Development of Microsimulation and Burden Structure of Personal Income Taxation[**]

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Abstract

As research in the field of taxation and social security increasingly uses household microdata, an increasing number of studies are dealing with a technique known as microsimulation. This method estimates the amount of taxes and benefits by applying the actual system to information on household family structure and income, and plays a variety of roles, including (1) estimation of policy changes, (2) calculation of marginal tax rates, (3) complementing of samples, (4) resolution of seasonality problems, and (5) extraction of contributions from system changes. This paper first summarizes the development of microsimulation and research results on personal income taxation in Japan. We also use a microsimulation model based on household microdata (1989-2019) to clarify the actual situation regarding the burden structure of personal income taxation in Japan while taking advantage of the diversity of this method.

Keywords: microsimulation, taxes, social insurance premiums, redistributive effects
JEL Classification: C15, H24

I. Introduction

As research in the field of taxation and social security increasingly uses household microdata, an increasing number of studies are dealing with a method called microsimulation. For example, using household microdata, tax and benefit amounts are estimated by applying the actual system to information on household family structure and income. The calculated tax and benefit amounts can be used to estimate the impact of changes in the tax and social security systems on economic agents, and the effects on, for example, the structure of household burdens and benefits, income inequality, the magnitude of redistributive effects (degree

[*] This article is based on a study first published in the Financial Review No. 151, pp. 53-82, Taro Ohno, 2023, Development of Microsimulation and Burden Structure of Personal Income Taxation, written in Japanese.

***** This research was partially supported by Grant-in-Aid for Scientific Research (KAKENHI) (Grant-in-Aid for Scientific Research (C) (General) 21K01538), and also utilizes questionnaire information from the National Survey of Family Income, Consumption and Wealth Statistics Bureau, Ministry of Internal Affairs and Communications. We would like to express our sincere appreciation to all parties involved. We would like to thank Masayoshi Hayashi (University of Tokyo), Michio Yuda (Tohoku University), Tomotsugu Imahori (Ministry of Finance), and participants in the Financial Review Paper Discussion Meeting at the Ministry of Finance's Policy Research Institute for their valuable comments on this report. We would like to express our gratitude to them. Please note that the content of this paper is entirely the personal views of the author and does not represent the official views of the institution to which the author belongs.

of correction of income inequality), and household working behavior can be examined. Such microsimulations have been actively used since the 1990s in Europe and the United States, and research has been accumulating in Japan as well, albeit a little later than in the United States.

This microsimulation not only allows us to estimate the effects of policy changes, but also plays diverse roles. To illustrate this point, we will first discuss the characteristics of household microdata and points to keep in mind when using them, focusing on the study of personal income taxation in Japan. Table 1 shows the main survey statistics used in microsimulation research in Japan, including the National Survey of Family Income, Consumption and Wealth (NSFICW, formerly the National Survey of Family Income and Expenditure, NSFIE; Statistics Bureau, Ministry of Internal Affairs and Communications), the Comprehensive Survey of Living Conditions (CSLC; Ministry of Health, Labour and Welfare), the Japan Household Panel Survey (JHPS; Keio University), the Employment Status Survey (ESS; Statistics Bureau, Ministry of Internal Affairs and Communications). Although there are differences in the content of these surveys, they provide detailed information on income, consumption expenditures, and working hours by households and individuals. In addition, while research on personal income taxation requires the use of household taxes and social insurance premiums (hereinafter referred to as "SIPs"), the NSFICW and the CSLC, among the statistics mentioned above, make it possible to obtain the amounts (indicated values) related to taxes and SIPs. Therefore, studies dealing with household taxes and SIPs may (1) use the amounts indicated in the survey forms (indicated values) or (2) use the amounts estimated by utilizing microsimulation (estimated values). However, in some cases, such as in the NSFICW, it is difficult to correctly grasp the actual situation of the burden even if the amounts of taxes and SIPs (indicated values) are used and tabulated due to the characteristics of the survey method. The reasons are that, first, households other than working or unemployed households (e.g., self-employed) are not surveyed with regard to the amount of taxes and SIPs. Second, the taxes and SIPs (on an annual basis) may be underestimated due to the seasonality of the survey period, which is limited to two to three months and does not include the bonus season. However, the use of estimated values overcomes this problem in the use of statistics.

Based on the above, the following are some of the roles played by microsimulation in the study of personal income taxation:

(1) Estimation of policy introduction
(2) Calculation of marginal tax rate
(3) Complementing of samples
(4) Elimination of seasonality problems
(5) Extraction of contribution from system changes

The first is an estimation of policy introduction. As noted above, through comparisons between before and after the introduction of various policies, it is possible to consider the impact of policy introduction on economic agents. At this point, it is important to take into account that the effects of the policies differ across households and individuals, and micro-

simulation is capable of capturing the distribution of policy effects and differences across households and individuals. Thus, microsimulation is a useful method for examining future institutional arrangements. Another feature of this method is that it enables micro-data analysis focusing on deductions, since the use of estimates handles the application of such deductions for each taxpayer. In the microsimulation analysis of the tax system in Japan, there are many considerations related to deductions for income and resident taxes (respectively, national and local taxes). Second is the calculation of marginal tax rates. In order to calculate marginal tax rates, it is necessary to reflect applicable tax rates and deductions in calculating the tax amount for a given percentage increase in income, and microsimulation makes it possible to calculate marginal tax rates for each individual. Third is the complementing of samples. By using the estimated values, self-employed households can be included in the sample even when using the NSFICW. Even when using statistics such as the JHPS or the ESS that do not include taxes and SIPs in their survey items, it will be possible to conduct research dealing with taxes and insurance premiums while taking advantage of the statistics used. Fourth is the elimination of the seasonality problem. By using estimates, taxes and SIPs can be handled with the seasonality problem eliminated even when using the NSFICW. In terms of complementing the sample and eliminating the seasonality problem, microsimulation is a useful method for understanding the actual conditions of the current system. Fifth is the extraction of contributions from changes in the system. For example, when evaluating the redistributive effects of tax and social security systems, changes in the redistributive effects are affected not only by changes in the systems but also by changes in income distribu-

Table 1: Comparison of Statistics

	National Survey of Family Income, Consumption and Wealth	Comprehensive Survey of Living Standards	Japan Household Panel Survey	Employment Survey Status
Implementor	Statistics Bureau, Ministry of Internal Affairs and Communications	Ministry of Health, Labour and Welfare	Keio University	Statistics Bureau, Ministry of Internal Affairs and Communications
Survey frequency	Every 5 years	Every 3 years	Every year	Every 5 years
Survey scale	90,000 households	50,000 households	4,000 households	520,000 households
Survey on annual income	Included.	Included.	Included.	Included. (main work only)
Survey on taxes and SIPs	Included (Working and Unemployed Households Only)	Included.	Not Included.	Not Included.
Survey on expenditure	Included.	Included. (total amount only)	Included.	Not Included.
Subject of survey on expenditure	Working and unemployed households only	Total households	Total households	-
Time of survey on expenditure	October and Nobember in survey year	May in survey year	January in survey year	-
Survey on working hours	Not Included.	Included.	Included.	Included.

tion and other factors. In this context, the use of microsimulation makes it possible to measure the true contribution of system changes to the redistributive effects. Thus, microsimulation is a useful method for evaluating past system changes.

The purpose of this paper is to show the diverse roles of this method by organizing the development of microsimulation and research results, and to show the actual burden structure of personal income taxation in Japan while taking advantage of the diversity of this method. Specifically, we will address the following two issues. First, we will summarize the development of microsimulation and the research results of personal income taxation in Japan. Second, using a microsimulation model based on microdata from the NSFICW (1989-2019), we will clarify the actual situation of household tax and SIP burdens and their redistributive effects in Japan, reflecting the results of previous studies.

The structure of this paper is described below. Section II describes the development of microsimulation research overseas, followed by an overview of the development of microsimulation research in Japan in section III. Section IV describes the data used and the method used to estimate the tax and SIP amounts. Section V presents the measurement results to clarify the structure of household tax and SIP burdens, the redistributive effect of taxes and SIPs, and the effect of tax deductions to reduce the burden. Section VI concludes the paper.

II. Development of Microsimulation Research

II-1. Characteristics and Classification of Microsimulation[1]

Microsimulation analysis was first proposed by Orcutt in the 1950s, and although progress was slow for a while, it has been developed in Western Europe and the United States since the 1990s with the development of PCs and the increased availability of micro data.

Microsimulation examines the impact of policy changes on economic agents. However, in capturing the impact on a complex reality, the question is to what extent to deal with factors that add complexity, including (1) the content of policies, (2) the structure of population distribution, and (3) the behavioral response to policy (see O'Donoghue, 2014). For example, when estimating the impact of a tax reform, one approach is the model household approach (hereafter referred to as "Hypothetical Model"), which assumes a model household such as "a couple and two children household" or "a single person household" for the estimation. The hypothetical model deals mainly with only "(1) the content of polices" among the complexity factors, and is superior in terms of public awareness because it can show the impact of policy changes on specific households in a straightforward manner. However, even if various model households are considered, it is not clear what the relative weight of each model household is when population distribution is not taken into account. Therefore, it is necessary to incorporate other complexity factors in order to capture more detailed im-

[1] Some introductions to the characteristics and classification of microsimulation include Redmond et al. (1998), Fiorio (2009), Zaidi et al. (2009), O'Donoghue (2014), Tajika and Furutani (2003), Yada (2011), and Kaneda (2018).

pacts.

Microsimulation models can be classified into several types, but Arithmetical Microsimulation (hereafter referred to as "Arithmetical Model") mainly deals with two complexities simultaneously: (1) the content of the policies and (2) the structure of population distribution. It considers the impact of policy changes without considering behavioral responses. Specifically, the model uses micro data to estimate tax and benefit amounts by applying the real system to information on household family structure and income. In the aspect of policy, this model has focused much on the tax and social security systems, dealing for example with income tax, SIPs, family benefits, social assistance benefits, unemployment benefits, and housing benefits. In addition, the focus has been on distributional issues rather than efficiency issues because the analysis does not take into account behavioral responses.

In contrast, Behavioral Microsimulation (hereinafter referred to as "Behavioral Model") deals with three complexities simultaneously, such as "(1) the content of policies", "(2) the structure of population distribution", and "(3) the behavioral response to policy", and considers the impact of policy changes by considering behavioral responses[2]. Some real-world policies aim to influence behavior, such as improving work incentives, and behavioral models are well suited for analyzing such policies. The focus has been on the decisions of labor supply and consumption. Behavioral models dealing with labor supply have been initiated since the late 1990s with the introduction of microsimulation into empirical studies of labor supply, and in recent years discrete choice models have often been employed as models of labor supply. Behavioral models consist of three steps: (1) identification of model, (2) calibration of model, and (3) estimation of policy changes. (1) In the identification of model, quadratic utility function and the Random Utility Maximization (RUM) model is employed, which includes a random variable related to unobservable individual preferences. The multinomial logit model or conditional logit model is used. The wage rate, unearned income, and household composition are assumed to be exogenous. (2) In the calibration of the model, the optimal choice is determined based on a series of random numbers, and if the optimal working hours in the model differ from the actually observed level, the series of random numbers is discarded and only the series that is consistent with the actually observed level is created. (3) In the estimation of policy changes, a new optimal choice is made while using the series of random numbers that were successfully determined by calibration. At this point, the estimation is stochastic, and the average reflecting the probability is obtained for the labor supply after the change for each individual.

As a point to keep in mind, the behavioral model is that it assumes wages are constant and does not take into account labor market analysis. By including labor demand in addition to labor supply in the microsimulation model, changes in wages can be addressed, and the impact on labor supply and household disposable income is considered. Such studies are made, for example, in models that combine microsimulation models with computable gener-

[2] Bourguignon and Spadaro (2006), Buddelmeyer et al. (2007), Creedy and Duncan (2002), and Creedy and Kalb (2005a, 2005b) provide descriptions of the behavioral model.

al equilibrium (CGE) models.

Under the classification on time, these are included in Static Microsimulation, which deals with the impact of policy changes at a single point in time. Dynamic Microsimulation, on the other hand, estimates changes in population distribution across different time points while taking into account the probabilities of birth, marriage, and death, and is suitable for analyses of redistribution over the life cycle, such as the impact of pension policy.

II-2. Microsimulation Models of Research Institutions

Many microsimulation models have been used in research institutions. For example, the European Commission's (EC) EUROMOD, a microsimulation model of taxes and benefits for the EU, was launched in 1996. The model was initially developed and managed by the Institute for Social and Economic Research (ISER) at the University of Essex, but since 2021 it has been moved to the Joint Research Center (JRC) of the EC. Since the JRC handles the systems of all EU member states, it is possible to apply the systems of each country and compare the results. For all countries, income tax, SIPs, family benefits, housing benefits, social assistance, and other income-related benefits can be estimated. The basic model is an arithmetical model, but there are extensions to other types of models, including behavioral models (Bargain 2007; European Commission website). In addition, UKMOD is a tax and benefit model for England, Wales, Scotland, Northern Ireland and the UK as a whole, which is an arithmetical model departing from the UK part of EUROMOD. The background to this is that the EC's decision not to update the UK part of EUROMOD following the UK's exit from the EU (Brexit) led to the launch of UKMOD (Richiardi et al. 2021).

The Institute for Fiscal Studies (IFS) in the UK has developed and maintains the IFS Tax and Benefit Microsimulation (TAXBEN) as a model of taxes and benefits for the UK. This model is a behavioral model that takes into account the response of labor supply and allows for annual estimates of the tax and benefit system (income tax, SIPs, VAT, benefits, etc.) since 1975 (Waters 2017). The Brookings Institute in the United States also has a model on the federal tax system, the Urban-Brookings Tax Policy Center Model. This model is a behavioral model that takes into account the response of labor supply and allows for estimates related to the tax system (income tax, corporate tax, payroll tax, estate tax, etc.) (Rohaly et al. 2005).

Microsimulation models used by German institutions include Ifo Tax and Transfer Behavioral Microsimulation Model (Ifo MSM), IZA Policy Simulation Model (IZA Φ MOD), and ZEW Combined Microsimulation CGE model (ZEW Model), which are sister models sharing the same underlying code. All models are behavioral models that deal with the response of labor supply, but they are unique in that they also deal with labor demand, making it possible to analyze the labor market under these models. The overall model consists of three components: (1) an arithmetical model, (2) a labor supply part, and (3) a labor demand part. (1) The arithmetical model deals with tax and benefit systems such as income tax, SIPs, child benefits, unemployment benefits, housing benefits, and social benefits. (2) The labor

supply part deals with a discrete labor supply model and the response of labor supply to changes in tax and benefit systems. (3) In the labor demand part, Ifo MSM and IZA Φ MOD estimate the elasticity of labor demand. The ZEW Model uses a fusion of a microsimulation model and a CGE model. All models reflect the impact of changes in wages on labor supply and household disposable income (Clauss and Schubert. 2009; Peichl et al. 2010; Blomer and Peichl 2020).

The OECD has the OECD Tax Benefit Simulation Model (TaxBEN), which handles over 40 OECD member and non-member countries and allows for inter-country comparisons. It is a hypothetical model that allows estimations on tax and benefit systems (income tax, SIPs, payroll taxes, benefits, etc.) for each country and provides indicators on household income and labor incentives (such as participation and marginal tax rates) (OECD 2020). The World Bank also has a microsimulation model that allows inter-country comparisons for 22 countries, mostly developing countries. This model is an arithmetical model that allows for estimations on each country's tax and benefit system (income tax, SIPs, payroll tax, value-added tax, food transfers, unemployment benefits, child benefits, social assistance, income-related benefits, education, health in-kind benefits, etc.) (Gao and Inchauste 2020).

II-3. Research Using Microsimulation

Microsimulation is able to construct virtually new variables by applying social systems to each household or individual from the available variables. By taking advantage of the characteristics of this method, various studies have been conducted in addition to the effects of policy changes: for example, (1) marginal tax rates, (2) extracting contribution of system changes, (3) burden reduction effect of deductions.

Microsimulation is also used to calculate marginal tax rates in personal income taxation on an individual basis. Although the calculation of marginal tax rates requires the calculation of the amount of tax due for a given percentage increase in income, which must reflect applicable tax rates and deductions, microsimulation can be used to compute marginal tax rates. For example, arithmetical models can be used to measure the distribution of marginal tax rates (Beer 1998, 2003; Dickert et al. 1994; Harding and Polette 1995; Immervoll 2002, 2004) and the effect of automatic stabilizers (the rate of change in gross income to change in disposable income) (Dolls et al. 2012).

Microsimulation is also used to measure the true contribution of tax and social security systems to changes over time in inequality indicators (Gini coefficient, Atkinson index, percentile ratio, etc.) and poverty indicators (FGT, etc.). Changes over time in various indicators such as inequality and poverty indicators are affected not only by system changes in the tax and social security systems during the comparison period (system change factors), but also by changes in income distribution and population composition (non-system change factors). In addition, when evaluating the functions of tax and social security systems, concepts such as redistributive effects are addressed, which focus on changes in income inequality through tax burdens and social security benefits. Similarly, changes in redistributive effects

over time are affected by system and non-system change factors. For example, the progressive structure of the income tax system has the function of reducing changes in income inequality. Therefore, even in the absence of system change, the magnitude of the redistributive effect of the income tax system will change due to changes in income distribution, population composition, and other factors. Therefore, it is not possible to ignore non-system change factors and explain changes in redistributive effects solely in terms of the impact of institutional change. In this situation, by taking advantage of the ability of microsimulation to measure counterfactual situations, it is possible to decompose and measure institutional change factors and non-system change factors. In other words, efforts are being made to extract the "true contribution of system change itself to the redistributive effect" (system change factor) while taking into account the "impact of changes in income distribution and population structure on the redistributive effect in the absence of system change" (non-system change factor) during the comparison period (Bargain and Callan 2010; Bargain 2012a, 2012b; Bargain et al. 2015, Bargain et al. 2017).

In addition, microsimulation has been used to measure the burden-reducing effects of deductions in personal income taxation. Such studies are included in the literature of tax expenditure. "Tax expenditures are special tax rules in the form of deductions, exclusions, credits and favorable rates that benefit selected activities, industries, or group of taxpayers" (Burman et al. 2017, p. 109), in which the magnitude of the burden reduction from tax expenditures has been discussed. While the calculation of income tax amounts requires the identification of various deductions that apply differently to different taxpayers, microsimulation takes advantage of the ability to handle these taxpayer-specific applications, and efforts have been made to measure the extent to which tax amounts change depending on whether or not the deduction is applied (Burman et al. 2008; Poterba 2011; Altshuler and Dietz 2011; Albarea et al. 2015; Burman et al. 2017; Avram 2018).

III. Development of Microsimulation Research in Japan

This section provides an overview of the development of microsimulation-based research on personal income taxation (income tax, resident tax, and SIPs) in Japan. Some studies using microsimulation not only estimate new tax reform proposals, but also examine the effects of past and current taxation systems. In the aspect of policy, many studies have focused on the effects of income and resident tax deductions. In addition, these are often categorized as using arithmetical models and, therefore, focus mainly on distributional issues regarding the effects of personal income taxation. In recent years, an increasing number of studies have dealt with behavioral models, particularly those examining the effects of deductions on working incentives.

III-1. Tax Reform Simulations

This section discusses studies that have made estimates of tax reform. The current in-

come and resident tax systems in Japan are structured to make extensive use of income tax deductions, and the future of the tax deduction system may be examined through a comparison of tax deduction and tax credit systems from the perspective of the burden-reducing effects of deductions. In this context, prior studies have examined (1) the shift from the income tax deduction to the tax credit, (2) the shift from the income tax deduction to the tax credit with benefits, and (3) the shift from the spousal deduction to the couple deduction.

First, there are estimates regarding the shift from income tax deductions to tax credits. For example, under tax revenue neutrality, if some deductions (including employment income deduction, public pension deduction, basic deduction, spouse (special) deduction, deduction for dependents, and widow/widower deduction) were abolished and shifted to a tax credit system, the tax burden would be reduced for most income groups, while the tax burden would increase for higher income groups, thus effectively correcting income inequality. However, when the deduction for employment income and public pension are excluded, the effect of these revisions on income inequality correction is small (Doi 2016, 2017).

Second, there are estimates regarding the shift from the tax deduction to the tax credit with benefits. For example, if some deductions (basic deduction, spousal (special) deduction, and deduction for dependents) are abolished and the tax deduction system is shifted to a tax credit system with benefits under tax revenue neutrality, the tax burden on lower income groups will decline while that on higher income groups will rise (Tajika and Yashio 2006a, 2006b, 2008, 2010). In addition, under tax revenue neutrality, the elimination of some deductions (spousal and dependent deductions) and a shift to a tax credit system with benefits would benefit low-income groups in particular, while a shift to a tax credit system without benefits would not benefit low-income groups (Abe 2008). In addition, there are estimates of what would happen if tax credits with benefits from Western countries (the US Earned Income Tax Credit, the UK Earned Income Tax Credit and Child Tax Credit, and the Canadian Value-Added Tax Credit) were introduced to Japan, with the results showing that in the case of the US model, the system would be one where benefits are received rather than tax credits (Shiraishi 2010; Takayama and Shiraishi 2010).

Third, there are estimates of the shift from the spousal deduction to the couple deduction. Although the results differ somewhat depending on whether the couple's deduction is based on the income tax credit method or the tax deduction method, these revisions have been shown to result in a tax cut for income tax, especially for dual-earner households, while for resident tax, the number of households that see their taxes increased exceeds the number of households that see their taxes reduced (Takayama and Shiraishi 2016, 2017).

Other efforts have examined the effects of actual tax reforms. Specifically, the introduction of child allowances and the reduction of the dependent deduction (Abe 2003; Doi 2010), the capping of the employment income deduction (Doi and Park 2011), tax rate increases and the capping of the employment income deduction (Kawade 2016), the impact of the deduction system changes in the 2010s on the redistributive effect (Doi 2021, 2022), and the impact of tax reforms between 1997 and 2009 on income tax revenues (Nakazawa et al. 2014).

III-2. Verification of Existing Tax System

This section discusses studies that have examined the existing tax system, specifically looking at (1) the redistributive effects, (2) the erosion of the tax base, and (3) the burden-reducing effects of deductions.

First, there is an accumulation of research on the tax burden and redistributive effects (i.e., the reduction of income inequality) in Japan's tax and social security systems, with an increasing number of efforts using household micro data in recent years (Yada 2011; Tanaka and Shikata 2012; Tanaka et al. 2013; Kitamura and Miyazaki 2013; Uemura and Adachi 2015; Kawade 2016, 2017). In the literature, it has been confirmed that the redistributive effects of the tax and social security system as a whole have increased since the 1990s, largely due to social security benefits (public pension benefits) (Tanaka and Shikata 2012). On the other hand, the tax system (income tax and resident tax) also makes a certain contribution to correcting income inequality, but over time, the redistributive effect of the tax system has declined since the 1990s (Kitamura and Miyazaki 2013; Uemura and Adachi 2015; Miyazaki and Kitamura 2016; Kaneda 2018, 2020). In addition, when the redistributive effect of the income tax is captured by age group, it tends to be relatively large for the elderly and small for the young (Kitamura and Miyazaki 2013; Miyazaki et al. 2019).

There are also studies to decompose the redistributive effects into factors. Among these studies are those that decompose the redistributive effects of taxes into tax rate and deduction factors, with tax rate effects contributing to reduced inequality while deduction effects contribute to increased inequality (Miyazaki and Kitamura 2016; Kaneda 2018; Miyazaki et al. 2019). There are also studies to decompose system and non-system change factors for intertemporal comparisons of redistributive effects. Looking at the redistributive effects of taxes and SIPs over time, the results show that while taxes and SIPs have been able to reduce the widening of income inequality to some extent, there has been little contribution from system changes (Ohno et al. 2018; Matsumoto et al. 2020).

Second, Japanese income tax and resident tax systems make extensive use of tax deductions, and it has long been pointed out that the tax base is heavily eroded by these deductions (Ishi 1979). In recent years, studies have been made to examine the degree of erosion of the tax base by measuring the size of tax deductions using household microdata. In a series of studies, it has been confirmed that Japan has a narrow tax base due to generous tax deductions compared to other countries (Tajika and Yashio 2010). It has also been confirmed that the size of the tax deduction varies from taxpayer to taxpayer depending on factors such as income and household attributes, with lower-income and older taxpayers having a relatively smaller proportion of the tax base (Tajika and Yashio 2006a, 2006b, 2008, 2010; Kaneda 2014).

In capturing trends in the tax base of income tax purposes, it is necessary to take into account the effects of changes in income distribution and population composition, but it has also been pointed out that the taxable base has been eroding as the proportion of households

with a small tax base has increased as a result of lower incomes and an aging population (Yashio and Hachisuka 2014; Ohno et al. 2020). Furthermore, some efforts have quantitatively estimated that the income tax base will shrink in the future as social security benefits are expected to increase with the aging of society and from the expansion of deductions for SIPs (Matsuda et al. 2014).

Third, the impact of the deduction on tax burden reduction has also been examined. A series of studies have shown that the effect of tax deductions on tax burden reduction (tax burden rate) was greater for higher income groups in the mid-1990s, but over time, the tax burden reduction for higher income groups has been declining, and the tax burden reduction effect in recent years has been proportionally structured (Ohno et al. 2021). Some studies have considered the effects of tax deductions, which are similar to the estimates that would be obtained if the deduction system under consideration were eliminated. There, it has also been confirmed that the tax burden reduction from employment income deductions, public pension deductions, and spousal (special) deductions is higher for higher income groups (Tajika and Furutani 2003, 2005; Tajika and Yashio 2006a, 2006b; Kaneda 2014). Some efforts have also considered the impact on redistributive effects, such as how the burden reduction associated with deductions changes the effect of reducing income inequality through taxes. Currently, the amount of deductions for employment income and SIPs increases with income, and it has been confirmed that these characteristics increase the burden reduction effect of deductions for higher income groups, while at the same time decreasing the redistributive effect (Ohno et al. 2022).

Other studies utilizing arithmetical models include studies to measure marginal tax rates for income and resident taxes, which have been used to measure the elasticity of taxable income (the effect of changes in marginal tax rates on taxable income) in income and resident taxes (Cabinet Office 2001; Kitamura and Miyazaki 2013; Kurita 2019), There is also a study to examine the effects of changes in the dependent deduction system on household consumption behavior (Kurita 2017).

III-3. Effects of Deductions on Working Incentives, etc.: Behavioral Model

This section discusses studies that use behavioral models and specifically examine the impact of deductions on working incentives. As in other countries, many of the studies using behavioral models are dealing with labor supply responses, where discrete choice models are employed as models of labor supply. Some studies have considered the impact of the elimination of the spousal deduction on women's labor supply (Bessho and Hayashi 2014; Adachi and Kaneda 2016), but "the increase in the labor supply of married women due to the elimination of the spousal deduction is quite small" and "the evidence that it suppresses female labor has not been obtained" (Hayashi 2020, p. 259)[3]. Other evidence also shows

[3] Kaneda and Kurita (2017) use a similar model to estimate the effects of Thailand's personal income tax reform, showing that the elimination of the spousal deduction has the effect of bringing female non-workers into the labor market.

that the introduction of child allowances and the reduction of the dependent deduction have the effect of reducing parent labor supply (Bessho 2018) and that the conversion of the basic tax deduction into a tax credit has the effect of increasing labor supply, especially in terms of the extensive margin (Ogasa 2019).

IV. Microsimulation Models and Changes in Personal Income Taxation in Japan

IV-1. Data used

Data will be taken from the household microdata (questionnaire information) of the NSFICW (1989-2019). Since this survey is conducted every five years, data as of point 7 are used here. The survey provides information on each household member's attributes (relationship, age, gender, etc.) and income for the past year for each household. In this paper, we apply the actual system to the attributes and income information of each household member to estimate the annual income tax, resident tax, public pension insurance premium, health insurance premium, long-term care insurance premium, and unemployment insurance premium for each household. The following households are excluded from the sample for reasons such as the inability to estimate tax amounts here.

Households with members of unknown age and gender
Households whose members live away from the family for employment
Households with members who had moved out

IV-2. Method of Estimating Income[4]

Income data are taken from the "Annual Income and Savings Questionnaire" of the NSFICW; in the case of the 2019 survey, annual income has 11 breakdown items, and each breakdown item further examines the income of the "head of household", "spouse of the head of household", "other household members (under 65 years old)", and "same (65 years old or over)". However, for households with multiple members in the "other household members (under 65 years old)" and "same (65 years old or over)" categories, only the total income of the household members in the respective categories can be ascertained. Therefore, for those households, the income of "other household members (under 65 years old)" and "other household members (65 years old or over)" is prorated as follows.

The average income for "annual income from employment," "income from agriculture, forestry, and fisheries," "business income other than agriculture, forestry, and fisheries," "public pensions and benefits," "social security benefits," "corporate pension benefits," and "individual pension benefits" is considered to differ depending on the gender and age of the household members. Therefore, we first obtain the average income by gender and age group

[4] The method for estimating income, SIPs, and income and resident taxes in this paper employs the methodology of Ohno et al. (2017, 2018). See Appendix for details.

from the income of the head of household and spouse, for whom individual income can be ascertained. Then, if there is more than one person in the "other household members (under 65)" and "same (65 or over)," the combined income is prorated for each household member according to the ratio of the aforementioned average income.

For "annual income from side job", "annual income from rent and land rent", "interest and dividends", and "other annual income" ("remittance sent from relatives" until the 2014 survey, if there is more than one person in "other household members (under 65 years old)" and "same (65 years old or over)", the total income is divided by the number of household members. However, household members under 15 years old are excluded from the apportionment.

IV-3. Method of Estimating Taxes and SIPs[5]

In estimating the amount of income and resident taxes, it is also necessary to estimate the amount of SIPs to be used for the deduction for SIPs. In this paper, the highest income earner is assumed to be the head of household (rather than the dependent relationship entered on the household survey form). The spousal and dependents relationships under the tax and social insurance systems are identified from the family relationship, age, occupation and income of the head of household and each household member.

In estimating the amount of SIPs, it is first necessary to identify which social insurance system each household member is enrolled in. Here, we estimate the amount of SIPs for public pension insurance, health insurance, long-term care insurance, and unemployment insurance by estimating the system in which each household member is enrolled and then applying the actual SIP calculation formula.

In estimating the amount of income and resident taxes, the amount is obtained by applying the actual tax system to information on household attributes and income. The Income Tax Law classifies income into 10 income categories, but here total income is calculated for "employment income", "business income", "miscellaneous income" and "real estate income", all of which are available in the NSFICW. Next, taxable income is calculated by subtracting various income deductions from the total income. The deductions to be applied here are the basic deduction, spousal (special) deduction, deduction for dependents, deduction for the elderly (until 2004), deduction for SIPs, deduction for employment income, and deduction for public pensions. For the deduction for SIPs, the amount of premiums estimated earlier is used. Finally, the marginal tax rate tables for income and resident taxes are ap-

[5] In this paper, we estimate the amount of taxes and SIPs by applying the actual systems to the income and attributes of the households in the survey. The methodology is the same as the microsimulation method, which hypothetically constructs new variables by applying social systems to each household from the available variables. Although this method can estimate highly individualized variables such as taxes and SIPs for each household from limited information, it may contain large measurement errors. However, Ohno et al. (2015) and Tada et al. (2016) used the CSLC to test the validity of the estimation method for the amount of taxes and SIPs and confirmed that the estimates are highly accurate. Sano et al. (2015) and Tada and Miyoshi (2015) find that the NSFICW/NSFIE and the CSLC are consistent in terms of household attributes and income information. Therefore, the methodology for estimating tax and SIP amounts is also applicable to the NSFICW/NSFIE, and the validity of the estimates constructed is considered to have the same level of accuracy.

plied to taxable income to estimate the amount of income and resident taxes. Note that the fixed-rate tax credit (from 1994 to 2006), the adjustment tax credit (from 2007, only for resident tax), and the special income tax for reconstruction (from 2013) are also taken into account here[6].

In adjusting the incomes and parameters for taxes and SIPs (e.g., applicable deductions) to make real values, the average income for each year is used to create the index, and the year 2019 is used here as the base year. However, as Japan's population ages, the level of average income is likely to be affected by changes in the age structure. Therefore, we will create an index to make the real values by excluding the effect of changes in the age structure. First, the household composition ratio in age group k ($k = 1, 2, \ldots, K$) in year t is n_t^k and the average income is y_t^k. In addition, let $\sum_{k=1}^{K} n_t^k = 1$. If the base year is year T, the index I_t is calculated based on the following formula.

$$I_t = \left(\sum_{k}^{K} n_T^k \cdot y_t^k \right) \Big/ \left(\sum_{k}^{K} n_T^k \cdot y_T^k \right) \tag{1}$$

Using the household composition rate in each age group as weights, the weighted average income for all households is obtained by weighting the incomes for each age group. The numerator of equation (1) is the weighted average income in year t and the denominator is the weighted average income in year T. In order to exclude the effect of changes in the age structure, we use the household composition ratio in 2019 as weights when determining the weighted average income in both year t and year T. In creating the age groups, we used 11 age groups based on the age of the head of household (under 35, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, and 80 or over).

In order to adjust for household size, each level of income, taxes, and SIPs is used on an equivalent household basis (each level divided by the square root of the number of household members).

IV-4. Changes in Income and Resident Taxes

This section provides an overview of changes in Japan's income and resident tax systems (from 1989 to 2019). The tax deductions examined include the basic deduction, the spousal deduction (including the special spousal deduction), the deduction for dependents, the deduction for SIPs, the deduction for employment income, the deduction for public pension, the deduction for the elderly, and the fixed-rate tax reduction. Table 2 shows the income and resident tax systems for each year. Since changes in the income tax and resident tax systems generally follow similar trends, we will focus mainly on changes in the income tax system in the following.

If we take a broad view of the tax reform, the 1990s saw a series of changes that gener-

[6] Deductions based on information not available from the questionnaire (e.g., deductions for disabled persons, deductions for medical expenses, special tax credit for housing loans, etc.) are not considered here.

Table 2: Changes in Taxation System (a) Income Tax in 1989-2004

	1989	1994	1999	2004
Tax rate	5 brackets (10, 20, 30, 40, 50%)	Same as left	4 brackets (10, 20, 30, 37%)	Same as left
Deduction for employment income	Minimum deduction amount: JPY 650,000 Deduction amount increases with income.	Same as left	Minimum deduction amount: JPY 650,000 Deduction amount increases with income. Bracket changed.	Same as left
Deduction for public pension	(1) Under 65 years old Minimum deduction amount: JPY 600,000 Deduction amount increases with income. (2) 65 years old or over Minimum deduction amount: JPY 1.2 million Deduction amount increases with income.	(1) Under 65 years old Minimum deduction amount: JPY 700,000 Deduction amount increases with income. (2) 65 years old or over Minimum deduction amount: JPY 1.4 million Deduction amount increases with income.	Same as left	Same as left
Basic deduction	Deduction amount: JPY 350,000	Same as left	Deduction amount: JPY 380,000	Same as left
Deduction for spouse	Deduction amount: General: JPY 350,000 70 years old or over: JPY 450,000	Same as left	Deduction amount: General: JPY 380,000 70 years old or over: JPY 480,000	Same as left
Special deduction for spouse	Maximum deduction amount: JPY 350,000 Deduction amount decreases with spouse's income. Added to the deduction for spouse.	Same as left	Maximum deduction amount: JPY 380,000 Deduction amount decreases with spouse's income. Added to the deduction for spouse.	Maximum deduction amount: JPY 380,000 Deduction amount decreases with spouse's income. Not added to the deduction for spouse.
Deduction for dependents	Deduction amount: General: JPY 350,000 16-22 years old: JPY 450,000 70 years old or over: JPY 450,000 Of which, cohabiting parent: JPY 550,000	Deduction amount: General: JPY 350,000 16-22 years old: JPY 500,000 70 years old or over: JPY 450,000 Of which, cohabiting parent: JPY 550,000	Deduction amount: General: JPY 380,000 Under 16 years old: JPY 480,000 16-22 years old: JPY 630,000 70 years old or over: JPY 480,000 Of which, cohabiting parent: JPY 580,000	Deduction amount: General: JPY 380,000 16-22 years old: JPY 630,000 70 years old or over: JPY 480,000 Of which, cohabiting parent: JPY 580,000
Deduction for SIPs	Same amount as SIP payment	Same as left	Same as left	Same as left
Deduction for the elderly	Deduction amount: JPY 500,000	Same as left	Same as left	Same as left
Fixed-rate tax credit	No existence	Fixed-rate tax credit: 20% Maximum credit amount: JPY 2 million	Fixed-rate tax credit: 20% Maximum credit amount: JPY 250,000	Same as left

Source: "Ministry of Finance Statistics Monthly", Policy Research Institute, Ministry of Finance of Japan

Table 2: Changes in Taxation System (b) Income Tax in 2009-2019

	2009	2014	2019
Tax rate	6 brackets (5, 10, 20, 23, 33, 40%)	Same as left	7 brackets (5, 10, 20, 23, 33, 40, 45%)
Deduction for employment income	Same as left	Minimum deduction amount: JPY 650,000 Deduction amount increases with income. Maximum deduction amount: JPY 2.45 million	Minimum deduction amount: JPY 650,000 Deduction amount increases with income. Maximum deduction amount: JPY 2.2 million
Deduction for public pension	(1) Under 65 years old Minimum deduction amount: JPY 700,000 Deduction amount increases with income. (2) 65 years old or over Minimum deduction amount: JPY 1.2 million Deduction amount increases with income.	Same as left	Same as left
Basic deduction	Same as left	Same as left	Same as left
Deduction for spouse	Same as left	Same as left	Deduction amount: General: JPY 380,000 70 years old or over: JPY 480,000 Deduction amount decreases with income.
Special deduction for spouse	Same as left	Same as left	Maximum deduction amount: JPY 380,000 Deduction amount decreases with spouse's income. Deduction amount decreases with income. Not added to the deduction for spouse.
Deduction for dependents	Same as left	Deduction amount: General (16 years old or over): JPY 380,000 19-22 years old: JPY 630,000 70 years old or over: JPY 480,000 Of which, cohabiting parent: JPY 580,000	Same as left
Deduction for SIPs	Same as left	Same as left	Same as left
Deduction for the elderly	Abolished	No existence	No existence
Fixed-rate tax credit	Abolished	No existence	No existence

Table 2: Changes in Taxation System (c) Resident Tax in 1989-2004

	1989	1994	1999	2004
Tax rate	Tax on income: Municipal tax: 3 brackets (3, 8, 11%) Prefectural tax: 2 brackets (2, 4%) Per capita tax is also added.	Tax on income: Municipal tax: 3 brackets (3, 8, 11%) Prefectural tax: 2 brackets (2, 4%) Per capita tax is also added. Bracket changed.	Tax on income: Municipal tax: 3 brackets (3, 8, 10%) Prefectural tax: 2 brackets (2, 3%) Per capita tax is also added.	Tax on income: Municipal tax: 3 brackets (3, 8, 10%) Prefectural tax: 2 brackets (2, 3%) Per capita tax is also added. Per capita tax changed.
Deduction for employment income	Minimum deduction amount: JPY 570,000 Deduction amount increases with income.	Minimum deduction amount: JPY 650,000 Deduction amount increases with income.	Minimum deduction amount: JPY 650,000 Deduction amount increases with income. Bracket changed.	Same as left
Deduction for public pension	(1) Under 65 years old Minimum deduction amount: JPY 600,000 Deduction amount increases with income. (2) 65 years old or over Minimum deduction amount: JPY 1.2 million Deduction amount increases with income.	(1) Under 65 years old Minimum deduction amount: JPY 700,000 Deduction amount increases with income. (2) 65 years old or over Minimum deduction amount: JPY 1.4 million Deduction amount increases with income.	Same as left	Same as left
Basic deduction	Deduction amount: JPY 280,000	Deduction amount: JPY 310,000	Deduction amount: JPY 330,000	Same as left
Deduction for spouse	Deduction amount: General: JPY 280,000 70 years old or over: JPY 290,000	Deduction amount: General: JPY 310,000 70 years old or over: JPY 360,000	Deduction amount: General: JPY 330,000 70 years old or over: JPY 380,000	Same as left
Special deduction for spouse	Maximum deduction amount: JPY 140,000 Deduction amount decreases with spouse's income. Added to the deduction for spouse.	Maximum deduction amount: JPY 310,000 Deduction amount decreases with spouse's income. Added to the deduction for spouse.	Maximum deduction amount: JPY 330,000 Deduction amount decreases with spouse's income. Added to the deduction for spouse.	Same as left
Deduction for dependents	Deduction amount: General: JPY 280,000 70 years old or over: JPY 290,000 Of which, cohabiting parent: JPY 330,000	Deduction amount: General: JPY 310,000 16-22 years old: JPY 390,000 70 years old or over: JPY 360,000 Of which, cohabiting parent: JPY 430,000	Deduction amount: General: JPY 330,000 16-22 years old: JPY 430,000 70 years old or over: JPY 380,000 Of which, cohabiting parent: JPY 450,000	Deduction amount: General: JPY 330,000 16-22 years old: JPY 450,000 70 years old or over: JPY 380,000 Of which, cohabiting parent: JPY 450,000
Deduction for SIPs	Same amount as SIP payment	Same as left	Same as left	Same as left
Deduction for the elderly	Deduction amount: JPY 480,000	Same as left	Same as left	Same as left
Fixed-rate tax credit	No existence	Fixed-rate tax credit: 20% Maximum credit amount: JPY 200,000	Fixed-rate tax credit: 15% Maximum credit amount: JPY 40,000	Same as left

Table 2: Changes in Taxation System (d) Resident Tax in 2009-2019

	2009	2014	2019
Tax rate	Tax on income: Municipal tax: uniform 6% Prefectural tax: uniform 4% Per capita tax is also added.	Tax on income: Municipal tax: uniform 6% Prefectural tax: uniform 4% Per capita tax is also added.	Same as left
Deduction for employment income	Same as left	Minimum deduction amount: JPY 650,000 Deduction amount increases with income. Maximum deduction amount: JPY 2.45 million	Minimum deduction amount: JPY 650,000 Deduction amount increases with income. Maximum deduction amount: JPY 2.2 million
Deduction for public pension	(1) Under 65 years old Minimum deduction amount: JPY 700,000 Deduction amount increases with income. (2) 65 years old or over Minimum deduction amount: JPY 1.2 million Deduction amount increases with income.	Same as left	Same as left
Basic deduction	Same as left	Same as left	Same as left
Deduction for spouse	Same as left	Same as left	Deduction amount: General: JPY 330,000 70 years old or over: JPY 380,000 Deduction amount decreases with income.
Special deduction for spouse	Maximum deduction amount: JPY 330,000 Deduction amount decreases with spouse's income. Not added to the deduction for spouse.	Same as left	Maximum deduction amount: JPY 330,000 Deduction amount decreases with spouse's income. Deduction amount decreases with income. Not added to the deduction for spouse.
Deduction for dependents	Same as left	Deduction amount: General (16 years old or over): JPY 330,000 19-22 years old: JPY 450,000 70 years old or over: JPY 380,000 Of which, cohabiting parent: JPY 450,000	Same as left
Deduction for SIPs	Same as left	Same as left	Same as left
Deduction for the elderly	Abolished	No existence	No existence
Fixed-rate tax credit	Abolished	No existence	No existence

ally led to a reduction in the burden on taxpayers. The tax rate structure was shifted from a five-tier to a four-tier system, and the maximum tax rate was lowered to 37% (1999). In addition, the amount of applicable deductions was expanded, including changes in the brackets for the deduction for employment income (1995), an increase in the minimum deduction for public pensions (1990), an increase in the amount of the basic deduction (1995), an increase in the deduction for spouses (1995), and an increase in the deduction for dependents (1993, 1995, 1998, and 1999). Fixed-rate tax credits were also implemented during this period. For example, in 1994, a special tax cut of 20% (up to 2,000,000 yen) and in 1999, a permanent tax cut of 20% (up to 250,000 yen) were applied.

In the 2000s, the revision trend changed. The tax rate structure was shifted from four to six brackets (2007) and then to seven brackets, and the maximum tax rate was raised to 45% (2015). During this period, as part of the decentralization reform, tax revenue sources were transferred from the national to the local government, and the tax rate structure of the resident tax was made more proportional, while that of the income tax was made more progressive. Various deductions have also been reduced in terms of the amount of applicable deductions, specifically, the brackets for employment income deductions were changed and the maximum amount of deduction was set (2013, 2016, and 2017), the brackets of deductions for public pensions were changed and the amount of deduction for public pensions was reduced (2018), the application of a special deduction for spouses was abolished (2004), the deduction for dependents was reduced (2011; however, this was a change to the child allowance system), and the deduction for the elderly was abolished (2005). During this period, the fixed-rate tax credit was also abolished (2007).

V. The Actual Burden Structure of Personal Income Taxation

V-1. Trends in Income Levels and Income Inequality

First, we will look at trends in income levels and income inequality. We use three income concepts: (1) “initial income,” which is initially earned; (2) “gross income,” which is initial income plus social security benefits (cash benefits); and (3) “disposable income,” which is gross income minus taxes and SIPs. The Gini coefficient is used as an indicator of income inequality, and the Gini coefficient is calculated for each of the three income concepts.

Table 3 shows the income level (average for all households) and the magnitude of the Gini coefficient for each survey year. Income level in terms of disposable income increased in the 1990s (1989-1999) and has been on a downward trend since then. The Gini coefficient for disposable income has also generally been on an upward trend from the 1990s (1989 onward) to the present day. When the Gini coefficient is examined by age group, the coefficient for younger households (households with a head of household under the age of 65) in particular has been on an upward trend.

We would also like to confirm the magnitude of the redistributive effect. The redistribu-

tive effect focuses on the degree to which income inequality is corrected through the burden and benefits provided by the tax and social security systems. Here, the extent to which the Gini coefficient decreases from initial income to gross income is considered to be the contribution of benefits. The Gini coefficient is also defined as the contribution of taxes and SIPs, based on the degree to which the Gini coefficient decreased from gross income to disposable income. Table 3 also shows the magnitude of the redistributive effect in each study year.[7] For example, in 1989, the Gini coefficient in terms of initial income was 0.331, but benefits lowered it by 0.032 p (points), and taxes and SIPs lowered it by another 0.030 p, resulting in a Gini coefficient in terms of disposable income of 0.269. Thus, we see that in 1989, the contributions of benefits and taxes and SIPs were comparable. By contrast, in 2019, the Gini coefficient declines by 0.063 p for benefits and by 0.033 p for taxes and SIPs. The contribution of benefits itself has continued to grow over the past 30 years, with the redistributive effect of benefits exceeding that of taxes and SIPs as of 2019. This is due to the fact that most of the cash benefits are public pension benefits, and the contribution of benefits has continuously increased with the aging of the population. On the other hand, the contribution of taxes and SIPs has changed only slightly over time, but the role of redistributive effects through taxes has increased as the intra-generational Gini coefficient for younger households has risen.

Table 3: Income Levels and Income Inequality

		1989	1994	1999	2004	2009	2014	2019	1989 to 2019
Income level (ten thousand yen)									
Initial income	(1)	315.1	315.4	315.2	305.7	297.4	288.8	304.2	−10.8
Gross income	(2)	354.8	364.0	375.1	374.9	373.5	370.3	373.4	18.5
Disposable income	(3)	298.5	308.4	318.8	316.0	308.3	302.0	298.9	0.3
Gini coefficient									
Initial income	(4)	0.331	0.343	0.361	0.380	0.406	0.413	0.393	0.062
Gross income	(5)	0.299	0.308	0.311	0.315	0.326	0.325	0.330	0.031
Disposable income	(6)	0.269	0.279	0.284	0.287	0.295	0.292	0.297	0.028
Change in Gini coefficient									
Contribution of benefits	(7) = (5) − (4)	−0.032	−0.035	−0.050	−0.065	−0.080	−0.088	−0.063	−0.031
Contribution of Taxes and SIPs	(8) = (6) − (5)	−0.030	−0.029	−0.027	−0.028	−0.031	−0.033	−0.033	−0.003
Gini coefficient: by age class									
Disposable income (under 65 years old)	(9)	0.257	0.264	0.273	0.275	0.287	0.279	0.282	0.025
Disposable income (65 years old or over)	(10)	0.336	0.337	0.307	0.304	0.294	0.293	0.303	−0.033

V-2. Household Tax and SIP Burdens

Next, we will look at the structure of the tax and SIP burden. Table 4 and Table 5 show the tax and SIP burden rates by income bracket, respectively, for younger households

[7] In studies of redistributive effects, the absolute value of the reduction in inequality due to burdens and benefits is usually taken, and the magnitude of the redistributive effect is therefore expressed as a positive value. On the other hand, for the sake of consistency, this paper focuses simply on changes in income inequality (without taking absolute values).

(households whose head is under 65 years old) and elderly households (households whose head is 65 years old or over). The burden rate is the amount of each tax and SIP burden divided by gross income (average tax rate). Income deciles are used to divide the sample into 10 equal groups according to income level, with decile I representing the lowest income group and decile X representing the highest income group. The burden structure is considered (1) "progressive" when the burden rate increases with income, (2) "proportional" when the burden rate is constant with income, and (3) "regressive" when the burden rate decreases with income.

Panel (a) of Table 4 shows the tax and SIP burden rates for active households in 2019. It shows that income and resident taxes are progressive, public pension and health insurance premiums are generally proportional, and long-term care insurance premiums are regressive, resulting in a progressive burden structure for taxes and SIPs as a whole. The progressive burden structure of taxes and SIPs as a whole has been the same in each survey year since 1989, but here we focus on changes over time. Panel (b) of Table 4 shows changes in the tax and SIP burden by income group from 1989 to 2019. For example, the overall burden rate for taxes and SIPs rose by 5.6% p on average for all households, and by income group, the

Table 4: Household Tax and SIP Burdens: Households whose head is under 65 years old

(a) 2019 (% of gross income)

Income deciles	Taxes and SIPs	Taxes	(Breakdown of taxes)		SIPs	(Breakdown of SIPs)			
			Income tax	Resident tax		Public Pension insurance	Health insurance	Long-term care insurance	Employment insurance
I	10.1%	1.1%	0.3%	0.8%	9.0%	2.5%	5.4%	1.0%	0.1%
II	15.4%	3.1%	0.9%	2.1%	12.4%	6.2%	5.2%	0.8%	0.2%
III	17.2%	4.1%	1.3%	2.8%	13.1%	7.0%	5.2%	0.7%	0.2%
IV	18.0%	4.6%	1.5%	3.1%	13.3%	7.4%	5.0%	0.7%	0.2%
V	18.9%	5.4%	1.8%	3.6%	13.6%	7.8%	5.0%	0.6%	0.3%
VI	19.3%	5.8%	2.0%	3.8%	13.5%	7.8%	4.8%	0.6%	0.3%
VII	20.2%	6.4%	2.3%	4.1%	13.7%	8.0%	4.9%	0.6%	0.3%
VIII	21.0%	7.2%	2.7%	4.4%	13.9%	8.1%	4.9%	0.6%	0.3%
IX	22.5%	8.4%	3.5%	4.8%	14.1%	8.2%	5.0%	0.7%	0.3%
X	26.1%	12.5%	6.8%	5.7%	13.5%	7.7%	4.8%	0.7%	0.3%
Total households	19.9%	6.6%	2.8%	3.9%	13.2%	7.3%	5.0%	0.7%	0.2%

(b) Change from 1989 to 2019 (% of gross income)

Income deciles	Taxes and SIPs	Taxes	(Breakdown of taxes)		SIPs	(Breakdown of SIPs)			
			Income tax	Resident tax		Public Pension insurance	Health insurance	Long−term care insurance	Employment insurance
I	1.4%	−0.1%	−0.3%	0.2%	1.5%	0.3%	0.4%	1.0%	−0.2%
II	5.0%	0.5%	−0.4%	0.9%	4.4%	2.7%	1.1%	0.8%	−0.1%
III	5.5%	0.3%	−0.8%	1.1%	5.2%	3.2%	1.4%	0.7%	−0.1%
IV	5.6%	0.1%	−1.1%	1.2%	5.5%	3.5%	1.4%	0.7%	−0.1%
V	5.7%	0.0%	−1.2%	1.2%	5.8%	3.8%	1.4%	0.6%	−0.1%
VI	5.3%	−0.4%	−1.4%	1.0%	5.8%	3.8%	1.4%	0.6%	−0.1%
VII	5.3%	−0.7%	−1.6%	1.0%	6.0%	3.9%	1.6%	0.6%	−0.1%
VIII	5.3%	−0.9%	−1.8%	0.8%	6.3%	4.1%	1.6%	0.6%	−0.1%
IX	5.2%	−1.4%	−2.0%	0.6%	6.6%	4.2%	1.8%	0.7%	−0.1%
X	4.1%	−2.7%	−2.5%	−0.2%	6.8%	4.2%	1.9%	0.7%	−0.1%
Total households	5.6%	0.0%	−1.0%	1.0%	5.6%	3.6%	1.4%	0.7%	−0.1%

Table 5: Household Tax and SIP Burdens: Households whose head is 65 years old or over

(a) 2019 (% of gross income)

Income deciles	Taxes and SIPs	Taxes	(Breakdown of taxes)		SIPs	(Breakdown of SIPs)			
			Income tax	Resident tax		Public Pension insurance	Health insurance	Long-term care insurance	Employment insurance
I	7.8%	0.1%	0.0%	0.1%	7.7%	0.1%	2.2%	5.4%	0.0%
II	7.4%	0.7%	0.2%	0.5%	6.7%	0.2%	2.6%	3.8%	0.0%
III	10.1%	1.5%	0.4%	1.1%	8.6%	0.4%	4.1%	4.1%	0.0%
IV	11.1%	2.3%	0.7%	1.6%	8.8%	0.6%	4.5%	3.7%	0.0%
V	12.3%	3.1%	1.0%	2.2%	9.2%	1.0%	4.8%	3.3%	0.0%
VI	13.1%	3.6%	1.1%	2.5%	9.5%	1.7%	4.8%	2.9%	0.0%
VII	14.2%	4.5%	1.5%	3.0%	9.7%	2.3%	4.8%	2.6%	0.0%
VIII	15.5%	5.5%	1.9%	3.6%	10.0%	2.8%	4.9%	2.3%	0.1%
IX	17.5%	7.1%	2.8%	4.3%	10.4%	3.2%	5.1%	2.0%	0.1%
X	22.8%	13.6%	7.9%	5.8%	9.1%	2.9%	4.8%	1.4%	0.0%
Total households	11.7%	3.1%	1.2%	1.9%	8.6%	1.1%	4.0%	3.5%	0.0%

(b) Change from 1989 to 2019 (% of gross income)

Income deciles	Taxes and SIPs	Taxes	(Breakdown of taxes)		SIPs	(Breakdown of SIPs)			
			Income tax	Resident tax		Public Pension insurance	Health insurance	Long-term care insurance	Employment insurance
I	5.0%	0.1%	0.0%	0.1%	4.9%	0.0%	−0.5%	5.4%	0.0%
II	4.6%	0.5%	0.1%	0.4%	4.1%	0.0%	0.3%	3.8%	0.0%
III	6.0%	0.8%	0.1%	0.7%	5.2%	0.1%	1.1%	4.1%	0.0%
IV	5.4%	0.7%	−0.1%	0.8%	4.6%	−0.2%	1.2%	3.7%	0.0%
V	6.8%	1.3%	0.0%	1.3%	5.5%	0.3%	1.9%	3.3%	0.0%
VI	5.8%	0.6%	−0.6%	1.2%	5.2%	0.7%	1.5%	2.9%	0.0%
VII	6.1%	0.8%	−0.6%	1.4%	5.3%	1.0%	1.7%	2.6%	0.0%
VIII	5.6%	0.4%	−0.9%	1.3%	5.2%	1.3%	1.7%	2.3%	0.0%
IX	6.1%	0.4%	−0.9%	1.4%	5.7%	1.7%	2.0%	2.0%	0.0%
X	3.7%	−1.0%	−1.2%	0.3%	4.7%	1.3%	2.0%	1.4%	0.0%
Total households	5.8%	0.7%	−0.2%	0.9%	5.1%	0.5%	1.1%	3.5%	0.0%

burden rate generally rose by about the same amount for each income group (except for the first income decile). However, when examined by tax item category, the income tax burden rate declined by 1.0% on average for all households, and the decline in the burden rate became larger as the income bracket increased, indicating that the income tax burden structure is becoming less progressive. This is not necessarily due to changes in the tax system, but also to changes in the income distribution, including the aging of the population. In contrast, the average premium burden rate for all households increased by 5.6% p, and the increase in the burden rate is larger as the income bracket rises. This is mainly due to the impact of public pension and health insurance premiums.

These results are similar for elderly households. Panel (a) of Table 5 shows the tax and SIP burden rates for elderly households in 2019, with a progressive burden structure for taxes and insurance premiums as a whole (except for tier I). Panel (b) of Table 5 shows the changes from 1989 to 2019 in the tax and SIP burden rates by income group. For example, the overall burden of taxes and SIPs rose by 5.8% p on average for all households, and by income group, the burden rose in all income deciles. By tax item category, the income tax burden rate declines by a larger margin as the income decile rises, indicating a decline in the

progressivity of the income tax system. In addition, the burden rate for SIPs rose by 5.1% p on average for all households, with the burden rate generally rising at about the same level for all income deciles.

V-3. Redistribution Effects

Given these changes in the burden structure over time, we also compare the redistributive effects of taxes and SIPs across time periods. Table 6 shows the magnitude of the redistributive effect of taxes and SIPs in two indexes: First, as in Section V-1, the change in the Gini coefficient due to taxes and SIPs (i.e., the difference between the Gini coefficient of gross income and disposable income); second, the rate of change in the Gini coefficient due to taxes and SIPs (i.e., the change in the Gini coefficient divided by the Gini coefficient of gross income). The results in Table 6 show that at each point in time, taxes and SIPs reduce the Gini coefficient by about 0.03 p, meaning that they reduce the Gini coefficient of the gross income base by about 10%. Over time, the magnitude of the redistributive effect of taxes and SIPs has increased slightly (by about 0.003 p) over the past 30 years. Also, looking at the redistributive effects of taxes and SIPs respectively, the redistributive effect of taxes has declined by 0.004 p while the redistributive effect of SIPs has increased by 0.006 p, and these results are consistent with the changes in the burden structure in Section V-2[8].

By the way, the intertemporal comparison of redistributive effects includes not only the effects of system change factors, but also the effects of non-system change factors resulting from changes in income distribution, population composition, and other factors. Therefore, we adopt a method similar to Bargain and Callan (2010) and Bargain (2012a) to decompose changes in the redistributive effect into system change factors and non-system change factors. As a general type, we denote data for year i by d_i and systems for year j by p_j. The Gini coefficient of gross income and the Gini coefficient of disposable income, measured under these conditions, are denoted as $G(d_i)$ and $G^*(d_i, p_j)$, respectively. The redistributive effects computed under data year i and system year j can then be denoted as follows.

$$RE_{i,j} = G^*(d_i, p_j) - G(d_i) \tag{2}$$

In order to focus on intertemporal comparisons, we denote the base year as 0 and the comparison year as 1. In this case, the change in the Gini coefficient in terms of disposable income can be factorized as follows.

(Case 1)

$$G^*(d_1, p_1) - G^*(d_0, p_0) = (G(d_1) - G(d_0)) + (RE_{1,0} - RE_{0,0}) + (RE_{1,1} - RE_{1,0}) \tag{3.1}$$

(Case 2)

$$G^*(d_1, p_1) - G^*(d_0, p_0) = (G(d_1) - G(d_0)) + (RE_{1,1} - RE_{0,1}) + (RE_{0,1} - RE_{0,0}) \tag{3.2}$$

[8] The redistributive effect of taxes was calculated by obtaining the Gini coefficients of pre-tax income (gross income) and post-tax income (gross income minus taxes), and then taking the difference between the two. Similarly, the redistributive effect of SIPs was calculated by obtaining the Gini coefficients of pre-tax income (gross income) and post-tax income (gross income minus SIPs), and then taking the difference between the two. Note that these efforts are not contribution decompositions, and the sum of the effects is not equal to the redistributive effect of taxes and SIPs.

(Case 3)

$$G^*(d_1, p_1) - G^*(d_0, p_0) = (G(d_1) - G(d_0)) + \frac{1}{2}\{(RE_{1,0} - RE_{0,0}) + (RE_{1,1} - RE_{0,1})\} + \frac{1}{2}\{(RE_{1,1} - RE_{1,0}) + (RE_{0,1} - RE_{0,0})\} \quad (3.3)$$

All of equations (3.1)-(3.3) all decompose the change in the Gini coefficient seen in disposable income into three components. The first term on the right-hand side represents "(a) the change in disparity of gross income". The second term captures the impact of changing only the year of the system while keeping the year of the data fixed, thereby measuring "the true contribution of the system change itself to the redistributive effect". We refer to this as "(b) system change factors". Case 1 is the case where the data are fixed to the base year (0), Case 2 is the case where the data are fixed to the comparison year (1), and Case 3 is the average of Case 1 and Case 2. The third term captures the impact of fixing the system year and changing only the data year, thereby measuring "the impact of changes in income distribution, population composition, etc. on the redistributive effects if there had been no change in the system". We refer to this as "(c) non-system change factors," where Case 1 is the case where the system is fixed to the comparison year (1) and Case 2 is the case where the system is fixed to the base year (0); Case 3 is the average of Case 1 and Case 2. The sum of the system and non-system change factors represents the change in redistributive effects.

This paper presents only the results for Case 3. Table 7 shows the factor decomposition of the change in the Gini coefficient (disposable income). For example, a comparison between 1989 and 2019 shows that the Gini coefficient in terms of disposable income has increased by 0.028 p over the past 30 years. The background to this is that while the Gini coefficient in terms of gross income rose by 0.031 p, taxes and SIPs suppressed the increase by about 0.003 p. However, the breakdown of the Gini coefficient shows that while non-system change factors contributed to a 0.010 p decrease in the Gini coefficient, system change factors contributed to a 0.007 p increase, indicating that the redistributive effect of taxes and SIPs was reduced by system change (first row of Table 7). These results have also been brought about mainly in the tax system (second row of Table 7). Table 7 also shows the re-

Table 6: Redistributive Effects

	1989	1994	1999	2004	2009	2014	2019	1989 to 2019
Change in Gini coeficient								
Taxes and SIPs	−0.030	−0.029	−0.027	−0.028	−0.031	−0.033	−0.033	−0.003
Taxes only	−0.029	−0.027	−0.023	−0.023	−0.024	−0.024	−0.025	0.004
SIPs only	0.001	0.000	−0.002	−0.003	−0.004	−0.005	−0.005	−0.006
Change rate in Gini coefficient								
Taxes and SIPs	−10.0%	−9.4%	−8.7%	−8.9%	−9.5%	−10.2%	−10.0%	0.0%
Taxes only	−9.7%	−8.8%	−7.4%	−7.3%	−7.4%	−7.4%	−7.6%	2.1%
SIPs only	0.3%	0.0%	−0.6%	−1.0%	−1.2%	−1.5%	−1.5%	−1.8%

Table 7: Factor Decomposition of Changes in Redistributive Effects

		Decomposition			
	Change in Gini coefficient (Disposable income) (1)	Change in Gini coefficient (Gross income) (2)	System change factor (3)	Non-system change factor (4)	Effect of Taxes and SIPs (5) = (3) + (4)
1989 to 2019					
Taxes and SIPs	0.028	0.031	0.007	−0.010	−0.003
Taxes only	0.035	0.031	0.008	−0.004	0.004
SIPs only	0.025	0.031	−0.002	−0.005	−0.006
Every 5 years (Taxes and SIPs)					
1989 to 1994	0.010	0.009	0.004	−0.003	0.001
1994 to 1999	0.005	0.003	0.003	−0.001	0.002
1999 tp 2004	0.003	0.004	0.002	−0.003	−0.001
2004 to 2009	0.008	0.011	−0.001	−0.002	−0.003
2009 to 2014	−0.003	−0.001	−0.001	−0.002	−0.002
2014 to 2019	0.005	0.005	0.001	−0.001	0.000

sults for every five years, but the 1990s (1989-1994 and 1994-1999) in particular saw a decline in the redistributive effect, which can be attributed to a reduction in the top tax rate, the introduction of a fixed-rate tax credit, and the expansion of various deductions. Since the 2000s (after 1999), the maximum tax rate has been raised, fixed-rate tax credit has been abolished, and various deductions have been reduced. However, when viewed from a 30-year comparison, the redistributive effect of taxes and SIPs has not been restored so far.

V-4. Burden Reduction Effect of Deductions

In Japan, the Gini coefficient has increased over the past 30 years. This is partly due to the aging of the population, which is reflected in differences in the Gini coefficient between the elderly and the younger. On the other hand, the Gini coefficient for younger households alone is also on the rise, so restoring the redistributive function of income taxes is a policy issue. Since the progressivity of the income tax is affected not only by the tax rate structure but also by income tax deductions (Masui 2014, p. 76), it is necessary to discuss the nature of deductions in order to restore the redistributive effect. In this section, we will look at the structure of the burden reduction effect of deductions.

In determining the burden reduction from the deduction, we employ the methods of Burman et al. (2017) and Ohno et al. (2021). First, we apply a tax calculation process that reflects the actual tax system and estimate the tax amount (tax amount (a)) when the deduction is applied. Next, a hypothetical tax amount (tax amount (b)) is estimated when the deduction is not applied. The difference between the two tax amounts (= tax amount (b) - tax amount (a)) is treated as the burden reduction due to the deduction. The deductions in this paper are the basic deduction, the spousal deduction, the deduction for dependents, the deduction for SIPs, the deduction for the elderly, the deduction for employment income, the deduction for public pensions, the fixed-rate tax credit, and the adjustment tax credit.

First, the structure of the applicable deduction amounts is discussed. Table 8 shows the size of deductions by income group. Note that since the structure of deductions is the same for income and resident taxes, only the results for income tax (2019) are presented here. Panel (a) of Table 8 shows the results for households whose head is under 65 years old. The structure is such that the total amount of deductions increases with income group, and these characteristics are particularly due to the deduction for employment income and the deduction for SIPs. Panel (b) shows the results for households whose head is 65 years old or over. Again, the total amount of deductions increases with income group. Although the deduction for public pensions is particularly large, there is no evidence that the deduction for public pensions increases with income group.

Next, we consider the effect of deductions in terms of reducing the tax burden. Table 9 shows the magnitude of the burden reduction from deductions by income group, where the effect is the combined effect of both income and resident taxes. Panel (a) shows the amount of tax burden reduction due to deductions, indicating that the higher the income group, the

Table 8: Applicable Deductions (Income Tax, 2019)

(a) Households whose head is under 65 years old (ten thousand yen)

Income deciles	Deduction amount	(Breakdown)					
		Deduction for employment income	Deduction for Public Pension	Deduction for SIPs	Basic deduction	Deduction for spouse	Deduction for dependents
I	93.64	33.35	15.70	8.24	23.78	3.06	9.50
II	137.05	52.13	14.60	21.08	30.56	8.35	10.32
III	161.52	67.63	13.98	27.82	33.20	10.33	8.56
IV	180.89	80.57	13.19	33.23	34.74	10.95	8.20
V	193.83	92.75	10.19	39.24	35.93	9.24	6.47
VI	216.19	105.45	11.32	44.90	37.34	10.19	7.00
VII	235.46	117.38	11.28	52.77	38.53	8.57	6.93
VIII	261.51	131.39	10.98	62.42	40.58	8.88	7.25
IX	291.98	150.05	9.29	77.25	42.13	7.04	6.21
X	360.68	182.94	8.82	113.52	44.06	3.47	7.87
Total households	233.86	113.70	11.34	56.06	37.51	7.69	7.57

(b) Households with head is 65 years old or older (ten thousand yen)

Income deciles	Deduction amount	(Breakdown)					
		Deduction for employment income	Deduction for Public Pension	Deduction for SIPs	Basic deduction	Deduction for spouse	Deduction for dependents
I	154.20	6.02	113.39	6.98	12.17	1.67	13.98
II	200.22	9.57	127.29	11.46	31.52	8.36	12.03
III	220.37	12.15	134.55	18.20	34.01	14.58	6.88
IV	236.13	17.15	137.39	21.92	36.37	17.39	5.91
V	251.75	26.00	137.05	26.36	39.32	17.46	5.56
VI	272.12	39.23	134.59	31.28	42.23	17.93	6.86
VII	287.78	51.37	133.50	36.85	44.28	16.37	5.41
VIII	309.18	67.61	128.67	44.89	47.74	15.24	5.03
IX	333.66	83.13	126.56	57.08	49.16	13.88	3.84
X	377.93	109.93	122.81	81.57	49.44	7.57	6.61
Total households	242.96	31.40	129.16	26.87	35.18	12.29	8.07

Table 9: Burden Reduction Effect of Deductions (Total Income Tax and Resident Tax)

(a) Amount of reduction (ten thousand yen)

Income deciles	1989	1994	1999	2004	2009	2014	2019
I	16.53	16.28	15.71	15.45	14.47	14.98	13.27
II	28.16	29.03	28.09	26.88	25.02	24.88	23.05
III	33.89	36.58	35.84	34.14	30.93	30.40	28.67
IV	38.87	42.73	41.62	40.16	35.27	34.60	33.29
V	44.03	50.36	47.91	45.76	40.53	39.54	37.54
VI	49.25	57.76	54.75	53.11	47.15	45.50	44.35
VII	55.68	66.92	63.27	61.69	54.73	53.05	52.07
VIII	65.16	78.54	72.98	72.24	64.40	62.96	62.57
IX	77.64	95.50	87.60	87.58	78.00	77.79	76.57
X	109.25	145.56	119.84	124.07	110.88	111.47	114.18
Total households	51.64	60.97	56.09	56.07	49.91	49.37	50.04

(b) Reduction rate (% of gross income)

Income deciles	1989	1994	1999	2004	2009	2014	2019
I	14.0%	13.9%	13.4%	13.7%	13.1%	13.4%	13.6%
II	15.3%	15.5%	14.8%	14.4%	13.5%	13.6%	13.5%
III	15.2%	16.1%	15.4%	15.0%	13.7%	13.5%	13.5%
IV	15.1%	16.2%	15.4%	15.2%	13.4%	13.3%	13.4%
V	15.1%	16.7%	15.5%	15.1%	13.5%	13.2%	13.0%
VI	15.0%	16.9%	15.6%	15.4%	13.8%	13.4%	13.4%
VII	14.9%	17.2%	15.7%	15.6%	13.9%	13.6%	13.6%
VIII	15.0%	17.4%	15.6%	15.6%	14.0%	13.8%	13.9%
IX	14.9%	17.5%	15.4%	15.6%	13.9%	14.0%	14.0%
X	13.9%	17.4%	14.3%	14.7%	12.9%	13.3%	13.4%
Total households	14.8%	16.4%	15.1%	15.0%	13.5%	13.5%	13.5%

greater the burden reduction due to deductions. When viewed over time, the amount of burden reduction for each income group rises in the first half of the 1990s (1989 to 1994), but then tends to decline from the latter half of the 1990s onward. In addition, the change is relatively large, especially for the higher income group. Panel (b) shows the burden reduction rate (% of burden reduction to gross income). Looking over time, the burden reduction rate for each income group increased in the first half of the 1990s (1989 to 1994), and as of 1994, the higher the income group, the greater the burden reduction effect. Thereafter, the burden reduction rate for each income group has been on a declining trend, and the higher the income bracket, the greater the relative decline. As a result, as of 2019, the burden reduction effect of the deduction is similar for all income groups and has a proportional structure. Some prior studies have considered the impact of the burden reduction due to deductions on redistributive effects, such as how the burden reduction associated with deductions changes the effect of reducing income inequality through taxes. Under the current system, there is little contribution from deductions, and this arises from the fact that the burden re-

duction effect of deductions has a proportional deduction (Ohno et al. 2021, Ohno et al. 2022).

VI. Conclusions

This paper first introduces the development of microsimulation and research results on personal income taxation in Japan. We then use a microsimulation model based on household microdata from the NSFICW (1989-2019) to examine the actual situation regarding the burden structure of personal income taxation, taking advantage of the diversity of this method. In the following, we summarize the measurement results on households' tax and SIP burdens, redistributive effects, and the burden-reducing effects of deductions.

The overall burden structure for taxes and SIPs is progressive, and when viewed over time, the burden rate has generally increased for all income groups. However, a breakdown of the burden structure confirms that the income tax has become less progressive. These changes also appear in the redistributive effects. Over time, the redistributive effects of taxes and SIPs (the amount and rate of change in the Gini coefficient) have increased slightly, while the redistributive effects of taxes have decreased. The comparison of redistributive effects between time periods includes not only the effects of system changes, but also the effects of changes in income distribution and population composition. When we focus on the true contribution of system changes, we find that the redistributive effect of taxes and SIPs has declined over the past 30 years, and that this has been mainly due to the tax system. The structure of the burden reduction effect of deductions is also important in that it affects the structure of the tax burden, and it has recently been confirmed that the burden reduction effect of deductions is similar for all income groups and has a proportional structure.

In Japan, the Gini coefficient has increased over the past 30 years. This is partly due to the aging of the population, which is reflected in differences in the Gini coefficient between the elderly and the younger. On the other hand, the Gini coefficient for younger households alone is also on the rise, and restoring the redistributive function of income taxes is a policy issue. Since the progressivity of the income tax is affected not only by the tax rate structure but also by income tax deductions, we expect to see a discussion on how deductions should be made in order to restore the redistributive function of the income tax.

In recent years, as the promotion of Evidence-Based Policy Making (EBPM) has been called for, microsimulation can play many roles, such as estimating the introduction of policies and grasping the actual functions of the current system. In fact, studies dealing with microsimulation are increasing in Japan, but the depth of study results from both arithmetical and behavioral modeling approaches is still insufficient, and there is a need to expand the scope of the study in terms of content. For example, microsimulation study in Japan has focused on models that reflect only the burden aspect, and there are relatively few models that also reflect the benefit aspect. In addition, when considering reform proposals based on the tax and social security systems of other countries, it may be possible to provide important information by applying such systems to Japan's micro data and performing trial calcula-

tions. Microsimulation is also very effective in promoting EBPM, and it is hoped that it will provide new evidence through even wider use, while learning from the results of other countries where its use is progressing.

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Appendix: Methods of Estimating Revenue, Taxes and SIPs

This supplement explains the estimation methods for income, taxes and SIPs, respectively, covered in Section IV.

A.1 Method for Estimating Income Data

We used the annual incomes listed in the Annual Income and Savings Survey Questionnaire of the NSFICW for income data. Income is broken down into the following forms of income.

(1) Annual income from employer
(2) Income from agriculture, forestry and fisheries
(3) Business income from sources other than agriculture, forestry and fisheries
(4) Annual income from side jobs etc.
(5) Annual income from rent and land rent
(6) Public pensions and government pensions
(7) Social security benefits
(8) Income from corporate pensions
(9) Income from private pensions
(10) Interest and dividends
(11) Other annual income
(12) Remittance sent from relatives etc. (Prior to 2014 survey)

The Annual Income and Savings Questionnaire surveys the annual incomes of the head of the household, spouse of the head of the household, other household members under 65 years of age and those 65 years of age or over. However, for households with multiple persons in the other household members under 65 years of age and those 65 years of age or over, only the total value of income of all the household members in the respective categories can be known. For this reason, in these households, income from the above-mentioned categories is prorated according to the following rule:

First, in the case of income items (1)(2)(3)(6)(7)(8)(9), the annual income differs depending on the age and gender of the household member. Therefore, from the income of the head of the household and their spouse, for whom individual incomes are known, the average income is calculated by gender (male/female) and age bracket (15-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70+ years of age). Where there is more than one individual in the above-mentioned categories, the combined income is prorated to each household member according to the ratio of the average income calculated previously.

In the case of income items (4)(5)(10)(11)(12), where there are multiple individuals in the two categories, the annual income is prorated based on the number of members in the household. However, household members under the age of 15 are excluded from proration.

A.2 Method for Estimating SIPs

In estimating SIPs, we must first specify to which social insurance system each household member is enrolled. Regarding the public pension, health insurance, nursing insurance and employment insurance systems, we first inferred to which system each household mem-

ber is enrolled and then applied the actual premium calculation to estimate the burden.

A.2.1 Estimating Public Pension Premiums

Regarding the system of enrollment, household members whose annual income from employer is greater than the average wage of a part-time worker multiplied by 20 hours and 52 weeks are considered enrolled in the employees' pension insurance (No. 2 insured persons), those whose annual income is below a certain amount, (for example, less than 1.3 million yen in 2019) whose spouse is a No. 2 insured person are No. 3 insured persons, and all others are considered enrolled in the state pension (No. 1 insured persons). Additionally, household members under the age of 19 or over the age of 60 are principally not required to make pension contributions. However, those aged 70 and below that satisfy the income requirements to be No. 2 insured persons are considered enrolled in the employees' pension insurance.

In terms of premiums, No. 1 insured persons pay a fixed premium (for example, 16,410 yen per month in 2019, on an annual basis), and persons meeting the income criteria of the exemption system (full, three quarters, half or one quarter) always apply the exemption. For the No. 2 insured persons, the average premium rate for the employees' pension listed on the website of the Japan Pension Service is split between the employer and the insured, and the annual income from employer is multiplied by the premium rate after that split. We also considered the standard monthly value of employees' pensions and the maximum value of standard bonuses.

A.2.2 Estimating Health Insurance Premiums

Regarding the system of enrollment, household members aged 75 years and above are considered enrolled in the latter-stage of the elderly healthcare system (since 2009 survey following the introduction of the system). Those aged 74 and below enrolled in the employee's pension were considered enrolled for health insurance (employee insurance), while all others were considered enrolled in the national health insurance system. Additionally, where annual income is less than a certain amount (e.g., less than 1.3 million yen in 2019) and there are relatives cohabiting with a person enrolled in the health insurance (employee insurance), those household members are considered dependent on that health insurance (employee insurance).

Regarding the health insurance, the premiums for health insurance (employee insurance) are considered the insurance premiums of the Japanese Health Insurance Association listed on their website, split between the employee and employer, and the annual income from employer is multiplied by the premium rate following the split. The National Health Insurance premiums are calculated using the national average of levy on income, asset rate, per-capita rate, and per-household rate from the National Health Insurance Survey. We also considered the limit on the value of the national insurance premiums imposed, as well as the reduction system corresponding to the benefit rate. The premiums for the latter-stage of the elderly healthcare system used the national averages for per-capita income and income-based levies

listed on the Ministry of Health, Labour and Welfare website. We also considered the upper limits on payments in the latter-stage of the elderly healthcare system, as well as the reduction system for the income-based levy and per capita rate.

A.2.3 Estimating Long-term Care Insurance Premiums

The national average (weighted average) of base premiums for each prefecture listed in the Ministry of Health, Labour and Welfare website are applied to the insurance premiums for the No.1 insured persons (65 years old or over). The premiums for the No.2 insured persons (aged 40-64 years) are separated into those enrolled in the national health insurance system and those enrolled in employee health insurance. The national average for the income-based and asset-levy, per-capita rate and household rate for long-term care insurance premiums from the National Health Insurance Survey were applied to persons enrolled under the National Health Insurance. (However, due to the characteristics of the statistics used, this method has been applied since 2009 survey. Years previous to 2004 were estimated based on the sum of the health insurance premiums.) We also considered the limit on the value of the national insurance premiums imposed, as well as the reduction system corresponding to the benefit rate. For those enrolled in the employee health insurance, the national average premium rate recorded on the National Japan Health Insurance Association website was split between employee and employer, and the annual income from employer was multiplied by the premium rate following the split. We also considered the upper limit of the standard monthly income category and maximum standard bonus value for the employee health insurance.

A.2.4 Estimating Employment Insurance Premiums

Regarding the enrollment in employment insurance, employees whose annual income from employer exceeds a certain amount (e.g., the average wage for part-time workers multiplied by 20 hours and 52 weeks) were considered enrolled.

Regarding the insurance premiums, we applied the worker contribution rate for general businesses listed in the Ministry of Health, Labour and Welfare website (e.g., 0.3% in 2019), and multiplied the contribution rate by the annual income from employer.

A.3 Method for Estimating Income and Resident Tax Liability

To estimate income tax, we applied the actual tax system to the data on household attributes and income to calculate the value of the tax burden. Although the Income Tax Act classifies income into 10 categories, we used income available from the NSFICW, that is, the salary, business, miscellaneous and real estate income. Specifically, the income categories were classified as follows, and total income calculated.

Salary income = [(1) Annual income from employer] − Employment income deductions

Pension income = [(6) Public pensions and government pensions]

+ [(8) Income from corporate pensions]

− Public pension deductions
Business income = [(2) Income from agriculture, forestry and fisheries]
+ [(3) Business income from sources other than agriculture, forestry and fisheries]
+ [(4) Annual income from side jobs etc.]
Real estate income = [(5) Annual income from rent and land rent]
Total income = Salary income + Pension income + Business income + Real estate income

Taxable income is then calculated by subtracting various deductions from the total income. The deductions applied here are the basic, (special) spousal, dependent, elderly (up to 2004) and the social insurance premium deductions. The social insurance premium values estimated earlier were used for social insurance premium deductions. Note that deductions based on information not obtained from the questionnaire (e.g., disability deductions, medical expense deductions, special credits for home loans etc.) were not considered. Specifically, we calculated this as follows:

Provisional taxable income 1 = Total income − Basic deduction
− Social insurance premium deduction − Deduction for the elderly
Provisional taxable income 2 = Provisional taxable income 1 − Deduction for spouse
− Special deduction for spouse
Taxable income = Provisional taxable income 2 − Deduction for dependents

First, the value after subtracting the basic, social insurance premium and elderly deductions from the total income is considered provisional taxable income 1. The (special) spousal deduction is applied to the household member whose provisional taxable income 1 is higher within the couple, which is considered provisional taxable income 2. The dependent deduction is applied to the member with the highest provisional taxable income 2 in a household where there are members subject to the dependent deduction. This is then considered taxable income. Lastly, the marginal income and resident tax rate table is applied to that taxable income to estimate the income and resident tax liability. We also considered the fixed-rate tax credits (from 1994 to 2006), the adjustment tax credit (from 2007, only for resident tax), and the special income tax for reconstruction (from 2013).