumulative sum up to each age is obtained by converting the net benefits at each age into the present value, considering the discount rate, as shown in Figure 2 (2). This is the net benefit (discounted present value) that can be expected at the time of birth. As a result, the lifetime balance of payments of the parents' generation is consistently black, while that of the children in their 50s and grandchildren in their 40s turns red. In the late 60s of subsequent generations, the deficit will shrink but will not turn black. Assuming the current average life expectancy of the early 80s, generations born in 1980 and beyond would be overburdened in terms of benefits and burdens to the government. Thus, we confirmed that the existing research results on generational accounting could be reproduced in the data of this study.

### （2）Discounted present value of lifetime consumption

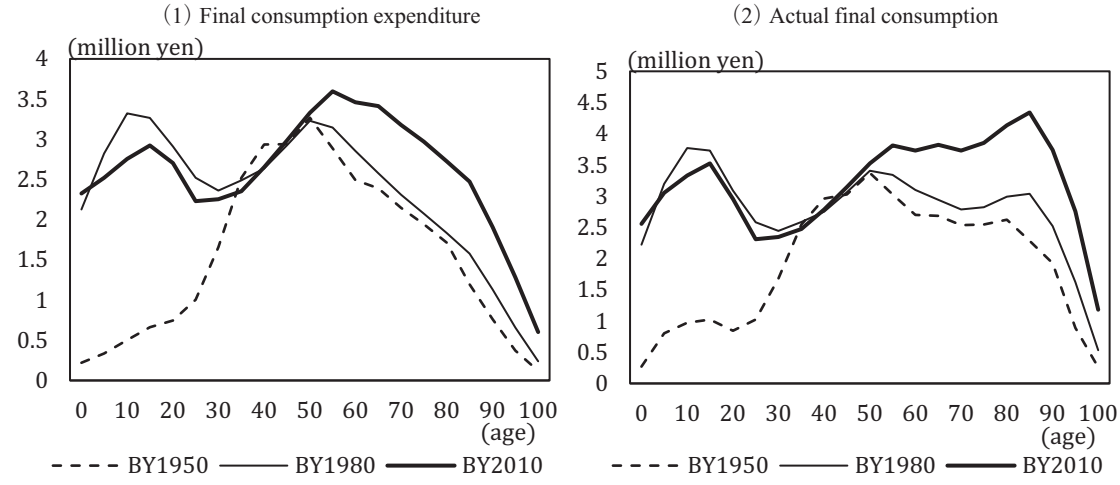
When calculating the discounted present value of lifetime consumption based on equation (3), it is first necessary to obtain the final consumption expenditure and benefit in kind at each age rather than the benefits and burdens of

Figure 2. Generational Accounting: Expected Values of Net Benefits




(Note) 2011 price.

Figure 3. Expected value of consumption by age

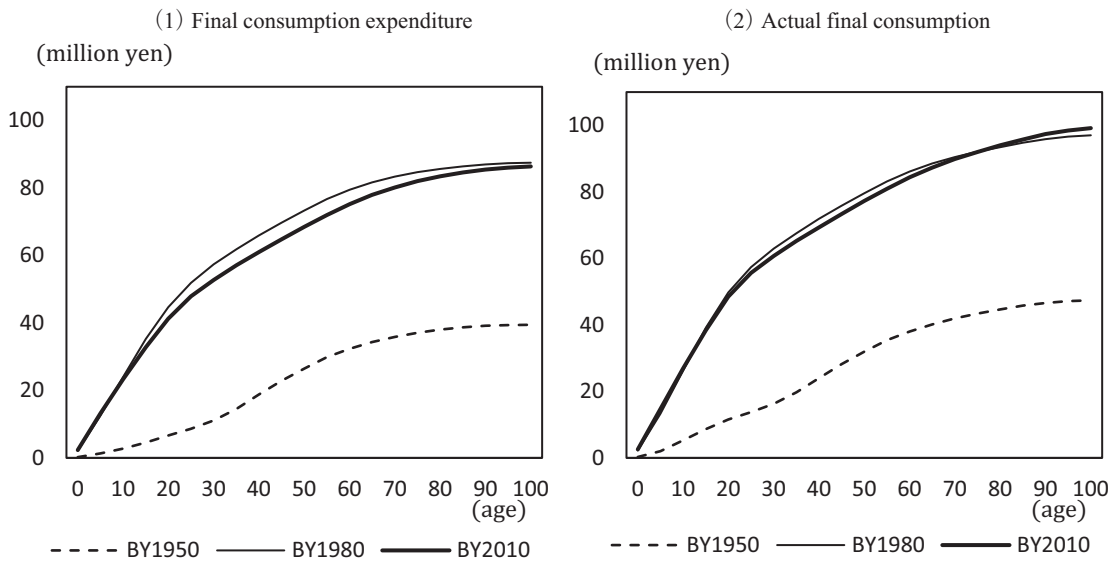



(Note) 2011 price.

social services shown in equation (1).

As for final consumption expenditure (Figure 3 (1)), the amount spent by later generations is larger than that of parents, with a particularly large difference in consumption levels among minors. The parents' generation was born in 1950, when Japan was still relatively poor and could not enjoy the benefits of a strong economy, while the latter two generations could. The consumption level of teenagers in the generation of children is equivalent to that of the parents in their 40s. According to equation (4), disposable income (Figure A4 (1)), which affects the movement of final consumption expenditure, peaks around the age of 50 for parents and the age of 55 for children and

Figure 4. Lifetime Consumption: Cumulative sum up to each age




(notes) 2011 price. The discount rate is 3%.

grandchildren[11]. Moreover, assuming that labor productivity remains at 1% through the estimation term, both disposable income peak and consumption level in the later life of grandchildren are predicted to be higher than those in the later life of the child generation.

Furthermore, looking at the actual final consumption (Figure 3 (2)), including benefits in kind (Figure A4 (2)), the impact of medical and long-term care benefits for later generations increases significantly with age, in addition to childcare and educational benefits at a young age. Therefore, children and grandchildren enjoy more in their old age as compared to final consumption expenditure.

Figure 4 shows the cumulative lifetime consumption $W_i$, calculated using the consumption based on the equation (3). Accordingly, the lifetime consumption level of children and grandchildren exceeds that of their parents at all ages. Regarding final consumption, the children's generation has a higher lifetime consumption level at any age, but this is not necessarily true when looking at the actual final consumption, including benefits in kind. The actual final consumption of grandchildren, considering average life expectancy, can exceed that of children, as their level catches up with that of their children in their 70s, and surpasses that of their children in their 80s. Thus, the expected lifetime consumption levels of children and grandchildren are likely to exceed the latter in terms of final consumption expenditure, but the actual final consumption, including benefits in kind, is almost the same.

Figure 2, depicting the estimation results using conventional generational accounting methods, and Figure 4, based on consumption, give a considerably different impression of intergenerational equity, but both are based on the same economic scenario. It is important to note that later generations have an advantage regarding the discounted present values of lifetime consumption, but will be overburdened when evaluated in terms of the relationship between benefits and burdens of social services due to the enhancement of social security and the deterioration of insurance finances. Due to the fortune of being born after rapid economic growth period, children and grandchildren can enjoy higher levels of consumption, including advanced social services, at an early age.

The relative relationship between the consumption levels of the two generations, children, and grandchildren, depends on economic assumptions. As shown in Figure 2, the grandchildren's generation bears a greater burden because of the 1% annual growth in labor productivity, and taxes and insurance premiums rise up to maintain a constant government debt balance. However, its consumption level exceeded that of the parent generation. The difference between these two generations may change depending on various assumptions; however, the fact that they are in a more favorable situation than their parents' generation will probably not change.

## 5. Conclusion

This paper compares the actual final consumption, including benefits in kind (education, medical, and nursing care) that can be expected over the lifetime courses of three generations (the generations born in 1950, 1980, and 2010, respectively) using survival probabilities for estimation. We also confirmed that conventional generational accounting, based on the economic scenario that our trial calculation employs, suggests that benefits and burdens related to social security will increase in later generations. In other words, the calculations in this study were based on the same economic assumptions as those used in conventional generational accounting.

According to the results of the trial calculations, later generations can be expected to enjoy a higher level of consumption than the generation born in 1950. Specifically, the expected discounted present value of the lifetime real actual final consumption for the generations born in 1980 and 2010 is approximately twice as much as that of the generation born in 1950. This is a result of the good fortune of being born after a period of high economic growth, which allows later generations to enjoy a high level of consumption while they are still young. Generally, there is no significant difference in the consumption levels of the latter two generations, but this relative relationship is thought to depend on various assumptions. Under the assumption that labor productivity growth is at 1%, there would not have been a noticeable difference between the two generations, even if we assume that the burden and life expectancy would increase in later generations.

Finally, we should consider possible future complications. First, it is necessary to confirm the robustness of the results and to what extent they can withstand changes in economic assumptions, especially the impact of changes, such as assumptions about labor productivity growth. Further, the model should be improved in the future. It is particularly important to consider assets and property incomes. For example, if the assets held by the elderly today are used to support their consumption, then this estimate would underestimate the lifetime consumption of the generation born in 1950. However, if the younger generation is left behind, this estimate would underestimate the lifetime consumption of future generations.

## Notes

1） Net burden is the opposite of net receipts, and Suzuki et al. (2012) compare the ratio of this net burden to lifetime income as the net burden ratio between generations. If we consider lifetime income as the standard, calculating from adjusted disposable income is more accurate than from disposable income, as in Suzuki et al. (2012).

2） This assumes that the pattern of economic growth in the 2010s will continue. In addition, since the interest rate is fixed at the nominal interest rate of 1%, the price increases accompanying the consumption tax rate increases in later years will correspond to a reduction in the real interest rate.

3） For example, it corresponds to system changes, such as raising the amount of remuneration for nursing care

benefits and making education free of charge. If such a system change occurs, there is a possibility that medical or educational expenditures in final consumption expenditures, such as self-pay nursing care (pay as you go) and tuition fees, will increase or decrease, replacing benefits in kind. Partly because we do not anticipate major system changes that would increase benefits in kind, we do not consider such a strict impact. See Maeda and Kawagoe (2015) for the effects of system changes using attribute-specific accounts.

4） See Appendix 4 for the discussion of the discount rate and the calculation results reflecting the change in setting.

5） Household consumption and income are sub-sectored by attributes (income and age group). See Kawagoe and Maeda (2017) and Yamazaki and Sakamaki (2018) for details about this approach.

6） We assume that savings are not accumulated as financial or real assets, which is consistent with not considering property income. Therefore, there is no legacy for later generations.

7） The effective tax rate, that is, the ratio of direct tax to income, is fixed.

8） For the parent generation, the actual results of 2015 are applied to the labor force participation rate for those in their late 60s and beyond. The labor force participation rate as of 2030, in the case of positive employment, is applied.

9） These have been excluded from the personal contribution and benefits for the period.

10） As a result, the ratio of medical and long-term care insurance premiums to total wages and salaries will increase until 2065 and remain constant thereafter. At the age of 55, when the income is the highest and the burden is heavy in each generation, it is approximately 9% for those born in 1950, 13% for those born in 1980, and 22% for those born in 2010. The burden rate increases in all generations. The consumption tax rate is assumed to rise from 2035 to 2045, reaching 19%, and then to remain flat until the final year of the trial calculation period (year 2110).

11） As shown in Figure (3), medical and long-term care insurance premium rates will continue to rise until 2065, when the disposable income of those born in 2010 will peak. For this reason, those born in 2010 bear a greater burden than people born in 1980 of the same age. However, as shown in Supplementary Figure 4 (1), the level of disposable income in real terms exceeds that of the population born in 1980.

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