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Estimating the Elasticity of Taxable Income: Evidence from Top Japanese Taxpayers

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Abstract

This study measures the elasticity of taxable income (ETI) using data on top Japanese taxpayers between 1986 and 1989. During these years, Japan decreased the income tax rates of the top-to-bottom income earners and number of income brackets drastically. We construct a panel dataset of top taxpayers in Japan in this period, using Japanese tax return data and estimate the ETI. We find that the ETI with regard to the net-of-tax rate is approximately 0.074–0.055, considerably lower than those for the United States and most European countries but nearly equal to that for Denmark.

JEL Classifications: H21, H24

Keywords: Elasticity of taxable income; income tax; Japan; top taxpayers

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1. Introduction

Most OECD member states comprehensively reformed their income tax systems in the 1980s; in many cases, these reforms included substantial declines in the marginal tax rates and changes in the tax bases. The United States reduced its top marginal tax rate of federal income tax from 70% to 28% and cut the number of tax brackets from 15 to four through a series of tax reforms during 1981–1988. Turning to Japanese individual income tax, the comprehensive tax reforms carried out in 1986–1989 reduced the top marginal tax rates of national and local income taxes from 88% to 65% as well as narrowed the tax base by expanding existing deductions and exemptions and creating new ones.

Given these wide-scale tax reforms, academic researchers have shown interest in the extent to which taxable income responds to changes in the marginal tax rates of income tax. The pioneering work by Lindsey (1987) addresses the response of taxable income to the Economic Reform Tax Act of 1981, by using cross-sectional data on US taxpayers; it estimates the elasticity of taxable income (ETI) with respect to the tax policy change as being 1.6–1.8. Feldstein (1995) assesses the ETI by using individual-level panel data and a natural experiment in income tax reform, namely the Tax Reform Act of 1986, also in the United States, and estimates an ETI greater than 1. While that study piqued other researchers' interest in ETI estimations, it raised some conceptual concerns regarding the measurement of the ETI. Indeed, although the use of taxpayer panel data has provided researchers with the opportunity to undertake a richer examination of the ETI, it could raise the problem of mean reversion in transitory income (e.g., Auten and Carroll, 1999; Gruber and Saez, 2002).

Against the background of this academic debate, Gruber and Saez (2002) propose a more comprehensive and standard estimation model, which has since been used widely by a number of empirical researchers, to address the aforementioned empirical issues. More recently, a variant of the Gruber–Saez model was developed to address empirical issues other than those noted by Gruber and Saez (2002). For example, a change in the definition of "taxable income" has been highlighted as a factor that may lead to the overestimation of the ETI, given the large availability of tax deductions and declining marginal tax rates. In relation to this problem, Kopczuk (2005) and Blomquist and Selin (2010) argue model misspecification and propose other instrumental variables (IVs). Giertz (2009) also deals with the mean reversion and divergence of the income distribution simultaneously by using longitudinal panel data and several methods such as the inverted panel technique. Furthermore, Chetty (2009) and Doerrenberg et al. (2015) examine the issue of whether taxable income provides sufficient statistics to calculate the deadweight loss and find that the sufficiency holds only in limited cases. In this respect, many researchers have recently attempted to estimate the ETI with regard to a net-of-tax rate from an empirical econometrics viewpoint and assess the impact of tax changes on social welfare. [1]

[1] Although some ETI studies have been carried out in Japan, they have not used panel and tax return data. Cabinet Office Japan (2001) estimates the ETI during the 1995 tax reform to be 0.074, using the 1994 and 1996 pooled cross-section data. Yashio (2005) uses the aggregate tax return data published by the national tax authority and estimates the ETI during the 1999 tax reform to be 0.053. Kitamura and Miyazaki (2010) estimate the ETI during the 1995 and 1999 tax reforms to be 0.2–0.28; however, they also report that the estimates are sensitive to the size of the sample and the definitions of the treatment and control groups.

This study estimates the ETI with regard to a net-of-tax rate, using data from top Japanese taxpayers during 1986–1989. In particular, we focus on the tax policy changes caused by the 1987/1988 comprehensive tax reform (this reform continued until 1989 in the form of transition measures), which substantially reduced the top marginal income tax rate, and estimate how the top Japanese taxpayers responded to these precipitous declines in the marginal tax rates. We create panel data on top taxpayers that comprise tax return data as well as demographic information by using the published list of top Japanese taxpayers, which was collected and arranged into a publicly disclosed top taxpayer list. In contrast to Nordic countries, original tax return data in Japan are not available to researchers. Hence, by using this unique database, this study attempts to precisely estimate the ETI for Japanese top taxpayers.

Our contribution to the literature is to find ETI estimates by using unique tax return panel data on Japanese top taxpayers and exploiting a rigorous regression methodology. The data and the Japanese income tax system have some preferable properties for estimating the ETI. First, and most importantly, in our framework a change in tax base definition has little effect on ETI estimation. The ETI literature has drawn attention to a bias from a change in the definition of the tax base, which generally appears in the difference between taxable income elasticity and broad income elasticity (e.g., Gruber and Saez, 2002). There are two sources of the difference: a behavioral response and the mechanical effect (Kopczuk, 2005; Gruber and Saez, 2002). Regarding the behavioral response, in Japan itemized deduction was not available in the sample period. Most taxpayers have not utilized itemized deduction until recently because of the presence of a relatively large amount of standard deduction. Thus, the use of Japanese tax return data allows us to remove the bias caused by deduction changes from the ETI estimates.

Second, this study estimates taxable income elasticity in the absence of a potential concern about the small estimates of broad income elasticity. To cope with the bias from the tax base change, researchers have attempted to measure the elasticity of broad income, which is by definition not susceptible to a tax deduction change, rather than that of taxable income (e.g., Kleven and Schulz, 2014; Kopczuk, 2005). Owing to the abovementioned mechanical effect, however, broad income elasticity is likely to be small compared with taxable income elasticity; indeed, it typically accounts for about 40% of the margin between them (Gruber and Saez, 2002). Therefore, the unbiased estimation of elasticity using taxable income, not broad income, offers some insight into the ETI study.

Third, the distribution of Japanese top income was stable throughout the sample period. Because the top income distribution of the United States was volatile during the period of TRA86, which is the radical income tax reform that has often been exploited to estimate the ETI, researchers have to deal with estimation biases such as mean reversion and heterogeneous income trends. By contrast, as Moriguchi and Saez (2008) argue, the top wage income shares in Japan remained stable from 1980 to 2005. This stability of the top income distribution then alleviates the threat of such endogeneity.

Regressions rely on several estimation approaches in terms of sampling and specification to ensure robustness. In order to cope with the attrition of observations,[2] in the robustness check we limit our sample to extremely high taxpayers expected not to drop out of the sample during the sample period.[3] In another estimation, we incorporate occupation variables as controls to tackle the endogeneity arising from the correlation between lagged income and permanent income potentially underlying the errors of regressions and heterogeneous income trend (e.g., Auten and Carroll, 1999; Weber, 2014). Further, this study performs a non-income weighted regression and a regression using a sample of only executives of companies. The former is utilized because a non-weighted regression tends to bring about smaller ETI estimates than those obtained by an income-weighted one, as weighted regressions place more weight on larger income earners (Giertz, 2007); the latter is to estimate the ETI of taxpayers whose income sources are principally labor income such as compensation for executives. In addition, we investigate the existence of short-term and long-term responses to the tax changes along in line with the discussions of Giertz (2009) and Weber (2014).

The estimation shows that the ETI with regard to the net-of-tax rate ranges between 0.074 and 0.055 in Japan. A baseline estimation based on the specification of Gruber and Saez

[2] We have the complete list of taxpayers whose taxable income is approximately 28 million JPY or more. However, attrition bias may be non-negligible for taxpayers marginal to the threshold. We thus limit our sample to extremely high taxpayers for which the distribution of taxable income does not seem to be skewed due to attrition bias.

[3] Specifically, in this case we sampled those whose taxable incomes exceed on average 43 million JPY.

(2002) generated ETI estimates of approximately 0.074, and many of the subsequent regressions demonstrated similar estimation values. These findings suggest that the ETI for top Japanese taxpayers is smaller than that for their counterparts in Canada (i.e., 0.25) (Sillamaa and Veall, 2001), Germany (i.e., 0.54–0.68) (Doerrenberg et al., 2015), Hungary (i.e., 0.24) (Kiss and Mosberger, 2015), Sweden[4] (i.e., 0.4–0.5) (Hansson, 2007), and the United States (i.e., 0.4) (Gruber and Saez, 2002), but almost the same as that in Denmark (i.e., 0.06) (Kleven and Schultz, 2014).[5] Given that Kleven and Schultz (2014) estimate the broad income elasticities, which, as stated above, are likely to be smaller than the ETI, the magnitude of the ETI for Japanese top income is quite small relative to other countries.[6] Another interesting finding is that the short-term response to the 1987 tax change—the first among consecutive tax reforms at that time—is strong (that is, an ETI of 0.13), whereas the long-term response for 1986–1989 is very weak and insignificant. This insight may indicate that top taxpayers respond to a large tax cut in the short-term, but not in the long-term, consistent with the findings of previous studies such as Giertz (2009). This result also

[4] Taking into consideration the sex differences in the taxable income elasticity, Blomquist and Håkan (2010) report ETIs of 0.14–0.16 for men and 0.41–0.57 for women, using Swedish individual panel data. Both elasticities are also greater than those of Japan.

[5] The relative magnitude of the ETI between Japan and Norway (whose ETI ranges from -0.6 to 0.2) is ambiguous (Aarbu and Thoresen, 2001).

[6] Note that the sampled taxpayers are quite high income earners whose taxable incomes are no less than 28 million JPY (about 280 thousand USD) per annum, which is much greater than the corresponding sampling lower limits of 100 thousand USD in Weber (2014) and for upper income filers in Giertz (2007), and then the ETIs in this study are estimated from them.

provides support for the evidence that Japanese top taxpayers are relatively not responsive to tax rate changes.

The remainder of this paper is organized as follows. Section 2 provides background information on the Japanese income tax system. The estimation strategy used is presented in Section 3. Section 4 describes the data, and the estimation results are presented in Section 5. Finally, Section 6 provides concluding remarks.

2. Background Information on Japanese Income Tax

2.1 Japanese Income Tax System

Under Japanese personal income tax, individuals who have wage income, business income, temporary income, transfer income, and miscellaneous income pay individual income tax. Such income categories are aggregated by using certain formulae (e.g., excluding necessary expenses) to calculate gross income.[7] Individuals can also enjoy tax deductions such as the basic deduction, employment income deduction, and deduction for dependents.[8] More

[7] Some income categories such as interest income are usually subject to separate withholding tax and are not included in gross income.

[8] A few people enjoy tax credit (i.e., foreign tax credit, tax credit for certain donations, and tax credit for dividends). As a special deduction, deductions for transfer income (income from the transfer of assets) and retirement income are permitted with some limitations for the amounts of deductible income.

concretely, the deductions, except exemptions, for the following expenses are also allowed: casualty losses, medical expenses, social insurance premiums, life insurance premiums, fire and other casualty insurance premiums, and charitable contributions. All deductions of the outlays besides casualty losses and social insurance premiums have some upper limitation for the applicable amounts; by contrast, casualty losses and social insurance premiums are fixed expenditure that taxpayers cannot easily increase/decrease. The resulting taxable income is subject to progressive individual income tax. The transition of the marginal tax rates of individual income tax is described in Table 1. This table shows that after WWII, the tax system became more progressive until the 1970s and then became flatter until the 2000s. Recently, it has become more progressive again.

Table 1 is inserted around here.

Local income tax, which has been much flatter than individual income tax and is currently a completely flat tax, shares a similar tax base and is levied on the same individuals repeatedly.[9] It employed a progressive tax system with rates of 4–18% until 1986, but then gradually became flatter and it is now a 10% flat tax.

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[9] Rigorously speaking, the deduction on national income tax is slightly different from that on local income tax. For example, consider a salaried worker with an aggregate gross income (AGI) of 6 million JPY with a housewife and two dependent children. His deduction on national income tax in 1989 was at least 3.095 million JPY (employment income deduction 1,695 thousand + basic deduction 350 thousand + spouse deduction 350 thousand +

While the income tax system in Japan is similar to that in the United States, there are several differences between them. Firstly, this tax is imposed on individual income, not on household income. Secondly, although tax filing is in principle required for most people, a great majority of people are exempt from this requirement. Notably, salaried workers typically pay their taxes without filing because their employers file their taxes on their behalf; specifically, salaried workers whose income is below 20 million yen do not have to file their own tax return. Thirdly, people in the United States choose between two deduction strategies, itemized deduction and standard deduction, whereas in practice, people in Japan do not have such a choice. In Japan, the employment income deduction, similar to the standard deduction in the United States, is applicable to salaried workers; salaried workers are able to choose the itemized deduction strategy instead of legitimately calculated employment income deduction. However, itemized deduction hardly exceeds employment income deduction; for example, only four people in 2011 and six people in 2012 chose itemized deduction.

2.2 Tax Reform in the 1980s

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dependent deduction 350 thousand ×2), whereas his deduction on local income tax in 1989 was at least 2.815 million JPY (employment income deduction 1,695 thousand + basic deduction 280 thousand + spouse deduction 280 thousand + dependent deduction 280 thousand ×2). Therefore, the present study ignores the differences between them (see, for example, http://www.cao.go.jp/zeicho/siryou/pdf/kiso18d.pdf).

As explained in the Introduction, similar to the experiences of most OECD countries during the 1980s, Japan reduced its individual income tax rates as well as the number of brackets in this decade. For instance, the top marginal tax rate of individual income tax decreased from 70% in 1984 to 50% in 1987, while the tax brackets were simplified from 15 in 1984 to five brackets in 1987. Local income tax, having been much flatter than national income tax, also experienced a similar reform during the 1980s. For high taxpayers, however, local income tax has been almost a flat tax. It was 16–18% in 1986, 16% in 1987, and 15% in both 1988 and 1989. These tax rate changes before and after the reform are shown in Table 1.

3. Empirical Strategy

3.1 Econometric Specification

To estimate the ETI, we employ the conventional estimation model developed by Gruber and Saez (2002). Specifically, the regression equation is expressed as follows:

$$\log\left(\frac{z_{it+1}}{z_{it}}\right) = \alpha + \epsilon \log\left[\frac{1-\tau_{it+1}}{1-\tau_{it}}\right] + \beta \log z_{it} + \boldsymbol{X_{it}\gamma} + c_t + u_{it},$$

$$i = 1,..,N, t = 1986, \ldots, 1988, \qquad (1)$$

where z_{it} is the taxable income of individual i in year t and z_{it+1} is that in year $t+1$. τ_{it} is the marginal tax rate of the tax scheme in year t and $\boldsymbol{X_{it}}$ represents a vector of the other control variables. The dependent variable is the difference in the log of taxable income between years $t+1$ and t. The first explanatory variable, to which we pay most attention among the covariates, is the difference in the net-of-tax rate, thereby suggesting that ϵ is the ETI with regard to the net-of-tax rate $1-\tau_{it}$. The log of taxable income is included in the controls to account for the mean reversion of income and linear heterogeneous growth in income, in line with previous research. The vector of the other controls comprises a sex dummy that takes the value of one for men, which captures the variation arising from differences in sex and is conventionally employed in this type of estimation. Occupation dummies are also adopted as a control in one regression. As explained later, using occupation as a control copes with the heterogeneity in income trend and mitigates endogeneity bias in the estimation compared with the standard IV estimation (Carroll, 1998; Auten and Carroll, 1999; Singleton, 2011; Weber, 2014). c_t stands for the year dummy and u_{it} is an error. The coefficients of the explanatory variables are given by α, β, and $\boldsymbol{\gamma}$. The definitions and units of the variables are presented in Table 2.

Table 2 is inserted around here.

Eq. (1) is mainly estimated by using the 2SLS because of the emergence of endogeneity between the log change in taxable income and that in the net-of-tax rates. In the ETI literature, there is concern that the estimate of elasticity appears to be biased because of the presence of a progressive taxation, which yields a positive correlation between realized income z_{it+1} and the marginal tax rate $1-\tau_{it+1}$ after controlling for the other covariates. To address this concern, using the mechanical change in the tax rate structure (caused by the tax policy reform) as an instrument has been suggested, which is created by applying the post-reform tax schedule in year $t+1$ to pre-reform taxable income in year t in order to isolate the mechanical effect of the net-of-tax rate from the behavioral response of taxpayers to a tax policy change (e.g., Gruber and Saez, 2002). The growth in taxable income, however, can be correlated with the predicted log change in the net-of-tax rate (Gruber and Saez, 2002);[10] to control for this endogeneity, the log of taxable income is included in an estimation equation, as seen on the RHS of Eq. (1).

3.2 Identification Problems

Regarding the heterogeneous effects of pre-reform income on income growth, two potential factors are argued in this literature. The first is mean reversion.[11] Mean reversion entails bias for an elasticity estimate, although the direction of the bias depends on whether pre-reform incomes are larger or smaller than those on average. Mean reversion can be controlled for by using one-year lagged income (here defined as $\log z_{it}$) as a proxy. The second is a change in income distribution. In the United States, income inequality has widened over the past three decades, notably in the 1980s (Giertz, 2007). Turning to Japan, Moriguchi and Saez (2008) provide evidence that top wage income shares remained relatively stable from 1980 to 1997 (see their Figures 10 and 11). Some of the studies cited in their Figure 2, however, indicate that the Gini coefficients increased slightly from 1986 to 1989. The possibility of widening inequality over time might thus be present, even in Japan.

[10] This is because the income growth of each individual can vary by her/his income level, which is positively associated with the change in the marginal tax rate under a progressive tax schedule.

[11] This is that if high (low) income is realized in the current period relative to the average, it will tend to fall (rise) to the average level in the next period.

In this case, one solution is to incorporate the log of lagged taxable income as a control. However, if income change occurs nonlinearly, this approach does not explain income growth well. Another is to exploit a spline regression with regard to the log of the base year income (e.g., Gruber and Saez, 2002). Several studies have employed a 10-piece spline in their ETI estimations, while fewer researchers have used a lower piece spline, such as a five-piece (Weber, 2014). Related to the choice of spline number, previous researchers employ samples of lower-income as well as high-income taxpayers by setting the sampling thresholds as above 15,000 USD (Auten and Carrol, 1999) or above 10,000 USD (Giertz, 2007; Gruber and Saez, 2002). However, given that our database is composed of quite high taxpayers with at least approximately 28 million JPY (about 280 thousand USD) taxable income, setting many splines would seem to be unsuitable. For example, Weber (2014) employs a five-piece spline while the employed taxable income threshold is 100 thousand USD (which is much smaller than ours). This study thus adopts a four-piece spline to capture heterogeneous changes in income growth as a robustness check.

In practice, the use of lagged taxable income or its spline as a proxy for income growth in the regression raises some concerns. Weber (2014) points out that if the log of one-year lagged (current year in this study) taxable income is used as a proxy for income growth, permanent income remaining in the error term after controlling for transitory income by taking the log of lagged taxable income is associated with lagged income. Since this correlation biases an ETI estimate, another proxy that accounts for permanent income but does not correlate with a temporary variation in income is needed. The present study adopts occupation dummies as additional proxies in the robustness check. [12,13]

Another substantial concern about the estimation of the ETI is the diverse definitions of taxable income. In many large-scale tax reforms, tax rates are changed along with changes in deductions, which makes it difficult to assess the effects of a change in the tax rate precisely. In general, broader deductions and/or exemptions lead to a large estimate of the ETI (Slemrod and Kopczuk, 2002; Saez et al., 2012; Slemrod, 1995). In the United States, changes in deductions and exemptions affect the relative prices of itemizing activities for taxpayers, making them alter their itemization status. Even when deductions remain unchanged, a change in tax rates could affect tax filing behavior through a change in the relative prices of tax benefits such as charitable deductions (Kopczuk, 2005; Slemrod and

[12] Weber (2014) argues that unless the log of lagged taxable income is included in an estimation equation, occupation or education level variables cannot proxy for transitory income, resulting in a failure to solve the endogeneity. By contrast, the present study takes the estimation strategy that including a lagged taxable income as a proxy for a transitory income, the remaining error of a permanent income is controlled for by the occupation variable.

[13] The dummies are classified into the following categories: president, executive advisor, vice president, board member, administrative officer, hospital director, doctor, dental manager, dentist, school manager, professor, law and accounting office manager, lawyers and accountants, chief priest, entertainer, sport player, artist, agriculture worker, public official, politician, office worker, and others.

Kopczuk, 2002). Kopczuk (2005) states that half of the behavioral responses of taxpayers to the Tax Reform Act of 1986 can be accounted for by the response to broadening tax bases and half by the response to reductions in tax rates. To cope with this problem, existing studies estimate the elasticity of broad income in place of that of taxable income, demonstrating that broad income elasticity is significantly smaller than the ETI (Giertz, 2007; Kopczuk, 2005).

Turning to the Japanese tax reform during 1986–1988, no choice over deduction strategies is substantially available, as explained in Section 2. In addition, commodities deductible from income, such as medical expenses and charitable contributions, were rarely available for Japanese top income earners relative to the United States. At that time, top income earners did not have a culture of making charitable giving, which can be viewed one of the most crucial reasons to a behavioral response to tax changes, in contrast to the United States.[14] In addition, preferable tax treatment such as deduction is mostly limited to commodities unlikely to be manipulated such as medical expenses, expenses for earthquake damages, and so on, and for most deductions the upper ceilings are present. Overall, the use of Japanese tax return data allows us to remove the bias caused by behavioral responses, specifically itemization behavior, from the ETI estimates.

[14] Charitable donations subject to taxable deduction were approximately 0.01% of GDP (Statistics of National Tax Authority). Total charitable donations, including those that were not claimed deduction, were still less than 0.1% of GDP (Family Income and Expenditure Survey). Note that there is a great contrast to United States situation, where charitable donations were approximately 1.5–2% of personal income (Andreoni, 2006).

By contrast, a variation in the tax base arising from a change in the size of deductions, not including a change from any behavioral response—an effect of the changes in deduction size—appears under the Japanese income tax system. Because taxpayers experienced a tax rate cut and a tax base narrowing at the same time in the Japanese tax reform, their marginal tax rates became lower than without any change in the tax base, holding other things constant. Thus, we should control for this "size" effect to ensure a consistent estimation of the ETI, such as by using broad income instead of taxable income or adding the overall change in the deduction into the empirical equation.

Nevertheless, a variation in deductions due to the Japanese tax reforms does not strongly affect the estimation of the ETI. Assuming a behavioral response to a deduction change is not present, the change in deduction appears as the ratio of a change in the deduction to current taxable income. Following the theoretical model developed by Gruber and Saez (2002), the size effect is expressed as follows:

$$d\log z = \zeta^c d\log(1-\tau) - \frac{dD}{z}, \qquad (2)$$

where z denotes taxable income, τ is the marginal tax rate, and D is the deduction. The derivation of Eq. (2) is presented in Appendix A. Analogous to Eq. (1) of Gruber and Saez (2002), $d\log z$ is the percentage change in taxable income, $d\log(1-\tau)$ is that in the marginal tax rate, and ζ^c represents the compensated elasticity of taxable income. A change in the applied deduction relative to taxable income, dD/z, represents the impact of the change in deduction in our regression. For our sample of extremely high taxpayers, this ratio is quite small; for example, for a married salaried worker with one spouse and two dependent children and earning an AGI of 50 million JPY, the ratio is about 0.002.[15] We could thus ignore the expansion of deductions in our estimation. Although there remains the potential for bias from changes in the tax base, this possibility seems to be negligible because such a change in deductions affects high taxpayers almost uniformly.

4. Data

The current study employs panel data on top taxpayers in Tokyo, Japan from 1986 to 1989, named *The List of Top Taxpayers*. The Japanese tax authority publicly notified high-income taxpayers from 1950 to 2005, and the name, address, and taxable income (until 1982) or tax liability (after 1982) were publicly posted on the boards of tax offices for a certain duration. Approximately 70–110 thousand people were subject to such a notification each year during the study period, of which about 120 million people lived in Japan. Although taxpayers with a tax liability of more than 10 million JPY (about 100 thousand USD) are contained in the original data, we focus on those who were reported in the lists from 1986 to 1989 and who

[15] Her/his deduction in 1986 was at least 5,415 thousand JPY (employment income deduction 4,095 thousand + basic deduction 330 thousand + spouse deduction 330 thousand + dependent deduction 330 thousand ×2), whereas her/his deduction in 1989 was at least 5,495 thousand JPY (employment income deduction 4,095 thousand + basic deduction 350 thousand + spouse deduction 350 thousand + dependent deduction 350 thousand ×2) (see, for example, http://www.cao.go.jp/zeicho/siryou/pdf/kiso11a.pdf).

lived in Tokyo during this period.[16,17] The income tax liabilities of the reference year and of the previous year are listed in the list if incomes or tax liabilities in both years are above the threshold for public disclosure. We then sampled the taxpayers reported in the top taxpayer lists in 1987 and 1989 and whose incomes in 1986 and 1988 were also reported, respectively, in the 1987 and 1989 lists. From this sampling procedure, a four-year panel dataset of top taxpayers was constructed, which consisted of their income tax liabilities, name and address (collected from the Japanese public notification records), and occupation.

The occupation variable contains information about types of jobs and company names for executives if the main incomes of respondents come from the described occupation and/or company. Then, limiting the sample to taxpayers of a certain occupation allows us to focus on those respondents whose main incomes came from labor income. Although labor and capital incomes are not completely distinguishable in our dataset, capital income accounts for only a small share of the AGI under the Japanese personal income tax at that time.[18] Thus

[16] The lower bonds of normalized taxable income to sample are approximately 34 million JPY in 1986, 33 million JPY in 1987, 32 million JPY in 1988 and 28 million JPY in 1989.

[17] We restricted the sample to Tokyo because a sufficient number of observations is available from Tokyo and collecting data on all top taxpayers in Japan is very difficult. Additionally, by restricting the location of taxpayers, it is possible to make conditions other than what is obtained from the data, such as regional economy and a change in real estate price, homogeneous.

[18] Many previous studies isolate and then eliminate capital income from the income data in order to address the great fluctuation in capital income (e.g., Gruber and Saez, 2002; Giertz,

including capital income in the AGI does not likely matter in the regressions of this study. As a robustness check, however, we estimate by choosing a sample of executives only, who are expected to earn most of their income from working as they were listed in the top taxpayer lists for several years. Because sex is not reported in the original data, our sex data are created by reference to the respondents' names, which can be used in Japan to identify sex in most cases. Taxpayers for which we could not discern their sex are omitted from the dataset. Panel data are constructed by matching the surname, given name, and address between the 1987 and 1989 top taxpayer lists.[19]

2007; Weber, 2014). In our dataset, although capital income may be included in AGI, the share of capital income could be quite small. First, as stated earlier, the sample employed in estimation is limited to the taxpayers whose main incomes are from labor income. Second, almost all interest income and most dividend income were subject to a separate withholding tax and thus not included in AGI. To be precise, Iwamoto et al. (1995) reveal that almost all interest income (specifically, more than 99.75%) was either subject to a separate withholding tax or exempt from taxation during the period we are interested in, in which most dividend income was subject to a separate withholding tax and thus only 20-30% of dividend income was included in AGI. Third, real estate transfer income was generally subject to a separate tax, too; capital gains were not taxed until 1988 and, after then, subject to a separate withholding tax. Other capital income such as real property income, however, was included in AGI.

[19] Because some high taxpayers have the same surname and given name, we use address as well to identify them correctly. Hence, we omit listed taxpayers who moved to another address during the sample period.

One concern about the dataset is the attrition of observations. The current strategy to create the database requires that selected taxpayers keep paying more than 10 million JPY income tax for four consecutive years, indicating that the proportion of the sample around the threshold is less dense than the actual income distribution. To deal with this problem, as a robustness check, we omit those who could have possibly dropped off the top taxpayer lists in each year. Specifically, we first estimate kernel density functions for each year to identify the maximums of the densities. As the extremely high income distribution in Japan typically follows a Pareto distribution[20] (e.g., Hasegawa et al., 2013; Souma, 2001), some taxpayers whose taxable incomes are below the maximum of the kernel density are omitted from the samples. Hence, Pareto density functions for every year are estimated by using taxpayers with taxable incomes above the maximum kernel density. Finally, we exclude from our sample taxpayers whose taxable incomes fall in the range where the Pareto probability densities are 10% greater than the kernel densities.[21] In the taxable income range where the Pareto densities are apparently greater than the kernel ones, attrition may occur. By setting the cut-offs below which the sample is omitted based on difference between the estimated

[20] Souma (2001) and Aoyama et al. (2011) point out that taxable income above about 20 million yen follows a Pareto distribution. Since the lower bound of *the List of Top Taxpayers* is well above this threshold, we can safely assume that the income distribution of our data should follow a Pareto distribution.

[21] The thresholds of taxable income to omit lower taxpayers are 46 million JPY in 1986, 45.7 million JPY in 1987, 42.1 million JPY in 1988, and 39.2 million JPY in 1989. The average threshold is 43.3 million JPY.

Pareto and kernel densities, we attempt to mitigate any bias from attrition in the regression.[22] The figures of the kernel density and Pareto distribution for every sample year and the related comments are provided in Appendix B.

Table 3 is inserted around here

Figure 1 is inserted around here

Table 3 presents the descriptive statistics of the data used in the estimation. Taxable incomes and tax liabilities are normalized by taxable income in 1989; the marginal tax rates are computed for the normalized taxable income and brackets of national and local income taxes. The log difference in taxable income, the marginal tax rates and those computed from lagged taxable income are quantified by using the weights of real taxable income. We see that on average, taxable incomes remain stable over time, whereas tax liabilities decrease steadily; indeed, the averages of marginal tax rates for our sample drop from about 81% to 65%. Since both the marginal tax rates and the number of brackets for high-income earners reduced in 1989, all the taxpayers in our sample faced the same marginal tax rate and the same one

[22] Since the top taxpayers list consists of tax file data submitted by March 31, some attrition from this list may be caused by delaying the tax filing. According to Hasegawa et al. (2013), approximately 1% of high taxpayers may have been dropped from this top taxpayers list, most of who were close to the threshold. We address this possible attrition as well by dropping people with a taxable income below the cutoff points.

predicted from the lagged taxable income, 65%. Finally, the sex dummy shows that most sampled taxpayers are men.

Figure 1 illustrates the average marginal tax rates (weighted by taxable income) and the average taxable incomes for the top 25%, median (top 50%), and bottom 25% taxpayers in our sample. As shown in Panel A, the average marginal tax rates for all taxpayers fell from around 86% to 65% in the sample period, showing a larger drop for higher taxpayers. By contrast, their taxable incomes increased over time; more specifically, taxpayers with higher taxable incomes rose largely, suggesting that taxpayers who faced a large decline in marginal tax rates are likely to increase their taxable incomes. This graphical evidence is in line with that of Kleven and Schultz (2014) and infers the existence of the positive ETI.

5. Estimation Results

5.1 Baseline Estimation

Table 4 is inserted around here

Table 4 provides the estimation results of the elasticity of taxable income with regard to the net-of-tax rates, using tax return data on top taxpayers in Japan. The OLS regression in column (1) shows a negative coefficient of the ETI, which is inconsistent with the intuitive prediction but consistent with the estimates of previous OLS estimations (e.g., Gruber and

Saez, 2002; Saez et al., 2012). The IV estimation excluding the log of taxable income, which can be used as a proxy for heterogeneous income growth as discussed above, in column (2) shows that the growth in taxable income is negatively and significantly correlated with that of the net-of-tax rate. Most previous empirical works have reported the same result, thus indicating that these counterintuitive results may reflect well-known problems with the econometric specification of income growth (e.g., Kleven and Schultz, 2014; Weber 2014).

Column (3) is our baseline regression. The IV regression with the log of taxable income being included provides a positive estimate of the ETI, supporting the existence of a positive elasticity with regard to the net-of-tax rate. The size of the ETI is about 0.074, which is smaller than earlier estimates, such as 0.4 in the 1980s of the United States by Gruber and Saez (2002), 0.26 in the 1990s in the United States (Giertz, 2007), and 0.5–0.6 by Saez et al. (2012); however, it is similar to others such as 0.06 (Kleven and Schultz, 2014). The estimate of the log of taxable income appears significant and negative, and its point estimate is close to previous ones such as -0.167 (see Table 4 of Gruber and Saez, 2002) and -0.165 (see Table 5 of Giertz, 2007). The sex dummies are all not strongly significant with small point estimates.

As in column (4), omitting low-income taxpayers by setting the thresholds at 39–46 million JPY does not change the ETI estimate dramatically, with an 0.055 point estimate of the ETI. In column (5), we incorporate the occupation dummies as controls to address the endogeneity problem stemming from the correlation between permanent income and income level. This estimation yields an ETI estimate of 0.072, very close to that of the baseline estimate.

It follows that, as seen in columns (3)–(5), the ETI for Japanese top taxpayers is around 0.074–0.055. One reason for this relatively small estimate is that the standard deduction for salaried workers in Japan (i.e., the employment income deduction) is generous[23] to the point that few salaried workers choose an itemized deduction instead of a standard deduction. It seems that partly because taxpayers have no choice of deduction, the ETI in Japan is less than that in the United States, where almost half of the ETI can be explained by the choice of deductions (Slemrod and Kopczuk, 2002; Kopczuk, 2005). Because of the disadvantage of the ETI in terms of deduction choice, recent ETI studies have estimated broad income elasticity; however, as stated above, broad income elasticity is not comparable with the ETI estimates obtained in previous studies as broad income is much bigger than the corresponding taxable income. Thus, the ETI estimates free from bias from the possibility of deduction choice give some novelty and insight in this literature.

5.2 Robustness Check and Extended Estimation

The results for the robustness checks are provided in Table 5. Giertz (2007) argues that an ETI estimate is sensitive to income weighting in the regressions: specifically, the absence of a broad or taxable income weight remarkably decreases estimates of the ETI compared with

[23] The standard deduction in Japan (i.e., the employment income deduction) for salaried workers increases with one's salary, whereas the standard deduction for US taxpayers is constant. Moreover, the standard deduction for high-earning Japanese workers is more than three times that for US workers.

those estimated with these weights, although standard in this literature. We thus model a regression without a taxable income weight and obtain an ETI of 0.064 (see column (1)).

Table 5 is inserted around here

Another identification strategy for the problem about income data is to sample only executives of companies. As shown in column (2), this regression yields a slightly large and significant ETI estimate of 0.08. Conversely, as in column (3), eliminating the executives from the sample leads to a smaller and insignificant estimate of 0.054. This finding suggests that the ETIs estimated earlier are robust even if the issues on the definition of the income variable are taken into account.

The estimation in column (4) utilizes the entire sample, including the high taxpayers omitted because their tax liabilities fell below the thresholds of the top taxpayer lists in either of the sample years, with more than twice the number of observations in the baseline. The regression finds a significant and positive estimate of approximately 0.13, larger than that in the baseline. Because this regression contains the sample excluded from the original, this result is partly attributed to mean reversion, thereby yielding an upward bias of the estimate. Overall, the regressions in the robustness check demonstrate that the ETI estimates are robust to alternative specifications and sampling approaches and that the results in this table seem to be in line with conventional arguments about the ETI, such as mean reversion (e.g., Saez et al., 2012).

Table 6 is inserted around here

The estimates of the other extended regressions are presented in Table 6. Column (1) provides the coefficients from a spline regression and shows that the usage of a four-piece spline instead of the log of taxable income lowers the ETI estimate to 0.046. However, this result does not seem to be serious for the present analysis. Since the used data are composed of extremely high taxpayers, their income growth trends are expected to be similar and thus not necessarily controlled for by the splines.

Another argument regarding the ETI is the duration of a taxpayer's behavioral response. As discussed in Weber (2014), arbitrary choices of one-year or several-years difference in the log of taxable income in the period when a tax reform is phased in may bias an ETI estimate. Neither a short-term response—usually defined as a one-year difference—nor a long-term one—more than a three-year difference—may measure the intended responses correctly because several changes to a tax scheme may affect the responses in such a phased-in duration. To deal with this problem, we assess the short-term response to the 1987 tax change by taking the difference in the log of taxable incomes between 1986 and 1987 and the long-term response by taking the difference between 1986 and 1989. As shown in columns (2) and (3), the short-term response is 0.131, greater than the baseline estimate, and significant, whereas the long-term one is quite small and insignificant. These findings support the existence of a short-term response to the Japanese income tax reform, but not the emergence of a significant long-term response.

6. Concluding Remarks

The current study estimates the ETI with regard to the net-of-tax rate, using data on Japanese top taxpayers during 1986–1989. We pay close attention to the drastic tax reforms in 1987 and 1988, which diminished the top marginal income tax rates sharply and largely broadened income tax deductions and exemptions, and estimate how taxpayers responded to the change in the marginal tax rates in Japan.

The data on top taxpayers are four-year panel and tax return data, including demographic information such as sex and occupation. One advantage of our dataset is that the Japanese personal income tax provided no choice of standard or itemized deduction, which allows us to estimate the elasticity of taxable income precisely. Another advantage is that the sample period of the data covers the major income tax reforms and represents the period during which the top income distribution in Japan remained stable. Although the standard estimation approach in this literature is to adopt the "mechanical" effect of the net-of-tax rate as an IV and the lags of taxable income as a control to address relevant econometric issues, other empirical concerns arise for the current estimation: the correlation between lagged income and permanent income, attrition from the top taxpayer lists, and definition of income. To deal with these issues, we carried out regressions that included the occupation variables in the estimation equation and restricted the sample to only extremely high taxpayers or executives of companies.

Based on the presented analysis, we find that the ETI with regard to the net-of-tax rate is about 0.074–0.055 in Japan. Moreover, the ETI estimates of other approaches, such as restricting the sample to extremely high-income earners, using a non-income weighting regression, using occupation dummies, and adopting a four-piece spline of taxable income as controls, are significant and positive with almost the same point estimate. Overall, we show that the ETI for Japanese top taxpayers is smaller than those in Canada, Germany, Hungary, Sweden, and the United States, but nearly equal to that in Denmark.

Nevertheless, there may be some caveats left in this study. One is that the elasticity of broad income is not estimated. As recent studies have drawn attention to the estimation of broad income elasticity because of the possibility of deduction choices (Chetty, 2009; Kopczuk, 2005), the estimation of the ETI and broad income elasticity and comparison between them are preferable and insightful for this literature. This comparison, however, is impossible for the present study because of the absence of broad income data. Another is that the ETI obtained here is just a Japanese case. Although the small ETI estimates here appear because the ETI, not broad income elasticity, is estimated and because of no choice of deductions in Japan, other factors specific to Japan may generate this result, such as tax moral, effectiveness of tax inspection, and so on. Further studies are needed to investigate the effects of these factors.

Appendix A. Derivation of Eq. (2)

A taxpayer maximizes utility with regard to consumption, c, and taxable (reported) income, z, subject to a budget constraint whose linear part in terms of the tax schedule is expressed as

$c = (Y - D)(1 - \tau) + R = z(1 - \tau) + R$, where Y is pre-tax income and R denotes virtual income. From the maximization problem, we derive a reported income function, $z = z(1 - \tau, D, R)$, where the function depends on the net-of-tax rate, the deduction, and virtual income. Taking the total derivative of z with regard to τ, D, and R yields

$$dz = -\frac{\partial z}{\partial(1-\tau)}\, d\tau + \frac{\partial z}{\partial D}\, dD + \frac{\partial z}{\partial R}\, dR. \qquad (3)$$

In the ETI literature, the uncompensated ETI with regard to the net-of-tax rate is represented by $\zeta^u = [(1-\tau)/z]\, \partial z/\partial(1-\tau)$; the income effect is $\eta = (1-\tau)\partial z/\partial R$. From the budget constraint, $\partial z/\partial D = -1$. Then, Eq. (3) is rewritten as

$$dz = -\zeta^u \frac{z}{1-\tau}\, d\tau - \, dD + \frac{\eta}{1-\tau}\, dR. \qquad (4)$$

By using the Slutsky equation $\zeta^u = \zeta^c + \eta$ and dividing both sides of Eq. (4) by z, we obtain

$$\frac{dz}{z} = -\zeta^c \frac{d\tau}{1-\tau} - \frac{dD}{z} + \eta\, \frac{dR - z d\tau}{z(1-\tau)}. \qquad (5)$$

Without the income effect and taking a logarithm form of this equation, Eq. (2) follows from Eq. (5).

Appendix B. Figures of Kernel Density and Pareto Distribution

Figure A1 depicts the fitted curves of the kernel and Pareto densities as well as the histograms of taxable income for 1986–1989. For every histogram, the densities of taxable income peak between 30 million and 40 million JPY, above which they decline with taxable income. Although our observations concur with the finding that the top 1% taxable income, including taxpayers in our sample, follows a Pareto distribution (Souma, 2001), this tendency does not hold at the low end of taxable income. As stated above, the thin densities at the low income level may occur because of our sampling strategy (i.e., only taxpayers who appear in the original data for all sample years are employed in the estimation).

Figure A1 is inserted around here

Moreover, the kernel density estimates of all panels mostly trace the densities of the histogram with only one peak where taxable incomes are below 40 million JPY. By contrast, the fitted Pareto densities exhibit a consistent downward sloping pattern. Below a taxable income of 50 million, they exceed the corresponding kernel densities steadily and greatly as taxable income declines, and the disparities between the Pareto densities and kernel estimates appear the largest when taxable incomes are the smallest. Indeed, the comparison of the Pareto and kernel densities highlights the remarkable attrition in our sample. As a robustness check, we thus use the sample without taxpayers earning less than about 43 million JPY.

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Table 1. Transition of the Marginal Tax Rate of Individual Income Tax (National Tax), 1950-2015

1950		1953		1969		1984		1987		1989		1995		1999		2007		2015	
MTR	TI	MTR	TI	MTR	TI	MTR	TI	MTR	TI	MTR	TI	MTR	TI	MTR	TI	MTR	TI	MTR	TI
																5%	1,950	5%	1,950
				10%	300					10%	3,000	10%	3,300	10%	3,300	10%	3,300	10%	3,300
						10.5%	500	10.5%	1,500										
						12%	1,200	12%	2,000										
				14%	600	14%	2,000												
		15%	20																
								16%	3,000										
						17%	3,000												
				18%	1,000														
20%	50	20%	70					20%	5,000	20%	6,000	20%	9,000	20%	9,000	20%	6,950	20%	6,950
						21%	4,000												
				22%	1,500														
																23%	9,000	23%	9,000
25%	80	25%	120			25%	6,000	25%	6,000										
				26%	2,000														
30%	100	30%	200	30%	2,500	30%	8,000	30%	8,000	30%	10,000	30%	18,000	30%	18,000				
																33%	18,000	33%	18,000
				34%	3,000														
35%	120	35%	300			35%	10,000	35%	10,000										
														37%	18,000-				
				38%	4,000														
40%	150	40%	500			40%	12,000	40%	12,000	40%	20,000	40%	30,000			40%	18,000-	40%	40,000
				42%	5,000														
45%	200	45%	1,000			45%	15,000	45%	15,000									45%	40,000-
				46%	7,000														
50%	500	50%	2,000	50%	10,000	50%	20,000	50%	30,000	50%	20,000-	50%	30,000-						
55%	500-	55%	3,000	55%	20,000	55%	30,000	55%	50,000										
		60%	5,000	60%	30,000	60%	50,000	60%	50,000-										
		65%	5,000-	65%	45,000	65%	80,000												
				70%	65,000	70%	80,000-												
				75%	65,000-														

Notes : This table describes the marginal tax rates and their thresholds in years 1950–2015. MTR denotes the marginal tax rate (%); TI taxable income (one thousand JPY; about 10 USD).

Table 2. Definitions of Variables, Units, and Sources

Variable	Definition	Unit
Taxable income (TI)	Taxable income of individual income tax	Thousand JPY
Income tax liabilities	Tax liabilities computed from the taxable income by applying the progressive tax rates of the Japanese income tax	Thousand JPY
Marginal tax rate	Marginal tax rate of income tax, computed from the taxable income; the marginal tax rate comprises an income tax rate and local tax rates for residents' income	Percentage
Marginal tax rate, computed from lagged TI	Marginal tax rate calculated by applying the income tax rate of the current year to one-year lagged taxable income	Percentage
Sex dummy	A dummy that takes the value one for men	-
Occupation dummies	Dummies for specific occupations: president, executive advisor, vice president, board member, administrative officer, hospital director, doctor, dental manager, dentist, school manager, professor, law and accounting office manager, lawyers and accountants, chief priest, entertainer, sport player, artist, agriculture worker, public servant, politician, businessman	-

Notes: The table reports the definitions and units of the dependent and explanatory variables and related variables. One JPY is equal to approximately 0.01 USD. All variables are sourced from *The List of Top Taxpayers* in 1986-1989.

Table 3. Descriptive Statistics, 1986–1989

	1986	1987	1988	1989
Taxable income (TI)	73,144	73,276	71,036	71,606
	(75499)	(80870)	(130109)	(158007)
Income tax liabilities	52,418	49,083	45,052	42,334
	(66018)	(62996)	(98772)	(102705)
log(forward TI / TI)	-0.08	-0.12	-0.24	-
	(0.39)	(0.50)	(0.73)	-
Marginal tax rate	0.814	0.738	0.714	0.65
	(0.05)	(0.03)	(0.05)	-
Marginal tax rate,	-	0.738	0.713	0.65
computed from lagged TI	-	(0.03)	(0.05)	-
Sex dummy	0.96	0.96	0.96	0.96
	(0.20)	(0.20)	(0.20)	(0.20)
Observations	4371	4371	4882	4882

Notes : The table reports the summary statistics of key variables in 1986–1989. The upper line in each row indicates the means; the values within parentheses, standard deviations. Units of income tax liabilities and taxable income are thousand JPY (about 10 USD), and units of the marginal tax rate and that calculated from lagged TI are percentages. Taxable income is normalized by its growth rates evaluated at the 1989 level; the two marginal tax rates are computed based on the normalized taxable income.

Table 4. Estimation of the ETI with regard to the Net-of-Tax Rate

	OLS	IV Estimation without Log(TI)	Baseline: IV Estimation with Log(TI)	Sample with High Taxable Income	Include Occupation Dummy
	(1)	(2)	(3)	(4)	(5)
Elasticity wrt (1- τ)	-0.245***	-0.193***	0.074***	0.055**	0.072***
	(0.025)	(0.023)	(0.026)	(0.028)	(0.026)
Log(TI)	-0.142***		-0.190***	-0.202***	-0.193***
	(0.015)		(0.016)	(0.020)	(0.016)
Sex dummy	-0.002	0.012	-0.004	-0.017	-0.003
	(0.016)	(0.016)	(0.017)	(0.020)	(0.017)
Observations	13624	13623	13623	9717	13623
Adjusted R^2	0.082				
Centered R^2		0.034	0.064	0.069	0.067

Notes : The table reports the estimation results of the ETI with regard to the net-of-tax rate, using panel data on Japanese top taxpayers from 1986 to 1989. Standard errors adjusted for clusters are in parentheses; *, **, and *** denote significance at 10%, 5%, and 1%, respectively. Every estimation includes year dummies, and is weighted by the log of taxable income. Basically, the sample is restricted to individuals listed in *The List of Top Taxpayers* in the four years and whose main income came from working. Column (4), however, adopts an alternative sample, which is restricted to extremely high taxpayers who are expected not to drop out of the sample during the sample period.

Table 5. Estimation of the ETI with regard to the Net-of-Tax Rate (Robustness Check)

	Non-Income Weighted Regression	Employ Only Executives	Exclude Executives from Sample	Use All Observations
	(1)	(2)	(3)	(4)
Elasticity wrt (1- τ)	0.064***	0.080**	0.054	0.128***
	(0.025)	(0.031)	(0.046)	(0.020)
Log(TI)	-0.183***	-0.192***	-0.186***	-0.263***
	(0.014)	(0.019)	(0.028)	(0.011)
Sex dummy	-0.007	-0.001	-0.014	-0.014*
	(0.016)	(0.023)	(0.019)	(0.008)
Observations	13624	10502	3122	29829
Centered R^2	0.058	0.061	0.083	0.090

Notes : The table reports the estimation results of the robustness check. Standard errors adjusted for clusters are in parentheses; *, **, and *** denote significance at 10%, 5%, and 1%, respectively. Every estimation includes year dummies, and is weighted by the log of taxable income except for column (1) (where no weights are used). The sample of column (2) is restricted to the top taxpayers who worked as an executive, whereas that of column (3) is restricted to those who did not work as it. Column (4) uses all the samples collected in our study.

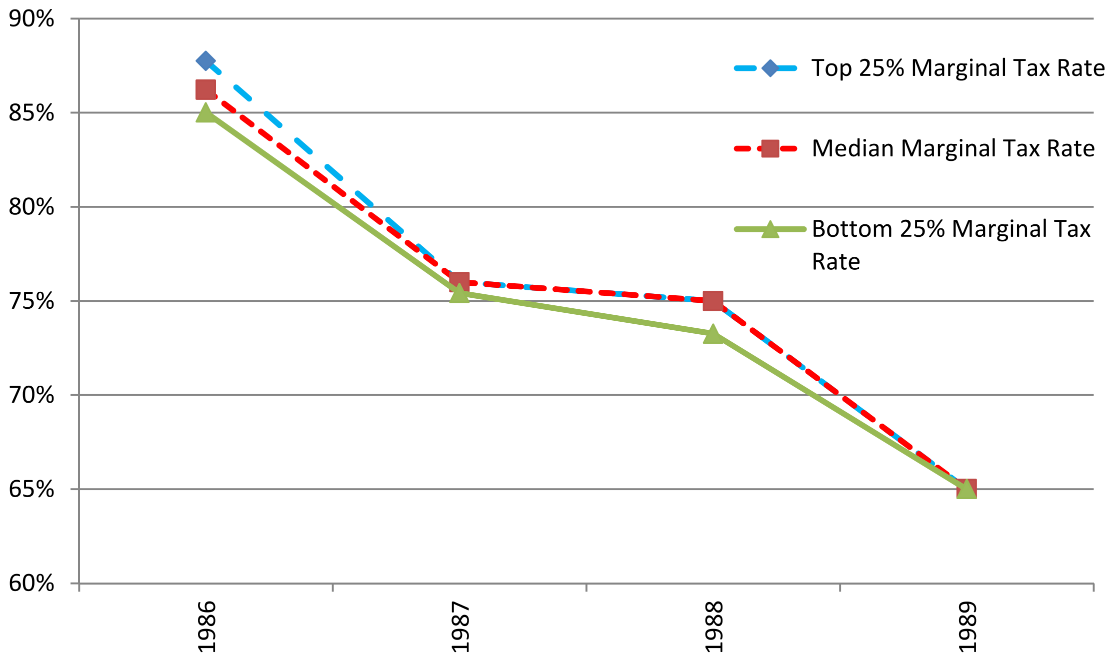
Table 6. Extended Estimation of the ETI with regard to the Net-of-Tax Rate

	4-Piece Spline	Short-term Response, 1986-87	Long-term Response, 1986-89
	(1)	(2)	(3)
Elasticity wrt (1- τ)	0.046*	0.131**	0.009
	(0.026)	(0.056)	(0.066)
Log(TI)		-0.175***	-0.194***
		(0.031)	(0.044)
Sex dummy	-0.008	-0.017	0.035
	(0.017)	(0.029)	(0.031)
1st spline	-0.317***		
	(0.061)		
2nd spline	-0.217***		
	(0.054)		
3rd spline	0.120***		
	(0.043)		
4th spline	-0.291***		
	(0.034)		
Observations	13623	4371	4371
Centered R^2	0.078	0.028	0.047

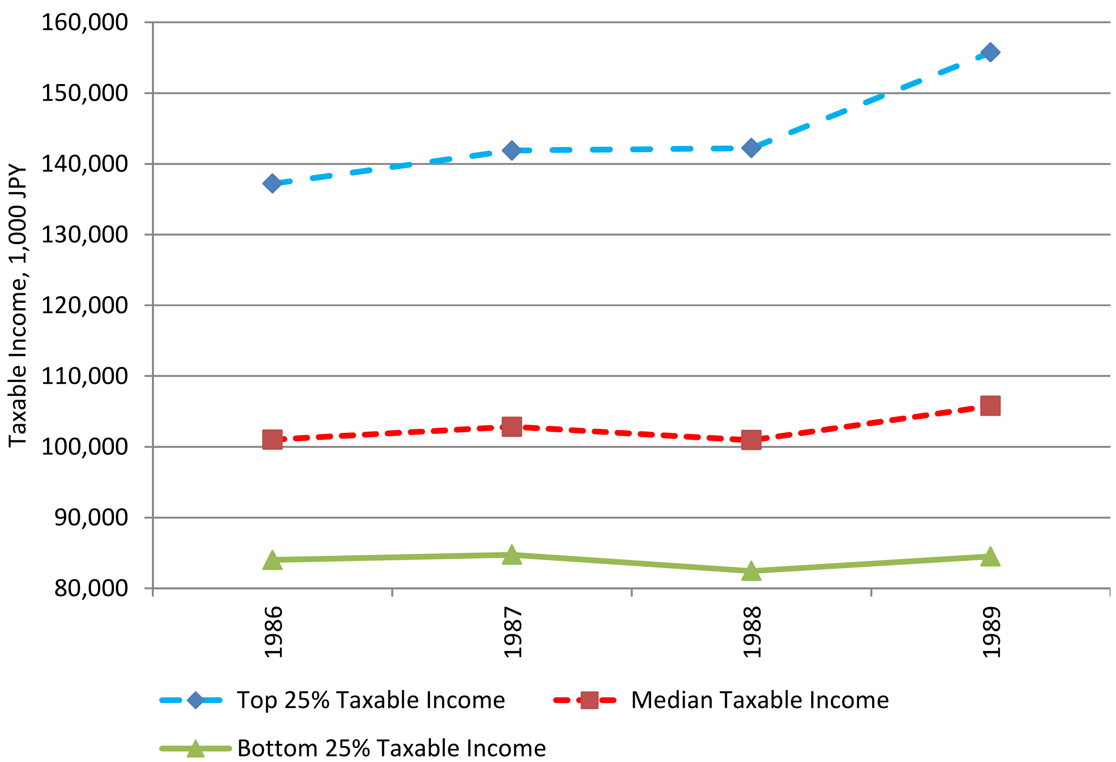
Notes : The table reports the results of the other relevant regressions of the ETI. Standard errors adjusted for clusters are in parentheses; *, **, and *** denote significance at 10%, 5%, and 1%, respectively. Every estimation includes year dummies, and is weighted by the log of taxable income. Column (1) includes four-piece splines; in columns (2) and (3), the samples are restricted to the taxpayers, respectively, in years 1986 to 1987 and in years 1986 and 1989.

Figure 1. Marginal Tax Rates and Taxable Income for the Top 25%, Median (top 50%) and Bottom 25% Taxpayers

Panel A. Marginal Tax Rates



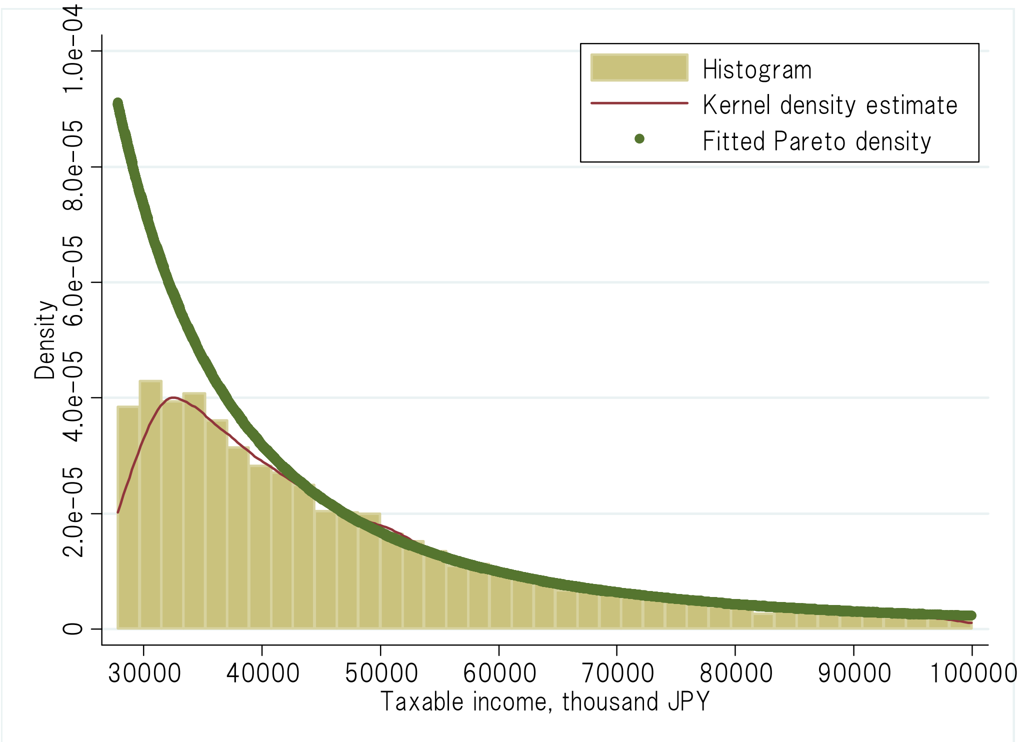
Panel B. Taxable Income



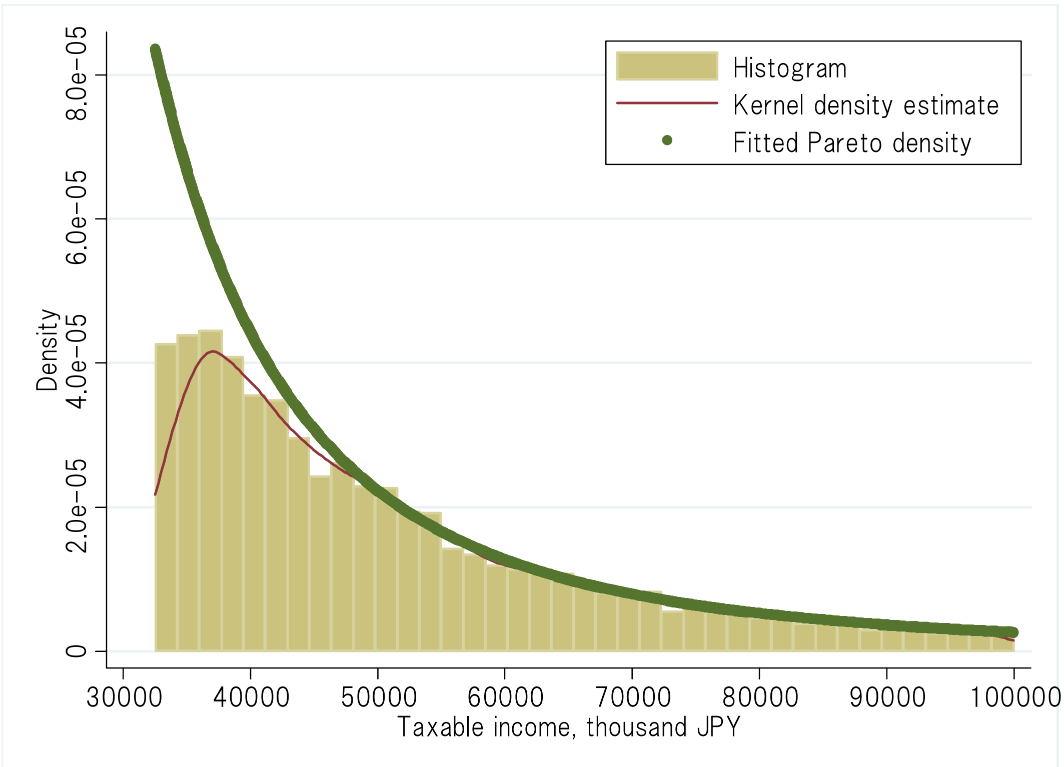
Notes: Computations in both panels are based on the sample used in our baseline regression. The marginal tax rates and taxable incomes are averaged with taxable income weights. One JPY is about 0.01 USD.

Figure A1. Histogram, Kernel Density, and Fitted Pareto Density of Taxable Income, 1986–1989

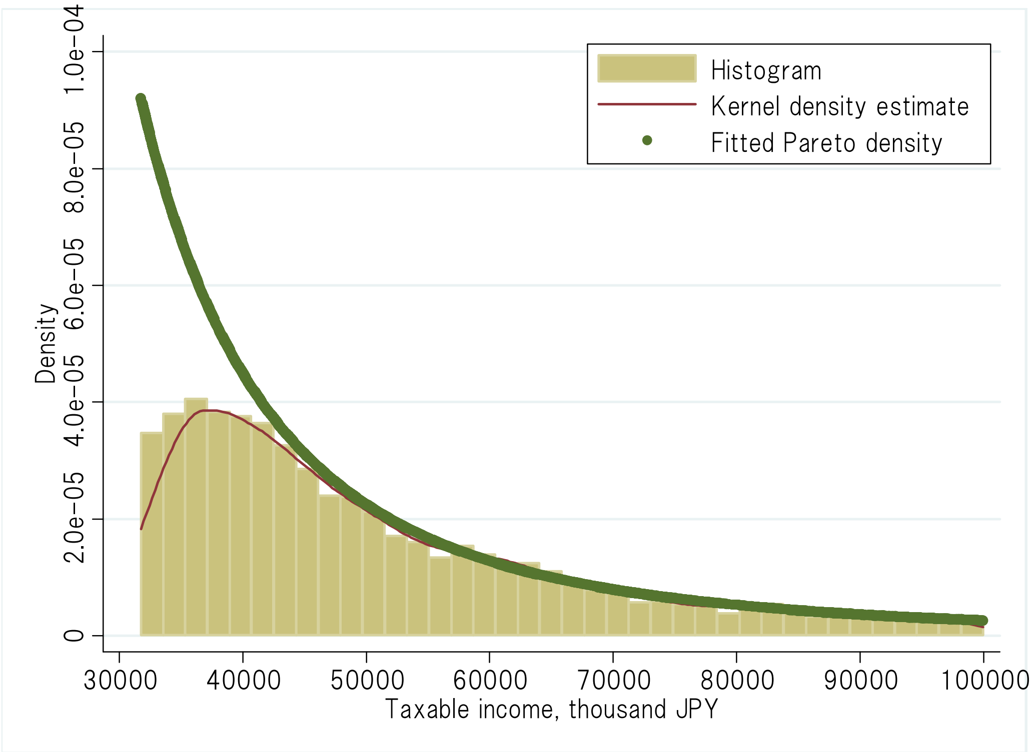
Panel A. Year 1986



Panel B. Year 1987



Panel C. Year 1988



Panel D. Year 1989