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Abstract

The primary objective of this paper is to examine how and to what extent changes in income tax rates and income tax deductions affect income inequality from longitudinal perspectives, by using microdata from Japanese individuals and households. The findings of this paper could shed light on the effects of tax rates and tax deduction on tax progressivity. First, redistributive effects of the Japanese income tax are likely to decline for the period 1984–2009. Second, the income tax reforms, i.e., reduction in tax rates and increase in tax base, give rise to greater redistributive effects of income tax rates and lower redistributive effects of tax base. Third, progressivity measures show the same trends with respect to the redistributive effects of tax changes on pretax income over the period.

Keywords: Income taxation, redistribution, tax deduction, tax rates
JEL classification: D3, H2, H24

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1. Introduction

Numerous researchers have conducted empirical studies to investigate the redistributive effects of income taxation across countries or year ranges, using microdata at the individual or household level (e.g., Bishop, Chow, Formby, & Ho, 1997; Bishop, Formby, & Zheng, 1998; Dandanoni & Lambert, 2002; Kakwani, 1974; Kasten et al., 1994; Lambert, 2001; Lambert & Thorensen, 2009; Thorensen, 2004). It is well known that the 1980s and 1990s tax reforms in Organization for Economic Co-operation and Development (OECD) countries led to substantial cuts in marginal tax rates and changes in income tax deduction thresholds (e.g., Bishop et al., 1997; Lambert & Thorensen, 2009). In empirical studies, researchers have examined the relationship between taxation reforms in the periods and the extent of redistribution in income taxes for Western countries, such as the United States (Bishop et al., 1997; Kasten et al., 1994), Norway (Lambert & Thorensen, 2009; Thorensen, 2004), Sweden, and the United Kingdom (Bishop et al., 1998). Similarly, in the 1987 and 1989 fundamental tax reforms in Japan there were large cuts to the marginal tax rates, in particular for those in the top income bracket, and an increase in income tax deductions (e.g., Ishi, 2001). In contrast to the case of Western countries, however, the redistributional effects of Japanese income tax reforms have rarely been examined using microdata at the individual or household level.[3] Although there exists a small number of empirical works concerned with income redistribution in Japan, they are primarily focused on the trend of posttax income inequality and inequalities arising from intergenerational transfers between the young and the elderly (e.g., Fukawa & Oshio, 2007; Oshio, 2006). Further, to the best of our knowledge, in studies concerned with tax reforms in Western countries researchers have not addressed how income tax rates and tax deductions each have distinct impacts on posttax income inequality.

The primary objective of this paper is to conduct a longitudinal study of how and to what extent changes in income tax rates and income tax base affect income inequality, using microdata from Japanese individuals and households. We used data sourced from the National Survey of Family Income and Expenditure (NSFIE) from 1984–2009, collected by the Ministry of Communication and Internal Affairs (MIC). We estimated the magnitude of redistribution caused by changes in tax rates and tax base by applying each year's tax law to earnings and computing income, taxable income, and after-tax

[3] Exceptions are Kitamura and Miyazaki (2012, 2013), who examined the same microdata used in the current research to determine to what extent Japanese tax reforms alter distribution of income and income inequality. However, in this study they do not distinguish between the effects of tax rates and of tax deduction.

income, taking into account household characteristics. The Reynolds–Smolensky (RS) and the Blackorby–Donaldson (BD) indices were employed as measures of inequality. Among progressivity measures that have been developed for substantial and strict evaluation of the progressivity of a tax system, the RS index is used to measure tax progressivity by comparing the distribution of pretax income to that of after-tax income; that is, by observing the disparity in the income shares of taxpayers in order of income. Pfahler (1990) and Lambert (2001) also showed that the RS index can be precisely decomposed into tax rate effects and tax base effects. This sort of measure, based on quantile share information, relies on there being no reranking of property, referring to the concentration coefficients for pretax income with respect to posttax or taxable incomes.[4] Under the Japanese personal income tax system the reranked property does not hold because tax bases are determined not only by pretax incomes but also by demographic composition of households and incomes of the individuals in a family. We then developed the modified RS indices, in the form of Gini coefficients employed as redistributive measures with respect to taxable and posttax incomes, to eliminate the influence of reranking. In contrast, the BD index is used to measure progressivity as the proportionate increase in equality relative to the initial level of equality, based on social welfare function reasoning. Because both indices have a wide range of disparity in terms of evaluation of inequality, this study we used both of these indices.

Further, in assessing tax policies from an intertemporal perspective, it is of great interest to isolate the effects of tax policies to obtain a better understanding of the driving forces behind pretax and posttax income inequalities. As a way to determine pretax income in this paper we adopted the “fixed income” approach, in which the distribution of pretax income at a base year is exposed to various tax laws in a given period of time, to determine exogenous income. However, the fixed income approach has some drawbacks, such as instability in inequality measurement (e.g., Lambert & Thorensen, 2009), so to improve the robustness of our results we also adopted the transplant-and-compare procedure developed by Dandanorni and Lambert (1992).

The primary contribution of this study is our assessment of the redistributive impacts of income tax rates and tax base using individual and household microdata. In a number of empirical studies researchers have attempted to find the association between tax reforms with declining progressivity and the redistributive effect of income taxation, by

[4] Refer to Lambert (2000) and Cowell (2011) for an introduction to the concept of rerankings in relation to inequality measures.

measuring the disparity of alternated income distributions between pretax and after-tax incomes (e.g., Bishop et al., 1997; Lambert & Thoresen, 2009; Thoresen, 2004). However, despite the fact that changes in tax deduction, as seen in tax reforms of the OECD countries in the 1980s and 1990s, and in tax rates are expected to have an effect on progressivity, no study has been aimed at distinguishing the redistributive effects of tax rates from those of tax base, caused by tax reforms in the period. It may be that both wider tax deductions and lower tax rates in each income bracket have a negative impact on tax progressivity. It is, however, difficult to determine in advance the effects on the redistributive effects of tax schedules of such a seemingly less progressive tax reform, because these effects also depend on the shape of income distribution. For example, under uniform income distribution no redistributive effects are reported as a result of progressive tax schedules because they are measured using standard inequality measures such as the modified RS index and the BD index. This paper then explores the redistributive effects of tax rates and base on the basis of progressivity measurements such as the RS and BD indices, using the aforementioned microdata. By including in our sample the major Japanese tax reforms over the period 1984–2009, and associated large variations in marginal tax rates and tax deductions, we ensured the robustness of calculations of tax progressivity.

Another contribution of this study is that we addressed progressivity effects of tax rates and base from the various perspectives of tax progressive measures and income distribution. To attain consistent estimates of such measures, as stated above we employed progressivity measures and rectified the inequality indices to take into account rerankings in income distribution. In addition, to deal with variations in income distribution over time, which are likely to result in a false measurement of progressivity, we used the fixed income approach. In this approach pretax income is fixed at the base year the transplant-and-compare method is carried out to improve the robustness of results. In relation to longitudinal comparisons, in particular, the inclusion of several base years of pretax incomes in the fixed income approach has significant effects on the assessment of redistributive measures.

We obtained three main findings from our review of the literature. First, the redistributive effects of the Japanese personal income tax declined between 1984 and 2009. Empirical researchers found that the redistributive effects of personal income tax did not change after tax reforms in the 1980s and 1990s in OECD countries including Sweden, the UK, and the US (Bishop et al., 1997; Kasten et al., 1994), but they did

decrease after the tax changes in the 1990s and 2000s in Norway (Lambert & Thoresen, 2009; Thoresen, 2004; Thorensen et al., 2011). In contrast, Japanese income tax reforms in the 1980s–2000s led to there being fewer redistributive effects on personal income taxes.

Second, the reduction in tax rates and increase in tax base resulting from income tax reform gave rise to greater redistributive effects of income tax rates and lower redistributive effects of tax base. The reduced redistributive effects from changes in tax base are in line with the logic that a uniform tax base reduction for all taxpayers is associated with less progressivity. It is, however, a surprising result that during the periods 1984–1989 and 1994–2004, the redistributive effects of tax rates increased despite the lower marginal tax rates for each income bracket resulting from the income tax reforms. This result is primarily attributable to the equalizing effects of tax rates, which rely on changes in tax base and are computed by comparing inequality measures of taxable income and posttax income. The declining tax bases brought about more unequal taxable income distribution, with the redistributive effects of tax rates being more progressive. When assessing the progressive impacts of tax reforms in terms of tax rates and tax base using the Gini-based inequality measures, it should be noted that changes in tax base as well as those in tax rates influence progressivity. In addition, smaller marginal tax rates for low taxpayers after the tax reforms and a somewhat less progressive property in high income taxpayers before the tax reforms in the periods 1984–1989 and 1994–1999 weakened the regressive impacts of the tax reforms.

Third, progressivity measures show identical trends when compared across approaches concerned with the determination of pretax income. The evaluation of tax reforms from the perspectives of redistribution is known to depend on the choice of inequality measures and the employed parameters for such measures, including Gini-based indices and Atkinson inequality-based indices (e.g., Lambert & Thorensen, 2009). Moreover, the method of choosing pretax income—the actual income, the fixed income approach, and the transplant-and-compare approach—and the selection of the base year income for the fixed income approach are closely related to tax progressivity outcomes (Kasten et al., 1994; Lambert & Thorensen, 2009). This improves the reliability of our analyses of the inequality measures and the substantially identical results we obtained. Results from the RS index and the two BD indices with the Atkinson inequality measures of 0.25 and 0.75 follow the same trends, although the amounts differ. Attaining consistent estimates from several sorts of tax progressivity measures and definition of pretax

income enhances the reliability of the results.

2. Japanese Personal Income Taxation and Calculation of Incomes

2.1 Japanese Income Tax and Its Reforms

In 1949, after World War II, the modern Japanese tax system was established by a tax mission headed by Carl S. Shoup, with the aim of establishing a stable and permanent tax system that centered direct taxes. One of the features of the Japanese tax system was that there was a strong reliance on direct taxes, mainly income taxes from individuals and corporations. In 1995, for example, 36.6% of total tax revenues in Japan were collected from income taxes, which is smaller than that in the USA (45.8%) and the UK (36.9%) but larger than in other European countries including France (17.6%) and Germany (30.1%) (Ishi, 2000).[5] This tendency toward heavy dependence on income taxes was stronger before 1990 because of the nonexistence of consumption taxes and greater tax burden on incomes.[6] In recent years, the ratio of consumption taxes to total taxes has increased because of the increase in consumption tax rates and the declining tax burdens on individual and corporate income taxes. In the 1970s and the 1980s, issues such as bracket creep caused by inflation and horizontal inequality in taxation on interest receipts became apparent. To deal with these issues, the Japanese government conducted fundamental reforms of the tax system in 1987 and 1989.

Insert Figure 1 about here

The Japanese income tax reforms in the 1980s and the 1990s resulted in lessened marginal tax rates, which are close to those of other developed countries, and increased tax deductions and exemptions, which causes a decline in the tax base. The income tax rates in every income bracket have been decreasing since the first half of the 1980s, and those for the highest income bracket, in particular, have dropped considerably. In the 1980s, there was a criticism that high income tax rates relative to other developed countries caused deterioration in the economic efficiency of Japanese firms and individuals (e.g., Ishi, 2000). Furthermore, the inflation that had prevailed over developed counties—including Japan—in the 1980s brought about a bracket creep problem, that is, an increase in income tax rates resulting from changes in the upper income tax bracket, via inflated nominal income. Figure 1 depicts marginal tax rates against taxable income for 1980, 1990, 2000, and 2010. As can be seen, the top income tax rates decreased over the period except for 2010 and at the same time, to cope with

[5] National and local taxes and social security contributions are included in the total tax revenue.
[6] According to the Ministry of Finance (2000), in 1990 70.7% of total national tax revenue came from income taxes, compared with 60.5% in 1995.

the bracket creep problem, the width of each bracket was enlarged.[7] In effect, one of the objectives of the tax reform was to widen the brackets for the medium income group to reduce the tax burdens stemming from bracket creep. In practice, by introducing the general consumption tax in 1989, the total income tax liabilities were reduced by declining income tax rates and increased tax deductions and exemptions, so the total tax burden for individuals remained unchanged.

Insert Table 1 around here

Moreover, there was an increase in income tax deductions and exemptions between their introduction in the early 1980s, and the early 2000s. Deductions of Japanese income tax mainly comprise casualty losses, medical expenses, social insurance premiums, life insurance premiums, fire and other casualty insurance premiums, earthquake insurance premiums, and donations. Exemptions comprise those for widows or widowers, working students, the disabled, dependents, spouses, special exemption for spouses, and basic exemption.[8] In the 1980s and 1990s, the deductions and exemptions increased and new types of deductions and exemptions were created to lessen income tax liabilities. Specifically, the 1989 reduction in income tax was aimed at compensating for the increased indirect tax burden through creation of the 1989 consumption tax. During the fundamental tax reforms in 1987 and 1989, almost all deductions and exemptions that existed at the time—including basic exemption and exemption for spouses, dependents, and the disabled—were enlarged, and several exemptions—including those for the young (aged 16–22) and the elderly, and special exemption for spouses—were created. In addition, because the 1995 tax reform also enlarged tax exemptions, in the 1980s and the 1990s taxable income—defined as income after withholding deductions and exemptions, or tax base—greatly reduced. Although it seems that the reduction in income tax deductions and exemptions lessens the progressivity of the income tax schedule, thus far few researchers have addressed this relationship.

2.2 Calculation of household income from microdata

In this study we employed microdata of Japanese individuals and households from the National Survey of Family Income and Expenditure (NSFIE) provided by Ministry of

[7] After 1989 the number of brackets for each income tax rate fell from 12 notches to 5.

[8] Special exemption for spouses is aimed at lessening income tax liabilities for salaried workers who have a nonworking spouse. Part of the special exemption was abolished in 2004 because it was determined that it provided incentives for spouses not to work.

Internal Affairs and Communication (MIC).[9] The NSFIE is a sample-based survey conducted every five years, comprising information on earnings, marital status, sex, age, job, and type and status of employment.[10] The demographic attributes are stored separately for each member of the household. The earnings of household members except for the head of the family and his/her spouse are aggregated as earnings for members aged 65 or over and those aged 64 or under. In some cases, it is difficult to match each member's properties with their earnings. Therefore, we matched as many members' demographic attributes and earnings as possible and eliminated from the sample households in which members' incomes were not able to be precisely identified.[11] The following earnings were included in the sample: salaries,[12] agriculture and fishery business, business other than agriculture and fishery, on-the-side jobs, pension and retired income, and housing and land rent. Earnings from interest and dividends were not taken into account because reports of these income sources are somewhat inaccurate in the NSFIE. We also excluded captive uses from agricultural and fishery products and owner-occupied house, because of difficulty in assessing of them.[13]

Each member's earnings, income, taxable income, and tax burdens were calculated for all households, according to the following steps. First, income is defined as earnings minus either costs (for business revenue) or deductions for salaries (for wage income). Employment income is income derived from salaries, wages, bonuses, and allowances. Second, taxable income is calculated by subtracting income tax deductions and exemptions from income. Tax deductions and exemptions taken into account in the current study include medical expenses, social insurance premiums, life insurance premiums, fire and other casualty insurance premiums, exemptions for working students,

[9] The NSFIE comprises few microdata from low income individuals when compared to other individuals in Japan, based on data collected using measures such as the Comprehensive Survey of Living Condition (CSLC) and the Survey on Income Distribution (SIR). Specifically, multiperson households with earnings lower than 2 million yen (approximately US$20,000) represent only 3% of those included in the NSFIE and single-person households in that bracket represent 10%, compared to a result of 19% from the CSLC in 2004. This means that inequality measures of the market income from the NSFIE tend to be lower relative to those gained from CSLC, but the measures from both microdata exhibit a similar downward trend.

[10] Consumption of specific items and holding properties was also surveyed.

[11] When matching the data, we made use of employment status data for identification purposes. For example, if only one employee aged 64 or under, or 65 or over exists in a household, then we were able to identify the source of earnings in the household.

[12] For employees, allowances for dependents, child benefits, and housing benefits are included in salaries.

[13] Several researchers do not include imputed income data from own-houses. Lambert and Thorensen (2009), for example, excluded from their sample taxable returns from housing investment owing to the issue of the undervaluation of imputed income from owner-occupied homes. Further, Bishop et al. (2004) used tax returns data for audited taxpayers without consideration of imputed rents from housing.

spouses, and dependents, special exemption for spouses, and basic exemption.[14] Total deduction is determined by summing up amounts of deductions and exemptions for each household on the basis of the household's characteristics and tax laws of the corresponding fiscal year. Third, tax liabilities for the head of each household are calculated by multiplying taxable income by progressive income tax rates. In the light of the purpose of this study—that is, examining the redistributive effects of tax rates and tax base—tax credits were not calculated here.[15]

To accurately compare different sized households, income was measured using an equivalent scale. Taking into account economies of scale in households, household income was divided by the square root of the number of household members (including children). After-tax income and taxable income were also adjusted using an equivalent scale. Trends in earnings and income were adjusted by growth rate, calculated by dividing total annual earnings by the corresponding annual earnings in the standard year.[16] Meanwhile, in order to make the tax systems comparable across the various years, the same normalization was applied to the thresholds of income brackets and tax deductions and exemptions in each year.

It is widely recognized that tax changes intrinsically accompany behavioral responses in several respects (e.g., Slemrod, 1992, 1995). The first is timing effects in receiving income. Thorensen et al. (2011), for instance, found that the temporary taxation on dividends in 2001 dropped dividend payments, and dividend payments rose steadily from 2002 onward. Timing effects problems, however, are especially serious for incomes that can readily be manipulated, such as dividends and capital gains. This is not a significant problem in this study because financial incomes were excluded. The second aspect, which is partly related to the first, is fiscal manipulation in the form of income shifting (e.g., Gordon & Slemrod, 2000; Slemrod, 1995). Yashio (2006) revealed that for self-employed workers, tax avoidance through wage payments for family members are associated with marginal tax rates in Japan. Therefore, in this study we split the sample into two groups—those one with only self-employed workers as head of family and others—and estimated inequality for both samples. The third aspect is tax evasion, a problem that is inherent to all empirical works aimed at exploring

[14] Deductions such as those for earthquake insurance premiums and donations, and exemptions for widows or widowers, and for the disabled, were excluded from calculation of income deduction, owing to inherent restrictions such as data availability and difficulty in measuring amount of deduction for each household.
[15] Local taxes for personal income are also not included in the tax liabilities.
[16] The standard year is defined as 2004 in this study.

income inequality by using microdata from households or individuals. For the current paper, however, tax evasion issues may be irrelevant because our survey data were sourced of households, not tax returns. In addition, analysis of only wage workers can eliminate the influence of tax evasion, in that Japanese personal income taxpayers with wage earnings under 20 million yen (approximately US$0.2 million) are required to follow the system of tax withholding at source, where personal income taxes are withheld prior to payment by the firm that employs them.

3. Measurement of the Redistributive Effects of Tax Rates and Base

We first calculated the RS and BD indices, and then evaluated the equalizing effects of tax scheme, tax rates, and tax base. With regard to the decomposition of overall redistribution effects into rate and base effects, we used the methodology shown in Pfahler (1990) and Lambert (2001, ch. 8) to compute the contributions to progressivity of the tax rates and deductions. It is assumed that for each $p \in (0,1)$ there is just one pretax income y with rank $p = F(y)$, where $F(y)$ is a distribution function of pretax income x. Because the Gini coefficient is a measure based on the Lorenz curve, Lorenz curves relating to this analysis are defined as:

$$p = F(y) \Rightarrow L_X(p) = \int_0^y \frac{xf(x)\mathrm{d}x}{\mu},$$

$$p = F_{X-T}(y-t) \Rightarrow L_{X-T}(p) = \int_0^{y-t} \frac{vf_{X-T}(v)\mathrm{d}v}{\mu(1-g)},$$

$$p = F_{X-D}(y-d) \Rightarrow L_{X-D}(p) = \int_0^{y-d} \frac{wf_{X-D}(w)\mathrm{d}w}{\mu(1-\delta)}$$

where $f(x)$ is a density function, μ denotes mean pretax income, and g denotes overall average tax rate. Then $L_X(p)$ indicates the Lorenz curve for pretax income. $F_{X-T}(v)$ and $f_{X-T}(v)$ are, respectively, the distribution and density functions of posttax income $v = x - t(x)$, and L_{X-T} is the Lorenz curve for posttax income. The same argument holds for gross income net of deduction: That is, $F_{X-D}(w)$ and $f_{X-D}(w)$ are the distribution and density functions of the tax base $w = x - d(x)$. δ denotes the average rate of deduction d/μ, and L_{X-D} is the Lorenz curve for taxable income.

The Gini coefficients for pretax income, posttax income, and income net of tax deduction can be expressed in terms of the Lorenz curves defined above:

$$G_X = 1 - 2\int_0^1 L(p)\mathrm{d}p,$$

$$G_{X-T} = 1 - 2\int_0^1 L_{X-T}(p)\mathrm{d}p,$$

$$G_{X-D} = 1 - 2\int_0^1 L_{X-D}(p)\mathrm{d}p,$$

where G_X is the Gini coefficient for pretax income, G_{X-T} the Gini coefficient for posttax income, and G_{X-D} the Gini coefficient for income net of deduction. From the definition of the RS index, versions of the RS index in terms of tax burdens and tax deductions are expressed as:

$$\Pi^{\mathrm{RS}} = G_X - G_{X-T},$$

$$\Pi_R^{\mathrm{RS}} = G_{X-D} - G_{X-T},$$

$$\Pi_D^{\mathrm{RS}} = G_X - G_{X-D},$$

where Π^{RS} is the RS index that measures the redistributive effects of overall tax burdens on income inequality, taking into account reranking after taxation. Π_R^{RS} is the RS index that measures the redistributive effects of tax rates. Π_D^{RS} represents the progressivity of income tax in the light of changes in tax deductions. The definitions of these indicators slightly differ from those based on standard concentration coefficients because the Gini coefficients were adopted as the indices to measure distribution after changes in tax schemes.

As shown in Lambert (2001, ch. 8), usually the overall RS index is defined in terms of the separation of the coefficients G_X and C_{X-T}, the concentration coefficient for posttax income, preserving the ranking of taxpayers equal to that in pretax distribution. However, the no reranking assumption does not hold for the Japanese income taxation, for deductions and exemptions are determined taking into account elements other than earnings, such as characteristics of household members. Therefore, to deal with this problem, in this study we quantified the equalizing effects of tax schedules in terms of its impact on the Gini coefficient, as shown above. Using such modified RS indices, the term capturing the negative contribution of reranking emerged as the difference between the Gini coefficient and the concentration coefficient for posttax income, which is expressed by $G_{X-T} - C_{X-T}$. We then evaluated the extent of the reranking effects by calculating the difference mentioned above, for every modified RS index. The reranking effects become positive by the definition of the concentration coefficients, as seen, for example, in Theorem 2.2 of Lambert (2001); the larger effects can be interpreted as frequent occurrence of reranking. It also seems that more rerankings arise from complicated tax schedules with tax liabilities being dependent on elements other than

income.

The BD index proposed by Blackorby and Donaldson (1984) is also used in this analysis:

$$\Pi^{\mathrm{BD}}(e) = \frac{I_X(e) - I_{X-T}(e)}{1 - I_X(e)},$$

$$\Pi_R^{\mathrm{BD}}(e) = \frac{I_{X-D}(e) - I_{X-T}(e)}{1 - I_{X-D}(e)},$$

$$\Pi_D^{\mathrm{BD}}(e) = \frac{I_X(e) - I_{X-D}(e)}{1 - I_X(e)},$$

where $I_X(e)$ represents the Atkinson index for pretax income, with a constant-inequality-aversion parameter e. Π^{BD} indicates the percentage increase in income equality resulting from overall tax reform, where equality is measured as (1 – inequality). Equally, Π_D^{BD} and Π_D^{BD} indicate the percentage increase or decrease in equality caused by change in tax rates and change in tax base, respectively.

As stated in the literature, the degrees of changes in redistributional effects through tax reforms across time are not only explained by the tax reforms themselves, but also changes in income distribution (e.g., Lambert, 2001). Because income distribution is subject to income, consumption, family characteristics, and demographic composition in society, it is difficult to precisely evaluate the effects of tax reforms on posttax income distribution and tax progressivity by using the actual pretax income. To isolate the effects of tax policy changes alone, we adopted the fixed income approach proposed by Kasten et al. (1994).[17] That is, we applied each year's tax law to a sample of families in a single year, to fix income, characteristics of families, and demographic composition.

The fixed income approach is considered better than that applied to actual incomes. It is, however, pointed out that the outcomes of this approach vary according to the adopted base year of the income. Lambert and Thorensen (2009), for example, stated that the criterion that results should not be sensitive to the choice of the base year when applying a methodology in order to rank tax progressivity effects of schemes, means that the fixed income approach is not adequate for this sort of analysis. Instead, they proposed using a transplant-and-compare (T-C) procedure developed by Dardanoni and

[17] Thorensen (2004) also applied the fixed income approach to explore the change in tax progressivity in Norway in the 1990s.

Lambert (2002), in which posttax distribution is compared to a common regime by correcting for any pretax distributional changes that may have happened across the period. Lambert and Thorensen (2009) also mentioned that the fixed income approach yielded unreasonable results in the application for the Norwegian tax reform, is difficult to apply, and requires information with respect to tax changes. Therefore, we also applied the T-C procedure to the Japanese tax reforms in order to examine robustness of this analysis.

However, in this paper we mainly refer to the results found using the fixed income approach rather than those found using the T-C procedure from the following reasons. First, unlike the previous studies in which the T-C procedure was adopted,[18] the pretax income distribution may not follow an isoelastic distribution, such as lognormal. As Lambert and Thorensen (2009) mentioned, the key assumption that has to be satisfied when the T-C procedure is conducted is that the base pretax income distribution differs from others only in location and scale isoelastically, with regard to logarithms. For example, they regressed the log of the gross income of Norway in the base years—1992, 1998, and 2004—on those in the remaining other years, and found that the goodness of fit of the regressions (R^2) is significantly high, with the majority over 0.95. In the current work less than one third of R^2 values for the regressions in each base year are over 0.95, and some of them are below 0.90, meaning that the assumption of isoelastic distribution is not satisfied. Second, deficits in the fixed income approach do not affect this analysis. Because we developed a calculation procedure for Japanese personal income tax schemes over every individual year, the application of the fixed income approach to our data is relatively easy. Moreover, using the fixed income approach we obtained an identical pattern of results from the income data of different base years, meaning that the issue of greatest concern with regard to this approach—the sensitivity of outcomes to the choice of the base year—did not arise in this case. It follows that while focusing more on the estimation results obtained by using the fixed income approach, we took into account the results from T-C procedure as well with the aim of determining more reliable implications of the progressivity effects of tax reforms.

4. Data

Descriptive statistics and basic measures for income inequality from 1984 to 2009 are provided in Table 2. In terms of descriptive statistics, mean income changed only slightly during the period, but standard deviation increased by 35%. Specifically,

[18] See, for instance, Lambert and Thorensen (2009) and Thorensen et al. (2011).

standard deviation rose rapidly in the period 1984 to 1989, during the implementation of the fundamental tax reform and a reduction in the tax rates for those in the top income bracket and enlargement of tax deduction. The same trends from an intertemporal perspective were observed with regard to inequality measures. Median income fell in this period, and there was a notable increase in inequality. In particular, the squared coefficient of variation (SCV), the Theil index (TI), and the two Atkinson indices (AI) increased by more than 80%. Concerning the specific percentiles of income, P10 declined but P90 increased, leading to an increase of P90/P10. These statistics reveal an increasing income inequality from 1984 to 2009.

Insert Tables 2, 3, and 4 about here

Table 3 presents the same statistics as Table 2, but in terms of taxable income. Similar to income, mean and median taxable incomes did not change in the period, but inequality measures increased, though less rapidly than income. Specifically, SCV, TI, and the two estimates of AI increased by more than 50%. Because the growth rates of the median and the mean logarithmic deviation (MLD) are negative, the extent of the increasing inequality could possibly be weak for taxable income compared with income. Table 4 also shows the after-tax income trends were close to those in Table 2 and 3. That is, mean and median values for after-tax income remained almost the same over the period, while inequality measures became larger more precipitously than income and taxable income. SCV, TI, and the two measures of AI more than doubled, and furthermore, the maximum and P90/P10 grew by approximately 150%. The swiftly increasing trend in posttax income may indicate that in addition to an increasing inequality in the pretax income, the redistributive effect of income tax schemes tends to be less progressive.

5. Results

5.1 Basic results

Insert Table 5 about here

Table 5 presents the redistributive effects of income tax rates and tax base, evaluated by the RS and BD indices, and the reranking effects between 1984 and 2009. In this analysis, each year’s tax law is applied to the same year’s pretax income, so it is probable that factors other than changes in tax law influence the magnitudes and signs of inequality measures. In the light of the growth rates from 1984 to 2009, in the rightmost column of Table 5, the overall RS index was found to decline by 25% during

the period. We also noted the growth rates of the RS indices in 1984–1989, 1994–1999, and 2004–2009 because there were significant income tax changes for tax rates and deductions in these periods. The growth rates of 1984–1999 and 1994–1999 were negative, but those of 2004–2009 were positive. Explaining this result is difficult because income tax rates and base altered at the same time, and both changes influence tax progressivity. Tax rate effects for redistribution exhibited unexpected results. Throughout the period tax rate effects declined, whereas despite the fact that tax rates in each threshold—including the top tax bracket—decreased in 1984–1989 and 1994–1999, the redistributive effects of tax rates increased during the periods. In contrast, in 2004–2009 rate effects dropped with increasing tax rates in every bracket. The redistributive effects of tax base fell in 1984–1989 and 1994–1999, but rose in 2004–2009. This pattern of changes in tax base effect can be explained by the reduced tax bases in the former two periods, and by an increased tax base in the latter. The growth rates of the BD indices are inconsistent with those of the RS indices, sometimes having the opposite sign. From these results, it can be inferred that some parts of the variation in inequality measures result from that in income, not in taxation. In other words, redistributive measures aimed at determining the progressivity effects of tax reform are likely contaminated by other factors such as economic trends and household composition. Therefore, we may not be able to place strong reliance on the results obtained above.

Insert Table 6 about here

We then use the fixed income approach developed by Kasten et al. (1994), who presented this procedure to understand the redistributive effects of US tax reform between 1980 and 1993. Table 6 provides the progressivity measures and trends in tax progressivity between 1984 and 2009, which were calculated by applying 1984–2009 tax laws to 1984 income. The total of each annual inequality index declined gradually until 2004, then increased slightly in 2009. In terms of the 1984–2009 growth rates, the RS indices and the two kinds of BD indices—corresponding to $e = 0.25$ and $e = 0.75$—have the same signs in every category of measures—negative trends in total and tax base effects and positive trends in rate effects—although the sizes vary. The total effects have the same signs as before, but the signs of tax rate and base effects change inversely compared with the estimates in Table 5. For the 1984–1989 and 1994–1999 periods, the overall RS and BD indices declined with changes into lower marginal tax rates, but in 2004–2009 the indices rose for higher or the same tax rates in

each income bracket. For 1984–1989 and 1994–1999 the RS and BD indices of tax rate effects increased despite the reduction in marginal tax rates in each income bracket during these periods. This result is surprising because lower marginal tax rates in each income bracket are usually expected to yield weaker tax progressivity, or less redistribution for posttax income. This counterintuitive result is primarily related to the changes in tax base which were carried out simultaneously with a reduction in tax rates. In contrast, larger tax deductions and exemptions—yielding a smaller tax base—for 1984–1989 and 1994–1999 reduced the RS and BD indices. The findings are intuitive relative to the tax rate effects because the equal amounts of shrinking in tax base for all taxpayers yield larger tax burdens for poorer income earners to total income, leading to the stronger redistributive effects of tax base. Further, the reranking effect measures show that total frequency of rerankings decreased but the rerankings for tax base increased. This indicates that from a horizontal equality perspective inequality became much less common.

Insert Tables 7–11 about here

With regard to the estimation of progressivity measures that are derived from applying 1984–2009 tax laws to an income in the base years—1989, 1994, 1999, 2004, and 2009, Table 7 presents the trend in inequality measures when 1984–2009 tax laws are applied to 1989 income. Further, Tables 8, 9, 10, and 11 present the results of the measures applied to incomes from 1994, 1999, 2004, and 2009. As can be seen in Tables 7–11, for all indices total redistributive effects and tax base effects fell throughout the period. However rate effects were greater, meaning that the redistributive effects of income tax schemes became less effective because of changes in the base effects toward more regressive ones, with tax base shrinking over the period. Regarding the growth of progressivity measures in each period, the RS and both BD indices shown in Tables 7–11 demonstrate that in the periods 1984–1989 and 1994–1999, the equalizing effects of tax rates improved after major marginal tax rate reduction, but such effects of tax base worsened after the expansions of tax deductions and exemptions. These surprising findings are consistent with those in Table 6. Further, the three indices indicate that from 2004–2009 rate effects declined but base effects rose, implying that an increase in tax rates in the term negatively affected the equalizing effects of tax rates, whereas a reduced tax base—i.e., increased tax exemptions—has a positive impact on base effects. This result is also counterintuitive, although consistent with the results obtained in the previous estimation of this article. The growth rates of reranking effects in these

analyses are also the same as those shown in Table 6, i.e., a negative trend in relation to total effects and positive trend in relation to base effects.

In summary, by using the fixed income approach, we found that for all indices the total redistributive effects decreased between 1984 and 2009, while over that period the trends in tax rate and base effects varied across the approaches to determine pretax income. Moreover, after the tax reforms toward lower marginal tax rates and smaller tax base the redistributive effects of tax rates were enhanced, but those of tax base were weakened. This is surprising and counterintuitive, though the latter is intuitive from the perspective of taxation and inequality measures. In addition, the trends in the RS index and the two BD indices have the same direction among the selected base years of the fixed income approach, except for the 1984–1989 growth rates of the total BD indices with 2004 and 2009 incomes. This fact could enhance the reliability and robustness of this study, as it is frequently pointed out that the outcomes of inequality measures and their trends vary by selected measures and approaches to determine pretax income (e.g., Lambert & Thorensen, 2009).

The obtained results revealed that when the tax reforms followed personal income tax rates and at the same time increased tax deductions and exemptions, total redistributive effects of tax scheme lessened, the corresponding effects of tax rates dropped, and the effects of tax base rose. This result is counterintuitive because decreasing marginal tax rates usually accompany a weak redistribution effect on posttax income, although it is intuitive from the perspective that larger uniform tax deductions, i.e., a smaller tax base, for all taxpayers lessen the redistributive effects of tax base. The unexpected outcomes could be explained by the uniform reduction of tax base for all taxpayers, which puts larger tax burdens on low income earners in terms of total income, with taxable income distribution being more unequal. Such an inequality in distribution then reduces the effectiveness of the equalizing effect of tax rates.[19] Thus, the decreasing tax base caused by expanding tax deductions and exemptions gives rise to stronger progression effects of tax rates. This logic could hold for changes in tax scheme in the periods 1984–1989, 1994–1999, and 2004–2009.

Insert Table 12 about here

[19] This phenomenon can be readily imagined from the fact that a uniform income distribution generates no redistribution, leading to no tax progression even if the tax schedule is progressive, whereas a greater income inequality brings about larger tax progression.

In addition, in the periods 1984–1989 and 1994–1999, smaller marginal tax rates for low taxpayers after the tax reforms and a somewhat less progressive property in high income taxpayers before the tax reforms seemed to weaken the regressive impacts of the tax reforms aimed at lowering tax rates in each bracket and shrinking tax base. This point can partly be explained by Table 12, which shows the marginal tax rates in each percentile as 1984–2009 tax laws are applied to 1984, 1994, and 2004 incomes. For every part of income, in 1984–1989 the marginal tax rates of P10, P25, P50, and P75 fell with large reductions being for lower percentiles. This downward tendency is not prominent for the period 1994–1999. In contrast, despite the top tax rates declining according to the statutory tax rates, tax rates of P95 did not drop for the 1984 and 2004 incomes, suggesting that a number of high income earners had not faced lower marginal tax rates at margin even after changes in the tax rates. This feature means that the progressivity of the 1984 personal income tax was substantially lower in spite of the high statutory tax rates shown in Figure 1, because these extremely high tax rates were actually not applied to anybody. As a result, the large scale tax reforms in the late 1980s possibly did not lessen the redistributive effects of tax rates, but, rather, strengthened its equalizing power. Because the Japanese income tax reforms were aimed at reducing both tax rates and tax base at the same time, vice versa, this argument holds for the tax changes in the periods 1994–1999 and 2004–2009.

5.2 Transplant-and-compare procedure

As mentioned in Section 2, the fixed income approach may be inadequate for this analysis. Therefore, we applied the T-C procedure to the income data for Japanese households, to test the tax progressivity effects and check robustness. Because the inequality measures obtained from applying the fixed income approach seem to demonstrate the almost identical pattern for every year's income, we employed the household income data from 1984, 1994, and 2004. To ensure that the T-C procedure is valid for the current analysis, it must be assumed that pretax income distribution is isoelastic, or has a property of base independence, as in Dandanoni and Lambert (2002) and Lambert and Thorensen (2009). We then assumed that isoelastic property pretax income distributions differ only in location and scale, or their logarithms differ only by the intercept and the slope parameter. When comparing a base year tax policy with a tax policy at year t, we then regress pretax income in the base year x_i^B on that in the year t, x_i^t:

$$\ln x_i^B = a + b \ln x_i^t + \epsilon_i$$

where ϵ_i is a random error, and subscript i stands for an index of households who are ordered from the bottom with regard to the pretax income in each sample. According to the empirical approach of Lambert and Thorensen (2009), we evaluated the goodness-of-fit of the regression based on a measure of R^2. If the fit is good, we can transform year t posttax income y_i^t into base-year-adjusted values of posttax income $\hat{y}_i^t$, which is calculated by $\exp(\hat{a} + \hat{b} \ln y_i^t)$ and where the circumflex symbol denotes estimated or fitted value. Analogous to this procedure, a base-year-adjusted value of taxable income $\hat{z}_i^t$ in year t is calculated from a year t taxable income z_i^t. By comparing inequality measures that are computed from these transplanted pretax income, taxable income, and posttax income, we again examined redistributive effects of tax rates and tax base.

Insert Tables 13, 14, and 15 16 about here

Table 13 provides the estimation results of the regressions where logs of the base year—1984, 1994, and 2004—pretax income are regressed on every year's pretax income. Less than one-third of R^2 values for the regressions are above 0.95, and some of them are below 0.90. Thus, for Japanese income data employed here, the T-C procedure is not a good estimation methodology to compare pretax and posttax income relative to the fixed income approach, which contradicts the recommendation of Lambert and Thorensen (2009). Tables 14, 15, and 16 present the results of the T-C procedure for 1984, 1994, and 2004 incomes. In line with the results of the fixed income approach, all the inequality indices demonstrate that total redistribution effects of the tax policies declined from 1984 to 2009. When looking at variation in total redistribution effects of each period, in 1984–1989 the inequality measures rose, whereas in 1994–1999 and 2004–2009 they fell. Moreover, from a number of the progressivity measures it is inferred that in 1984–1989 and 1994–1999 the tax reforms toward less progressive tax rates and lower tax base made the equalizing effects of tax rates intense, but such effects of tax base weak. However, some indices of rate effects and base effects—such as the 1984–1989 growth rate for the BD index with 1984 income as a base and the 1994–1999 growth rates for the two BD indices with 1994 income as a base—exhibit the opposite signs to the formers, thereby implying that the worse fits of the regressions somewhat affect the estimates. It follows that although in the current analysis the T-C procedure is not better than the fixed income approach, we can attain substantially the same pattern of changes in the inequality measures as when

the fixed income approach is used.

6. Conclusion

In the 1980s some OECD countries dropped their tax progressivity through tax reforms. When Japan implemented the 1987 and 1989 fundamental tax reforms the income tax rates—in particular of those in the top income bracket—were also reduced and tax deductions were increased. This was aimed at lessening the income tax burdens for those in the middle income bracket. A number of studies associated with redistributive effects of income tax reforms in the OECD countries have been accumulated in recent years (e.g., Bishop et al., 1997; Lambert & Thoresen, 2009; Thoresen, 2004; Thoresen et al., 2011). However, despite the income tax reforms implemented in Japan, few researchers have addressed the equalizing effects of tax reforms. Moreover, the focus has rarely been placed on the redistributive effects of income tax rates and tax base.

In this study we therefore aimed to reveal the progressivity effects of the Japanese tax reforms in terms of income tax rates and tax base, using microlevel data from Japanese households. The data employed here comprise household and member earnings data collected every 5 years between 1984 and 2009 by the NSFIE. Redistributive effects for taxable income and posttax income were measured by popular inequality measures used in the literature: tax progressivity, the RS index, and two types of BD indices. To control for exogenous factors to influence inequality measurement other than tax policies, we applied 1984–2009 income tax laws to a base year's fixed income, according to the fixed income approach. For robustness checks, the transplant-and-compare procedure was also used, where incomes are transplanted from another year income to get rid of any noisy elements. We evaluated the progressivity of income taxation in light of equalizing effects of tax rates and base, by comparing the sizes of total redistributive effects, tax rate effects, and tax base effects over this period.

We obtained the following three results: First, the total redistributive effects of the Japanese tax schedule declined between 1984 and 2009. During this period, the redistributive effects of tax rates increased despite tax rates being lowered for each income bracket, and in the same period, these effects of tax deductions and exemptions decreased along with larger tax deductions. Second, income tax reforms with reduction in tax rates and increase in tax base give rise to greater redistributive effects of income tax rates and lower redistributive effects of tax base. This is a surprising result in that a reduction in tax rates is generally expected to give rise to a less progressive tax schedule.

This result for rate effects draw from the logic that a shrinking of tax bases brought about more unequal taxable income distribution, with the redistributive effects of tax rates being more progressive. Moreover, it is confirmed that actual marginal tax rates for high income earners were not so high, even if the top tax rates are extremely high, compared with the statute tax rates because of a thin distribution of high income. Third, progressivity measures show identical trends over the period under approaches concerned with pretax income definition. Therefore, the analyses we used in this article seem to be consistent and reliable.

One caveat is that this work covers only the income redistribution arising from changes in the income taxation without taking into account the impacts of changes in local personal income taxes and social security expenses. In addition, income as defined here does not contain imputed income from housing and interests and dividends owing to difficulty in calculating their accrete values. Including these elements, which seem to be associated with the trends in tax progressivity, would provide further contributions to the existing literature.

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Table 1. Key Income Tax Deductions and Exemptions, 1984-2009

		1984	1989	1994	1999	2004	2009
		A. Tax Deductions					
Deduction for life insurance	Upper limit	50	50	50	50	50	50
Deduction for social insurance	Rates of deduction for premiums	100%	100%	100%	100%	100%	100%
Deduction for medical expenses	Maximum	2000	2000	2000	2000	2000	2000
		B. Tax Exemptions					
Basic exemption		330	350	350	380	380	380
Exemption for spouses	Maximum	330	350	350	380	380	380
Special exemption for spouses	Maximum, for qualified spouse for exemption	-	350	350	380	-	-
	Maximum, for not qualified spouse	-	350	350	380	380	380
Exemption for dependents	Maximum	330	350	350	380	380	380
Exemption for the elderly		250	500	500	500	500	-
Total of		1240	2250	2250	2400	2020	1520

Note Unit is thousand yen. One yen is about 0.01 USD.

Table 2. Descriptive Statistics and Measures of Income Inequality for Pretax Income, 1984‐2009

	1984	1989	1994	1999	2004	2009	Growth rates, 1984-2009
	A. Descriptive Statistics						
Mean	236.2	231.2	235.8	235.3	232.7	233.0	-1%
SD	169.4	195.5	208.3	195.6	218.0	228.3	35%
Minimum	0	0	0	0	0	0	0%
Maximum	7829.5	9550.5	11411.0	6800.4	8101.5	13502.0	72%
Observations	45899	52756	54182	53467	50611	47084	3%
	B. Measures of Income Inequality						
Median	200.9	193.8	197.6	195.7	188.8	185.0	-8%
CV	0.717	0.845	0.883	0.831	0.936	0.980	37%
SCV	0.514	0.715	0.780	0.691	0.877	0.961	87%
Gini	0.307	0.354	0.365	0.380	0.412	0.421	37%
TI	0.173	0.236	0.250	0.260	0.310	0.323	86%
MLD	0.163	0.201	0.215	0.228	0.259	0.269	65%
AI							
e=0.25	0.042	0.058	0.061	0.065	0.077	0.081	94%
e=0.75	0.118	0.189	0.205	0.227	0.270	0.281	138%
P10	52.019	42.364	38.728	34.578	28.440	26.818	-48%
P90	197.4	209.4	213.5	224.1	236.8	247.1	25%
P90/P10	3.795	4.943	5.512	6.480	8.325	9.214	143%

Note : Units of Mean, Minimum, Maximum, and Median are 10 thousand yen, and one yen is about 0.01 USD. SD denotes the standard deviation; CV the coefficient of variation; SVC the squared coefficient of variation; TI the Theil index; MLD the mean logarithmic deviation; AI the Atkinson index. P10 and P90 are the percentailes of income at each percentail. P90/P10 represents the P90 devided by P10.

Table 3. Descriptive Statistics and Measures of Income Inequality for Taxable Income, 1984‐2009

	1984	1989	1994	1999	2004	2009	Growth rates, 1984-2009
	A. Descriptive Statistics						
Mean	150.6	142.9	158.7	148.0	152.3	154.4	2%
SD	168.7	192.9	206.3	191.7	211.9	220.0	30%
Minimum	0	0	0	0	0	0	0%
Maximum	7764.1	9458.6	11376.4	6689.4	8047.8	13431.4	73%
Observations	45899	52756	54182	53467	50611	47084	3%
	B. Measures of Income Inequality						
Median	113.6	99.3	115.6	100.7	99.9	97.6	-14%
CV	1.120	1.350	1.300	1.295	1.392	1.425	27%
SCV	1.254	1.821	1.690	1.678	1.936	2.031	62%
Gini	0.473	0.543	0.520	0.566	0.581	0.575	22%
TI	0.411	0.559	0.511	0.595	0.636	0.619	51%
MLD	0.318	0.296	0.283	0.258	0.266	0.302	-5%
AI							
e=0.25	0.103	0.141	0.129	0.154	0.163	0.157	53%
e=0.75	0.368	0.528	0.492	0.599	0.621	0.584	59%
P10	14.852	0.000	0.000	0.000	0.000	0.000	-100%
P90	273.6	314.9	293.9	342.7	355.7	371.0	36%
P90/P10	18.424	.	.	.	.	.	-

Note: The same as Table 2.

Table 4. Descriptive Statistics and Measures of Income Inequality for Post-tax Income, 1984‐2009

	1984	1989	1994	1999	2004	2009	Growth rates, 1984-2009
	A. Descriptive Statistics						
Mean	212.7	211.2	216.6	219.0	216.1	217.4	2%
SD	122.9	145.2	157.0	161.1	178.9	183.2	49%
Minimum	0	0	0	0	0	0	0%
Maximum	3376.1	5062.9	6234.3	4457.2	5470.6	8439.7	150%
Observations	45899	52756	54182	53467	50611	47084	3%
	B. Measures of Income Inequality						
Median	187.6	183.6	188.0	187.7	180.9	180.2	-4%
CV	0.578	0.687	0.725	0.735	0.828	0.843	46%
SCV	0.334	0.473	0.526	0.541	0.685	0.710	113%
Gini	0.277	0.326	0.340	0.360	0.392	0.399	44%
TI	0.135	0.191	0.208	0.229	0.274	0.282	109%
MLD	0.133	0.169	0.185	0.202	0.231	0.239	79%
AI							
e=0.25	0.033	0.048	0.053	0.058	0.070	0.072	118%
e=0.75	0.098	0.167	0.185	0.211	0.254	0.263	170%
P10	54.547	44.379	40.351	36.017	29.366	27.531	-50%
P90	186.0	199.3	202.6	213.8	226.2	232.1	25%
P90/P10	3.410	4.491	5.022	5.935	7.704	8.431	147%

Note: The same as Table 2.

Table 5. Redistributive Effects of Income Tax Rates and Base, 1984‐2004

	1984	1989	1994	1999	2004	2009	Growth rates, 1984-1989	Growth rates, 1994-1999	Growth rates, 2004-2009	Growth rates, 1984-2009
RS index										
Total	0.0292	0.0280	0.0246	0.0202	0.0197	0.0219	-4%	-18%	11%	-25%
Rate effects	0.1952	0.2174	0.1797	0.2061	0.1893	0.1758	11%	15%	-7%	-10%
Base effects	-0.1660	-0.1894	-0.1551	-0.1858	-0.1695	-0.1538	-14%	-20%	9%	7%
BD index: e=0.25										
Total	0.0089	0.0103	0.0094	0.0075	0.0082	0.0094	16%	-20%	14%	6%
Rate effects	0.0779	0.1084	0.0882	0.1135	0.1121	0.1013	39%	29%	-10%	30%
Base effects	-0.0640	-0.0885	-0.0724	-0.0952	-0.0934	-0.0834	-38%	-31%	11%	-30%
BD index: e=0.75										
Total	0.0236	0.0266	0.0243	0.0205	0.0224	0.0248	13%	-16%	11%	5%
Rate effects	0.4277	0.7655	0.6021	0.9662	0.9669	0.7725	79%	60%	-20%	81%
Base effects	-0.2831	-0.4185	-0.3607	-0.4810	-0.4802	-0.4218	-48%	-33%	12%	-49%
Reranking effects										
Total	0.00010	0.00007	0.00006	0.00005	0.00004	0.00006	-24%	-20%	35%	-40%
Base effects	0.0046	0.0065	0.0042	0.0062	0.0053	0.0053	41%	46%	1%	15%

Note : RS index refers to Reynolds-Smolensky index; BD index to Blackorby-Donaldson index. Rate effects represent redistributive effects of tax rates; Base effects those of tax base. In the two BD indices, "e" denotes the Atkinson's inequality-aversion parameters.

Table 6. Redistributive Effects of Income Tax Rates and Base: 1984-2009 Tax Laws Applied to 1984 Incomes

	1984	1989	1994	1999	2004	2009	Growth rates, 1984-1989	Growth rates, 1994-1999	Growth rates, 2004-2009	Growth rates, 1984-2009
RS index										
Total	0.0312	0.0262	0.0213	0.0194	0.0182	0.0203	-16%	-9%	11%	-35%
Rate effects	0.1613	0.2126	0.2118	0.2533	0.1900	0.1964	32%	20%	3%	22%
Base effects	-0.1301	-0.1863	-0.1905	-0.2339	-0.1717	-0.1761	-43%	-23%	-3%	-35%
BD index: e=0.25										
Total	0.0094	0.0086	0.0073	0.0066	0.0064	0.0071	-8%	-9%	12%	-24%
Rate effects	0.0591	0.0964	0.1004	0.1319	0.0886	0.0923	63%	31%	4%	56%
Base effects	-0.0469	-0.0801	-0.0846	-0.1107	-0.0755	-0.0780	-71%	-31%	-3%	-66%
BD index: e=0.75										
Total	0.0250	0.0227	0.0191	0.0174	0.0168	0.0183	-9%	-9%	9%	-27%
Rate effects	0.2832	0.6476	0.7089	1.0804	0.6046	0.6246	129%	52%	3%	121%
Base effects	-0.2013	-0.3793	-0.4036	-0.5110	-0.3663	-0.3732	-88%	-27%	-2%	-85%
Reranking effects										
Total	0.00012	0.00006	0.00004	0.00004	0.00004	0.00007	-46%	-6%	65%	-43%
Base effects	0.0028	0.0047	0.0046	0.0073	0.0061	0.0084	67%	58%	38%	194%

Note : The same as Table 5.

Table 7. Redistributive Effects of Income Tax Rates and Base: 1984-2009 Tax Laws Applied to 1989 Incomes

	1984	1989	1994	1999	2004	2009	Growth rates, 1984-1989	Growth rates, 1994-1999	Growth rates, 2004-2009	Growth rates, 1984-2009
RS index										
Total	0.0322	0.0286	0.0209	0.0188	0.0193	0.0234	-11%	-10%	21%	-27%
Rate effects	0.1472	0.2112	0.2779	0.3158	0.1846	0.1810	44%	14%	-2%	23%
Base effects	-0.1149	-0.1826	-0.2571	-0.2970	-0.1653	-0.1576	-59%	-16%	5%	-37%
BD index: e=0.25										
Total	0.0106	0.0104	0.0082	0.0074	0.0075	0.0089	-2%	-10%	18%	-16%
Rate effects	0.0556	0.1035	0.1651	0.2060	0.0923	0.0869	86%	25%	-6%	56%
Base effects	-0.0426	-0.0844	-0.1346	-0.1647	-0.0776	-0.0717	-98%	-22%	8%	-68%
BD index: e=0.75										
Total	0.0276	0.0270	0.0206	0.0185	0.0194	0.0226	-2%	-10%	17%	-18%
Rate effects	0.2595	0.7142	1.5013	2.2566	0.6447	0.5564	175%	50%	-14%	114%
Base effects	-0.1842	-0.4009	-0.5920	-0.6873	-0.3802	-0.3430	-118%	-16%	10%	-86%
Reranking effects										
Total	0.00017	0.00008	0.00011	0.00009	0.00005	0.00006	-53%	-13%	22%	-62%
Base effects	0.0044	0.0061	0.0243	0.0285	0.0081	0.0071	39%	17%	-13%	61%

Note : The same as Table 5.

Table 8. Redistributive Effects of Income Tax Rates and Base: 1984-2009 Tax Laws Applied to 1994 Incomes

	1984	1989	1994	1999	2004	2009	Growth rates, 1984-1989	Growth rates, 1994-1999	Growth rates, 2004-2009	Growth rates, 1984-2009
RS index										
Total	0.0321	0.0252	0.0222	0.0199	0.0171	0.0221	-21%	-10%	29%	-31%
Rate effects	0.1404	0.3106	0.2084	0.2400	0.3104	0.1829	121%	15%	-41%	30%
Base effects	-0.1083	-0.2854	-0.1862	-0.2201	-0.2932	-0.1607	-164%	-18%	45%	-48%
BD index: e=0.25										
Total	0.0107	0.0097	0.0088	0.0078	0.0071	0.0086	-9%	-11%	22%	-19%
Rate effects	0.0526	0.1977	0.1119	0.1380	0.2099	0.0908	276%	23%	-57%	73%
Base effects	-0.0398	-0.1570	-0.0927	-0.1144	-0.1676	-0.0753	-294%	-23%	55%	-89%
BD index: e=0.75										
Total	0.0276	0.0244	0.0225	0.0201	0.0176	0.0218	-12%	-11%	24%	-21%
Rate effects	0.2437	2.1573	0.8782	1.2240	2.3535	0.6028	785%	39%	-74%	147%
Base effects	-0.1738	-0.6755	-0.4556	-0.5413	-0.6966	-0.3625	-289%	-19%	48%	-109%
Reranking effects										
Total	0.00015	0.00007	0.00005	0.00005	0.00011	0.00007	-50%	0%	-32%	-51%
Base effects	0.0032	0.0111	0.0060	0.0092	0.0336	0.0095	245%	54%	-72%	194%

Note : The same as Table 5.

Table 9. Redistributive Effects of Income Tax Rates and Base: 1984-2009 Tax Laws Applied to 1999 Incomes

	1984	1989	1994	1999	2004	2009	Growth rates, 1984-1989	Growth rates, 1994-1999	Growth rates, 2004-2009	Growth rates, 1984-2009
RS index										
Total	0.0298	0.0236	0.0208	0.0188	0.0160	0.0214	-21%	-10%	34%	-28%
Rate effects	0.1284	0.2897	0.2011	0.2280	0.3020	0.1680	126%	13%	-44%	31%
Base effects	-0.0987	-0.2661	-0.1803	-0.2092	-0.2861	-0.1467	-170%	-16%	49%	-49%
BD index: e=0.25										
Total	0.0091	0.0087	0.0079	0.0071	0.0063	0.0079	-5%	-10%	25%	-13%
Rate effects	0.0463	0.1861	0.1127	0.1353	0.2124	0.0832	302%	20%	-61%	80%
Base effects	-0.0355	-0.1496	-0.0942	-0.1129	-0.1699	-0.0695	-321%	-20%	59%	-96%
BD index: e=0.75										
Total	0.0249	0.0231	0.0216	0.0194	0.0166	0.0212	-7%	-10%	28%	-15%
Rate effects	0.2201	2.1890	0.9896	1.3090	2.7085	0.5670	894%	32%	-79%	158%
Base effects	-0.1600	-0.6792	-0.4865	-0.5585	-0.7259	-0.3483	-325%	-15%	52%	-118%
Reranking effects										
Total	0.00016	0.00008	0.00005	0.00004	0.00011	0.00008	-50%	-8%	-28%	-52%
Base effects	0.0027	0.0106	0.0054	0.0079	0.0315	0.0078	300%	48%	-75%	193%

Note : The same as Table 5.

Table 10. Redistributive Effects of Income Tax Rates and Base: 1984-2009 Tax Laws Applied to 2004 Incomes

	1984	1989	1994	1999	2004	2009	Growth rates, 1984-1989	Growth rates, 1994-1999	Growth rates, 2004-2009	Growth rates, 1984-2009
RS index										
Total	0.0318	0.0296	0.0204	0.0184	0.0197	0.0229	-7%	-10%	16%	-28%
Rate effects	0.1282	0.2019	0.2755	0.2990	0.1893	0.1646	57%	9%	-13%	28%
Base effects	-0.0964	-0.1723	-0.2551	-0.2807	-0.1695	-0.1417	-79%	-10%	16%	-47%
BD index: e=0.25										
Total	0.0103	0.0115	0.0086	0.0077	0.0082	0.0092	12%	-10%	12%	-10%
Rate effects	0.0476	0.1133	0.1965	0.2256	0.1121	0.0865	138%	15%	-23%	82%
Base effects	-0.0356	-0.0914	-0.1570	-0.1778	-0.0934	-0.0711	-157%	-13%	24%	-100%
BD index: e=0.75										
Total	0.0276	0.0314	0.0226	0.0202	0.0224	0.0244	14%	-10%	9%	-12%
Rate effects	0.2211	0.9471	2.5403	3.2603	0.9669	0.5925	328%	28%	-39%	168%
Base effects	-0.1585	-0.4703	-0.7112	-0.7605	-0.4802	-0.3568	-197%	-7%	26%	-125%
Reranking effects										
Total	0.00019	0.00009	0.00005	0.00004	0.00004	0.00008	-55%	-17%	75%	-60%
Base effects	0.0030	0.0049	0.0088	0.0104	0.0053	0.0066	62%	18%	25%	115%

Note : The same as Table 5.

Table 11. Redistributive Effects of Income Tax Rates and Base: 1984-2009 Tax Laws Applied to 2009 Incomes

	1984	1989	1994	1999	2004	2009	Growth rates, 1984-1989	Growth rates, 1994-1999	Growth rates, 2004-2009	Growth rates, 1984-2009
RS index										
Total	0.0324	0.0303	0.0237	0.0212	0.0206	0.0236	-7%	-11%	15%	-27%
Rate effects	0.1233	0.2082	0.2013	0.2205	0.1845	0.1620	69%	10%	-12%	31%
Base effects	-0.0909	-0.1778	-0.1776	-0.1994	-0.1639	-0.1384	-96%	-12%	16%	-52%
BD index: e=0.25										
Total	0.0105	0.0122	0.0102	0.0091	0.0089	0.0098	16%	-11%	10%	-7%
Rate effects	0.0451	0.1246	0.1289	0.1472	0.1142	0.0880	176%	14%	-23%	95%
Base effects	-0.0330	-0.0999	-0.1052	-0.1204	-0.0945	-0.0719	-202%	-14%	24%	-118%
BD index: e=0.75										
Total	0.0281	0.0334	0.0277	0.0247	0.0244	0.0260	19%	-11%	7%	-7%
Rate effects	0.2045	1.1539	1.3039	1.6044	1.0398	0.6135	464%	23%	-41%	200%
Base effects	-0.1464	-0.5202	-0.5540	-0.6066	-0.4978	-0.3641	-255%	-9%	27%	-149%
Reranking effects										
Total	0.00019	0.00009	0.00005	0.00004	0.00004	0.00007	-51%	-23%	61%	-63%
Base effects	0.0019	0.0048	0.0045	0.0057	0.0045	0.0044	150%	28%	-1%	132%

Note : The same as Table 5.

Table 12. Marginal Income Tax Rates of Taxpayers in Each Percentile: 1984-2009 Tax Laws Applied to 1984, 1994 and 2004 Incomes

Percentile	Tax laws					
	1984	1989	1994	1999	2004	2009
	A. 1984 Income					
P10	10%	0%	0%	0%	0%	0%
P25	12%	10%	8%	8%	8%	5%
P50	16%	10%	8%	8%	8%	5%
P75	21%	10%	8%	8%	8%	10%
P95	30%	29%	24%	16%	16%	20%
Max	70%	50%	50%	37%	37%	40%
	B. 1994 Income					
P10	12%	0%	0%	0%	0%	0%
P25	14%	0%	8%	7%	0%	5%
P50	17%	8%	8%	8%	6%	5%
P75	21%	8%	8%	8%	7%	10%
P95	30%	18%	23%	16%	15%	20%
Max	70%	50%	50%	37%	37%	40%
	C. 2004 Income					
P10	11%	0%	0%	0%	0%	0%
P25	14%	10%	0%	0%	8%	5%
P50	17%	10%	6%	6%	8%	5%
P75	21%	20%	7%	7%	8%	10%
P95	30%	30%	15%	15%	16%	20%
Max	70%	50%	50%	37%	37%	40%

Note : Marginal tax rates are listed in percent. "Max" denotes the top tax rates.

Table 13. Oridnary Least Square Regression Results; Log of Income in 1984, 1994 and 2004 Regressed against Log of Income in 1984-2004

Dependent variable		Year of data, regressors					
		1984	1989	1994	1999	2004	2009
Log of income 1984	Slope	1.000	1.123***	1.114***	1.042***	0.890***	0.619***
		-	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
	Adjusted R-square	1.00	0.90	0.90	0.91	0.94	0.96
Log of income 1994	Slope	0.808***	0.866***	1.000	0.802***	0.622***	0.549***
		(0.001)	(0.001)	-	(0.001)	(0.001)	(0.001)
	Adjusted R-square	0.90	0.95	1.00	0.97	0.91	0.87
Log of income 2004	Slope	1.053***	1.463***	1.454***	1.350***	1.000	0.715***
		(0.001)	(0.002)	(0.002)	(0.002)	-	(0.001)
	Adjusted R-square	0.94	0.91	0.91	0.93	1.00	0.93

Note : Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 14. Redistributive Effects of Income Tax Rates and Base: The 1984-Adjusted Values of Taxable and Post-tax Incomes

	1984	1989	1994	1999	2004	2009	Growth rates, 1984-1989	Growth rates, 1994-1999	Growth rates, 2004-2009	Growth rates, 1984-2009
RS index										
Total	0.0292	0.0347	0.0303	0.0227	0.0185	0.0129	19%	-25%	-30%	-56%
Rate effects	0.1952	0.2161	0.1712	0.2011	0.1929	0.1602	11%	17%	-17%	-18%
Base effects	-0.1660	-0.1814	-0.1409	-0.1784	-0.1744	-0.1474	-9%	-27%	16%	11%
BD index: e = 0.25										
Total	0.0089	0.0134	0.0118	0.0076	0.0059	0.0030	50%	-36%	-50%	-67%
Rate effects	0.0779	0.0945	0.0686	0.0860	0.0845	0.0547	21%	25%	-35%	-30%
Base effects	-0.0640	-0.0741	-0.0532	-0.0722	-0.0725	-0.0491	-16%	-36%	32%	23%
BD index: e = 0.75										
Total	0.0236	0.0323	0.0282	0.0197	0.0158	0.0084	37%	-30%	-46%	-64%
Rate effects	0.4277	0.3451	0.2231	0.3724	0.4086	0.2352	-19%	67%	-42%	-45%
Base effects	-0.2831	-0.2325	-0.1593	-0.2570	-0.2789	-0.1836	18%	-61%	34%	35%
Reranking effects										
Total	0.00010	0.00011	0.00011	0.00011	0.00011	0.00009	14%	0%	-19%	-9%
Base effects	0.0046	0.0042	0.0040	0.0047	0.0051	0.0052	-9%	18%	1%	12%

Note : The same as Table 5.

Table 15. Redistributive Effects of Income Tax Rates and Base: The 1984-Adjusted Values of Taxable and Post-tax Incomes

	1984	1989	1994	1999	2004	2009	Growth rates, 1984-1989	Growth rates, 1994-1999	Growth rates, 2004-2009	Growth rates, 1984-2009
RS index										
Total	0.0222	0.0227	0.0246	0.0158	0.0112	0.0107	2%	-36%	-5%	-52%
Rate effects	0.1721	0.2002	0.1797	0.1967	0.1630	0.1450	16%	9%	-11%	-16%
Base effects	-0.1499	-0.1775	-0.1551	-0.1809	-0.1517	-0.1343	-18%	-17%	12%	10%
BD index: e = 0.25										
Total	0.0052	0.0071	0.0094	0.0045	0.0029	0.0023	37%	-52%	-21%	-56%
Rate effects	0.0547	0.0849	0.0882	0.0848	0.0619	0.0457	55%	-4%	-26%	-16%
Base effects	-0.0469	-0.0717	-0.0724	-0.0740	-0.0555	-0.0416	-53%	-2%	25%	11%
BD index: e = 0.75										
Total	0.0142	0.0194	0.0243	0.0129	0.0091	0.0067	36%	-47%	-25%	-53%
Rate effects	0.2259	0.3859	0.6021	0.4128	0.2578	0.1823	71%	-31%	-29%	-19%
Base effects	-0.1727	-0.2644	-0.3607	-0.2831	-0.1977	-0.1485	-53%	22%	25%	14%
Reranking effects										
Total	0.00052	0.00005	0.00006	0.00005	0.00005	0.00017	-90%	-13%	251%	-66%
Base effects	-0.0023	0.0044	0.0042	0.0047	0.0049	-0.0021	292%	11%	-144%	7%

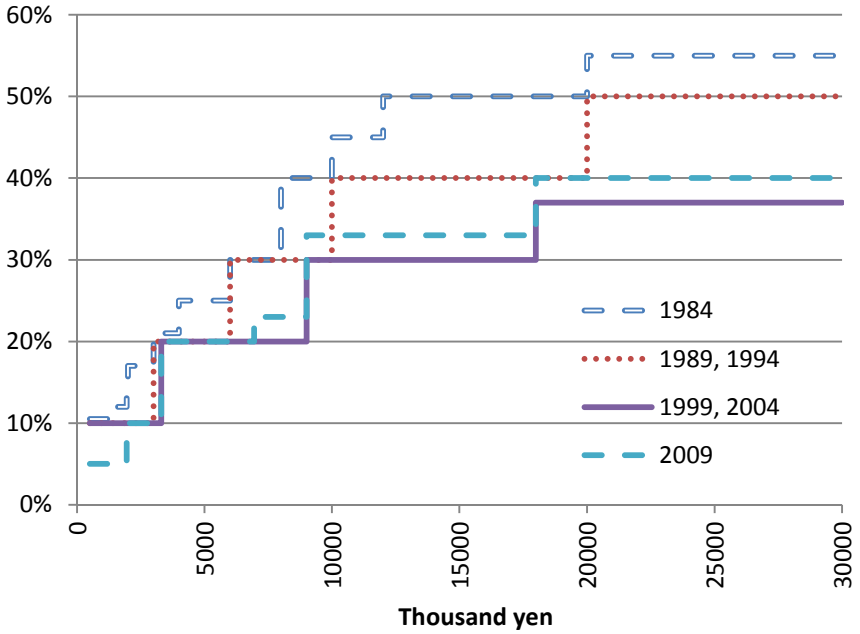
Note : The same as Table 5.

Table 16. Redistributive Effects of Income Tax Rates and Base: The 1984-Adjusted Values of Taxable and Post-tax Incomes

	1984	1989	1994	1999	2004	2009	Growth rates, 1984-1989	Growth rates, 1994-1999	Growth rates, 2004-2009	Growth rates, 1984-2009
RS index										
Total	0.0308	0.0492	0.0440	0.0299	0.0197	0.0146	60%	-32%	-26%	-53%
Rate effects	0.1958	0.2392	0.2012	0.2123	0.1893	0.1598	22%	5%	-16%	-18%
Base effects	-0.1651	-0.1900	-0.1572	-0.1823	-0.1695	-0.1452	-15%	-16%	14%	12%
BD index: e = 0.25										
Total	0.0102	0.0316	0.0292	0.0162	0.0082	0.0042	210%	-45%	-49%	-59%
Rate effects	0.0818	0.1828	0.1450	0.1464	0.1121	0.0643	123%	1%	-43%	-21%
Base effects	-0.0662	-0.1278	-0.1011	-0.1136	-0.0934	-0.0565	-93%	-12%	40%	15%
BD index: e = 0.75										
Total	0.0269	0.0727	0.0653	0.0409	0.0224	0.0120	170%	-37%	-47%	-56%
Rate effects	0.3532	0.8785	0.6183	0.8262	0.9669	0.2818	149%	34%	-71%	-20%
Base effects	-0.2411	-0.4289	-0.3417	-0.4300	-0.4802	-0.2105	-78%	-26%	56%	13%
Reranking effects										
Total	0.00004	0.00005	0.00005	0.00005	0.00004	0.00004	25%	-1%	-10%	-4%
Base effects	0.0045	0.0038	0.0038	0.0044	0.0053	0.0060	-15%	15%	14%	32%

Note : The same as Table 5.

Figure 1. Statutory Income Tax Rates against Taxable Income: 1984–2009



Note: One yen is equal to about 0.01 USD.