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Abstract

In this study, we recast the formula of the social marginal cost of public funds (SMCF) and highlight the role of what we call individual marginal costs of public funds (IMCF). After elaborating on aspects of distributional weights, we estimate the wage elasticity of labor supply and the IMCFs on a household basis. This allows us to explore not only the distributions of the elasticity and the IMCFs but also their relations to household income, which helps us assess the assumptions made in previous studies. Further, we use the SMCF estimates to evaluate the system of personal income taxes in Japan.

***Keywords**:* social marginal cost of public funds, distributional weights, progressive taxation, Japan

***JEL classification**:* H 21, H 24, H 31, J 22

1. INTRODUCTION

The marginal cost of public funds (MCF) functions as a multiplier that yields the effective cost of a public program. Furthermore, MCFs calculated over different tax bases indicate a desirable direction for tax changes. With these uses of the MCF in mind, the literature has provided a series of MCF estimates.[1] However, the earlier estimates assume a homogeneous economy and do not allow for the fact that households are heterogeneous. Therefore, the concept of the "social marginal cost of public funds" (SMCF)—an analogue to the MCF—has been developed that allows for heterogeneous households (Dahlby 1998; Sandmo 1998) and clarifies further aspects of the concept (Yitzhaki 2003; Gahvari 2006; Kleven and Kreiner 2006; Liu 2006). Despite these developments, only a few studies have actually estimated the SMCF (Poapongsakorn et al. 2000; Kleven and Kreiner 2006). This is understandable, since, as we shall see, there is not much significance in quantifying the SMCF per se. In addition, its estimation is a daunting task. The SMCF is a sum of individual marginal costs of public funds (ICMF) that are multiplied by distributional weights. Its estimation requires (i) specifications of social welfare and individual utility functions, (ii) estimates for the wage elasticity of labor supply *on an individual basis*, and (iii) data for individual household characteristics. However, existing studies dodge these requirements by assuming the following aspects. First, the wage elasticity of labor supply is identical within an income group. Second, the wage elasticity is identical in all income groups or increases with the income level of the group. Lastly, the distributional weight is expressed as a simple power function of a relative income level or is simply set to unity.

This study aims to improve on these approaches by presenting the SMCF that exploits micro-data from individual households. First, our SMCF formula differentiates *every* individual household. In particular, we utilize an individual-level component of the SMCF called the "individual marginal cost of public funds" (IMCF) — an analogue of the MCF at the household level. Since this requires wage elasticity estimates on an individual basis, we cannot borrow such estimates from existing empirical studies. Instead, we estimate individual labor supply responses from scratch and apply micro-data that contain a variety of household characteristics. This not only enables us to examine how wage elasticities and the IMCFs are distributed but also allows us to explore how they are related to income level and determine the validity of assumptions made in previous studies.

Second, we elaborate on aspects of distributional weight. We employ a utility function with constant elasticity of substitution (CES) and a social welfare function (SWF) with constant inequality aversion (CIA). The former is a standard form in tax simulation studies (Shoven and Whalley 1992), and the latter is a popular specification for social preferences (Boadway and Bruce 1984). With this setup, we show that the distributional weight, with specific restrictions imposed, turns out to be a power function of relative income. Further, we point out that the income used in the weight should not be actual income but "full income" obtained from linearization of the piecewise linear budget constraint if progressive income taxes are in place. In addition, we show that if the degree of inequality aversion is unity and individual preferences are homothetic, the distributional weight becomes the inverse of full income, which may be simple enough for practical uses.

Lastly, we conduct two types of tax evaluation. The first is concerned with the optimality of progressive income taxes. Given that weighted IMCFs are equalized across individuals when social welfare is maximized, we can examine such optimality by examining the distribution of the weighted IMCFs. While a perfect equalization may not be feasible, the weighted IMCFs should cluster more closely than otherwise if tax instruments are appropriately exploited. The second exercise draws on the SMCF estimates to identify an optimal flat-tax system and compare it to the existing system of progressive taxation. A flat tax is simple enough to be characterized by an exemption income and a flat rate. In the case that a tax system is likely to be misadjusted to the extent that it is complex, a flat tax may outperform the current progressive tax system when the former is optimally designed. Since the second exercise relies on a sample of single-male households, we regard it as an example; nonetheless, it should be readily transferrable to a full-fledged data set and warrants adequate evaluation as a policy option.

The remainder of the article is organized in the following manner. Section 2 sets up the model and presents our version of the SMCF formula. It also specifies the model and elaborates on distributional weights derived from the CES CIA specification. Section 3 draws on Japanese data to estimate labor supply elasticities and the IMCFs and examines their respective distributions. Section 4 conducts two exercises on progressive-tax and flat-tax systems. Section 5 provides the conclusion to this article.

2. SOCIAL MARGINAL COST OF PUBLIC FUNDS

2.1. The SMCF Formula and Comparisons to Previous Studies

Assume that individual i consumes a numéraire x_i and leisure l_i and obtains utility $v_i = u(x_i, l_i)$. His time endowment is expressed as T, so that his hours worked are expressed as $h_i = T - l_i$. His net wage rate is given as $w_i \equiv (1 - m_i)W_i$ where W_i and m_i are his pre-tax wage rate and marginal tax rate respectively. The tax system is progressive, so he faces different marginal tax rates as his labor income $Y_i \equiv W_ih_i$ changes. This makes his budget line piecewise linear, and when choices are made off the kink points of the budget line, the constraint can be represented as a linear budget constraint with slope w_i and virtual income y_i.[2] The following indirect utility function is obtained for of individual i:

$$v_i \equiv \max_{x_i, h_i} \left\{ u(x_i, T - h_i) \mid x_i = w_i h_i + y_i, h_i \leq T \right\}.$$

We follow Dahlby (1998) in setting aside the revenue effect of public services. The SMCFs are used to examine whether the existing tax system could be reformed—for example, by raising tax rates with low SMCFs and lowering tax rates with high SMCFs. Since this is a case of a revenue-neutral tax reform, it holds expenditures constant. In another case, the SMCF might be used to perform a cost-benefit analysis on a public project financed by labor income taxes. The revenue effects of the project could be evaluated on the benefit side, not the cost side, since these impacts would vary among projects (Mayshar 1990; Dahlby 1998; Sandmo 1998; Liu 2004, 2006). This case, too, holds expenditures constant.

Social welfare is indexed by the SWF of the Bergson-Samuelson type: $S = S(\boldsymbol{v})$ where $\boldsymbol{v} = (v_1, \ldots, v_i, \ldots, v_n)$ is a vector of utilities of the n individuals in the society. The tax revenue collected from individual i is R_i, with individual values being aggregated into the total tax revenue R. Then, the SMCF is defined as a reduction in S caused by a unit increase in R:

$$SMCF \equiv -\frac{dS}{dR}, \tag{1}$$

where changes in the tax system affect both v_i and R_i for some or all i's while dS and dR are nonzero. Next, we define the IMCF for i as a reduction in individual welfare due to an increase in taxes:

$$IMCF_i \equiv -\frac{dv_i / (\partial v_i / \partial y_i)}{dR_i} = \left[1 - \frac{m_i}{1-m_i}\left(\eta_i^c \frac{dm_i}{d\bar{a}_i} + \phi_i\right)\right]^{-1}, \qquad (2)$$

where $\eta_i^c \equiv (\partial h_i/\partial w_{i|u})(w_i/h_i)$ is the compensated wage elasticity of labor supply, $\phi_i \equiv w_i\partial h_i/\partial y_i$ is income effect, and $d\bar{a}_i$ is a change in the average tax rate before the individual's response occurs. The derivation of the far-right expression in (2) is analogous to Dahlby (1998).

Calculating the IMCF (and the SMCF) requires a specific pattern of tax changes, which can take various forms in the case of progressive income taxes. A plausible pattern is the one that maintains a degree of progressivity. Dahlby (1998) provides three SMCF formulae, each of which maintains one of the three types of tax progressivity characterized by Musgrave and Thin (1948) in terms of (i) average tax rate a_i, (ii) tax liabilities R_i, and (iii) residual income $Y_i - R_i$. In this study, we limit our analysis to tax changes that keep the average rate progression (ARP) constant. By setting $dm_i = d\bar{a}_i$ in (2), we obtain the IMCF that holds the ARP constant as

$$IMCF_i = \left[1 - \frac{m_i}{1-m_i}\eta_i\right]^{-1}. \qquad (2')$$

Here, what matters is solely the value of the uncompensated elasticity and not how this is decomposed into compensated elasticity and income effect.

Since (2) implies $dv_i = -(\partial v_i/\partial y_i)\cdot IMCF_i\cdot dR_i$, we obtain

$$dS = \sum_i \frac{\partial S}{\partial v_i} dv_i = -\sum_i \beta_i \cdot IMCF_i \cdot dR_i \text{ , where}$$
$$\beta_i \equiv \frac{\partial S}{\partial v_i}\frac{\partial v_i}{\partial y_i} \qquad (3)$$

is the marginal social welfare of i's income. Then, the SMCF defined as (1) becomes

$$SMCF = \sum_i \beta_i \cdot \frac{dR_i}{dR} \cdot IMCF_i \ , \qquad (4)$$

which allows for heterogeneous consumers *within* an income bracket. Furthermore, it is evident from (4) that the SMCF is the twice-weighted sum of the IMCFs. If efficiency is the only concern ($\beta_i = 1$), i's IMCF ($IMCF_i$) is weighted only with his share of revenue change (dR_i/dR) so that (4) will be $\sum_i(dR_i/dR)IMCF_i$. If taxes are not distortionary ($IMCF_i = 1 \forall i$) without distributional concerns, then (4) becomes unity, since

$\sum_i dR_i/dR = 1$. If there are distributional concerns, $(dR_i/dR)IMCF_i$ is now weighted with β_is to yield (4).[3] Note that (4) does *not* become unity even if taxes are not distortionary, since the combination of the two weights $\beta_i dR_i/dR$ does not generally add up to unity.

Other studies measure distributional weight in different units. For example, Liu (2006) expresses (4) in units of income of a reference individual k in the following manner:

$$SMCF_{Liu} = \sum_i \omega_i \cdot \frac{dR_i}{dR} \cdot IMCF_i \text{, where } \omega_i \equiv \frac{\beta_i}{\beta_k} \quad (5)$$

[4]

Further, Sandmo (1998) expresses (4) with average distributional weights $n^{-1}\sum_j \beta_j$:

$$SMCF_{Sandmo} = n\sum_i \lambda_i \cdot \frac{dR_i}{dR} \cdot IMCF_i \text{, where } \lambda_i \equiv \frac{\beta_i}{\sum_j^n \beta_j} = \frac{\omega_i}{\sum_j^n \omega_j}. \quad (6)$$

Therefore, we can relate (5) and (6) to (4) as

$$SMCF = \beta_k \cdot SMCF_{Liu} = \left(n^{-1}\sum_j^n \beta_j\right) \cdot SMCF_{Sandmo}. \quad (7)$$

Since the SMCF could be expressed in different units of measurement, there is not much significance in quantifying the values of the SMCF per se (Gahvari 2006). However, its values can have significance, for example, when the SMCFs from different tax instruments are compared to each other or when the social cost of a public project is compared to its social benefit, with both outcomes being evaluated using the same set of distributional weights. Therefore, in the following account, we do not obtain specific values of the SMCF per se, except in cases without distributional concerns.

2.2. Preference Specifications and Distributional Weights

We specify individual i's preferences as the following CES utility:[5]

$$v_i = [x_i^{-\mu} + \kappa_i \cdot (T - h_i)^{-\mu}]^{-1/\mu}, \quad (8)$$

where κ_i is a weight on leisure that expresses differences in preferences and μ defines the constant elasticity of substitution $\gamma \equiv 1/(1+\mu)$. When the individual consumes off the kink points of his piecewise linear budget line,[6] his labor choice is

$$h_i = \frac{T \cdot (w_i/\kappa_i)^{1/(1+\mu)} - y_i}{w_i + (w_i/\kappa_i)^{1/(1+\mu)}}, \quad (9)$$

which yields the following uncompensated wage elasticity of labor supply

$$\eta_i = \frac{w_i}{h_i} \cdot \frac{y_i + [1/(1+\mu)] \cdot (w_i / \kappa_i)^{1/(1+\mu)} \cdot (y_i / w_i - \mu T)}{[w_i + (w_i / \kappa_i)^{1/(1+\mu)}]^2}. \tag{10}$$

The estimates for these values depend on the time endowment T, an issue that we will elaborate on later. The indirect utility function for (8) will be $v_i = \pi(w_i;\ \kappa_i)\cdot I_i$ where $I_i \equiv w_i T + y_i$ is "full income" and

$$\pi_i \equiv \frac{[\kappa_i + (w_i / \kappa_i)^{-\mu/(1+\mu)}]^{-1/\mu}}{w_i + (w_i / \kappa_i)^{1/(1+\mu)}} \tag{11}$$

is the marginal utility of income. Note that (11) is independent of income since (8) is homothetic and is different among households if w_i and κ_i are also different.

We specify the SWF in a CIA form as

$$S(\boldsymbol{v}) = \sum_i \frac{v_i^{1-\theta} - 1}{1-\theta},$$

(12)

where $\theta > 0$ is a degree of inequality aversion. With reference to (8), the weight (3) becomes

$$\beta_i = \pi_i^{1-\theta} \cdot I_i^{-\theta}, \tag{13}$$

which is a geometric average of the inverse of full income ($1/I_i$) and the marginal utility of income (π_i) with the degree of inequality aversion (θ) as a "weight" (which, however, could be more than unity). Thus, holding other factors constant, an individual with a smaller (larger) I_i receives a larger (smaller) weight in the social evaluation. Given (15), the distributional weight in (5) by Liu (2006) can be expressed as

$$\omega_i = (\pi_i / \pi_k)^{1-\theta} \cdot (I_k / I_i)^{\theta}. \tag{14}$$

If leisure prices (w_i) and individual preferences (κ_i) are identical among households,[7] (14) reduces to a power function of the full-income ratio, $\omega_i = (I_k/I_i)^{\theta}$, which is analogous to the distributional weight used in several previous studies (Dodgson, 1980, 1983; Brent, 1984; Poapongsakorn et al., 2000).[8] However, two aspects are worth emphasizing. First, while previous studies used *observed* income ($w_i h_i$ or $W_i h_i$), we use full income ($I_i = w_i T + y_i$). Second, $\omega_i = (I_k/I_i)^{\theta}$ is not justifiable if progressive taxation is in place since such a tax system at least presumes that households have different leisure prices.

There is an important exception. When the SWF is Nash ($\theta \rightarrow 1$ or $S = \prod v_i$), then (13) and (14) respectively become

$$\beta_i = 1/I_i \quad \text{and} \tag{13'}$$

$$\omega_i = I_k / I_i . \tag{14'}$$

Note that these equations hold even if households face different leisure prices and have different individual preferences. The Nash SWF is one of three typical SWFs, occupying the middle ground between two polar opposites (Rawlsian $\theta \rightarrow \infty$ and Benthamite $\theta = 0$). Kaneko and Nakamura (1979) and Kaneko (1981) argue that the Nash SWF satisfies criteria that reasonably fit our intuitive understanding of social welfare. A further advantage of using (13') or (14') is that they require less information than distributional weights with $\theta \neq 1$. Thus, either may be a reasonable and convenient weight in distributional evaluations.

3. ESTIMATING LABOR SUPPLY RESPONSE AND THE IMCFs

3.1. Estimation Method

In order to estimate preference parameters, we follow Zabalza (1983), whose approach fits our setup well. First, it takes advantage of the CES preferences. Second, it allows for our limitation that data for labor supply are interval-coded. The method starts with the following optimal numéraire-leisure ratio, derived from the budget constraint ($x_i + w_i l_i = w_i T + y_i$) and the labor supply function (9):

$$\frac{x_i^*}{l_i^*} = \frac{(1-m_i)W_i h_i^* + y_i}{T - h_i^*} = (w_i / \kappa_i)^{1/(1+\mu)} , \tag{15}$$

where * indicates an optimum. The weight κ_i is specified as

$$\kappa_i = \exp(\mathbf{Z}_i \boldsymbol{\delta} - \xi_i) , \tag{16}$$

where $\boldsymbol{Z}_i$ is a vector of household characteristics and δ is a corresponding vector of coefficients. If we assume that unobserved factors ξ_i are normally distributed with a mean of zero and variance σ_ξ^2, the ratio (15) yields the following log-likelihood function:

$$\ln L = \sum_i \ln \left\{ \Phi\left[\frac{\mathbf{Z}_i \boldsymbol{\delta} - \ln w_{iH} + (1+\mu) \cdot \ln(x_{iH} / l_{iH})}{\sigma_\xi} \right] - \Phi\left[\frac{\mathbf{Z}_i \boldsymbol{\delta} - \ln w_{iL} + (1+\mu) \cdot \ln(x_{iL} / l_{iL})}{\sigma_\xi} \right] \right\} , \tag{18}$$

where h_i^L and h_i^H denote the upper and lower bounds of the interval that locates individual i's choice of number of working hours and $\Phi(\cdot)$ is the cumulative distribution of ξ. The maximum-likelihood (ML) estimator for $\{\mu,\delta,\sigma_\xi\}$ is obtained as argmax$\{\ln L(\mu,\delta,\sigma_\xi)\}$.

3.2. Sample and Data

Our sample has been taken from the 2002 Employment Status Survey (ESS) in Japan. This survey provides a comprehensive labor data set for Japan and contains a variety of household characteristics. Since the SMCF formula presumes a unitary household that behaves as if it were a single decision–making unit, dealing with households with more than one earner is not straightforward. We deal with this issue by focusing on males aged between twenty-five and fifty five who, if married, have a non-working spouse.[9] The ESS contains 47,336 such observations, constituting by far the largest sample among comparable data sources in Japan.[10] We exclude households from this sample for various other reasons as well. First, since the model assumes that households choose their labor supply for a given level of wage rate, we do not consider observations that do not fit such decision making. Second, since we measure labor supply as an annual flow, we exclude households whose characteristics changed during the survey year. Third, we exclude those that received non-labor income, since we cannot construct virtual incomes for them (the ESS provides no point data for non-labor income).[11] These exclusions, along with missing observations for some of the variables, reduced the sample size to 32,840 (69.4 percent of the original size).[12]

We construct key variables in the following manner. First, we cannot directly obtain the data for gross wage rate W_i from the ESS since it does not provide point data for that or for hours worked h_i and personal earnings Y_i. However, it codes h_i and Y_i as intervals;[13] thus, we can assign each household an interval for its gross wage rate, which allows us to perform an interval regression on the wage equation and use its fitted values as W_i.[14] Second, we obtain marginal tax rate m_i and virtual income y_i by examining the tax codes in 2002 as well as relevant household characteristics. Personal income taxes in Japan comprise (i) Income Tax (national tax), (ii) Inhabitants Taxes (prefectural and municipal taxes), and (iii) social security contributions. The national and local tax rates[15] in 2002 yield nine statutory tax rates of 0, 5, 15, 20, 30, 35, 45, 55, and 64 percent, which result in a maximum of eight kink points in individual budget sets. Social security contributions[16], levied at a flat rate on labor income, do not affect the kink points. Tax credits and deductions generate an additional six kink points and cause some to deviate from the points established by the statutory marginal tax rates. In sum, there were at most fourteen kink points in 2002. Third, household characteristics $\boldsymbol{Z}_i$, also obtained from the ESS, include age, age squared, number of children aged under fifteen, number of other dependents, and the three sets of binary variables. The first set comprises dummies for high-school graduates, junior-college graduates, and four-year college graduates. The second set comprises (i) dummies for regular employment, large-company employment (more than 500 employees), and public-sector employment, (ii) dummies for eight types of jobs, and (iii) dummies for seventeen industry sectors. The last set comprises five dummies for Japanese regions (excluding the Kanto area).

3.3. Uncompensated Elasticity and the IMCFs

For the estimation, we must specify the time endowment T. While consensus has not been obtained for any specific value in the literature, T = 8,760 hours per year seems to be the most frequently used (e.g., Ziliak and Kniesner 2005; Bloemen and Kapteyn 2008; Bastani, Blomquist, and Micheletto 2010). However, in order to check the robustness of their results, Ziliak and Kniesner also use T = 5,840, assuming that eight hours of non-leisure sleeping time are required. Similarly, we examine the two cases with $T_L \equiv$ 8,760 and $T_S \equiv$ 5,840. For each case, we estimate $\{\mu, \delta, \sigma_\xi\}$ in (18) with four different combinations of the controls. A series of nested tests selects the model that includes all the controls in $\boldsymbol{Z}_i$, as mentioned in the previous subsection.[17]

Following (10), we calculate the uncompensated wage elasticity of labor supply η_i on an individual basis.[18] Table 1 presents the summary statistics. The values of η_i range from $-.100$ to .197 with an average of $-.008$ for T_L and from $-.122$ to .145 with an average of $-.026$ for T_S. These averages are consistent with results found in the literature (Pencavel 1986; Blundell and MaCurdy 1999). In order to show the differences across the observations, we plot η_is for each individual in Figure 1, which measures T_L and T_S on the horizontal and vertical axes, respectively, along a forty-five degree line. It indicates that a smaller T results in a smaller η_i, except in the range from around $-.05$ to .00. This shows that the value of T does affect the elasticity estimates, which is consistent with the results of Ziliak and Kniesner (2005).

Table 1 and Figure 1

In previous studies, SMCF estimates assume that the values of uncompensated elasticity are identical within income groups (Poapongsakorn et al. 2000) or, while keeping identical elasticity within an income group, decline as income increases (Kleven and Kreiner 2006). However, these assumptions do not conform to our results. Figure 2 plots the two sets of uncompensated elasticities against after-tax income, along with locally weighted scatterplot smoothing (LOWESS) curves. The two curves show that the average of the uncompensated elasticities conditional on after-tax income is smaller if T is smaller, except in ranges of very low or relatively high after-tax income. While the shapes of the two curves are similar, the shapes themselves may be unexpected. Starting at more or less the same values, the two curves slope upward until they hit yearly earnings somewhere above JPN¥ 3 million (US$ 37,000), where they begin decreasing. This shape is due to the large variations in the elasticities for a given level of income, which mirrors variations in κ_i[19] and virtual income. Our estimates do not support the assumption that wage elasticities of labor supply are identical within an income group or that they monotonically decline with income level.

Figure 2

Table 2 lists the quintiles of IMCFs along with their averages. The IMCFs fall between .982 and 1.223 for T_L and between .978 and 1.150 for T_S, which reflects the distribution of η_is. In both cases, the median is smaller than the average. Figure 3 shows the kernel density distributions of (2') for the two cases. The distribution for T_L has a thicker right tail, which reflects the result that T_L has yielded larger η_is than T_S. It also shows that a majority of households have IMCFs that are less than one. This result may be surprising but should be expected, since, as seen in Table 1 and Figure 3, a majority of households is on the backward-bending section of the labor supply curves with their negative uncompensated elasticities. Figure 4 plots the IMCFs for T_L and T_S against after-tax income, along with their LOWESS curves. As expected from (2'), the shapes of the two curves may or may not correspond to those in Figure 2. First, the curves slope upward until a certain income level is reached, as those in Figure 2. Second, however, they then become almost horizontal, while those in Figure 2 began declining.

Table 2 and Figures 3 & 4

The SMCF without distributional concerns ($\beta_i = 1\ \forall i$) is obtained as

$$\sum_{i}^{n} \frac{dR_i}{dR} \cdot IMCF_{ARP,i} = \sum_{i}^{n} Y_i \cdot \left[\sum_{i}^{n} Y_i \cdot \left(1 - \frac{m_i}{1-m_i} \eta_i \right) \right]^{-1} . \tag{19}$$

With our sample, this value is calculated as 1.017 for T_L and as 1.004 for T_S. Again, the case with T_L results in a smaller value. However, given the small difference (.013) between the two "S"MCFs, we may argue that the effects of time endowments are negligible when distributional concerns do not matter. Furthermore, it may be worth mentioning that these estimates are more or less comparable to the analogous estimates in previous studies, despite the different assumptions on the wage elasticity of labor supply. For example, Poapongsakorn et al. (2000) consider the ARP case with the unit distributional weight for Thailand and obtain estimates ranging from 1.04 to 1.11. In addition, Kleven and Kreiner (2006) present a set of estimates that vary from .85 to 1.08 across OECD countries in a case where they only consider intensive margins.

4. TAX EVALUATION EXAMPLES

4.1. Optimality of a Progressive Tax System

The distribution of the weighted IMCFs ($\beta_i \cdot IMCF_i$) helps us examine the optimality of taxes. If the government could perfectly differentiate tax liabilities R_i among individuals, the weighted IMCFs would be equalized at the optimum for any pair of individuals. Of course, we do not expect IMCFs to be perfectly equalized, since the government is constrained in some ways in setting R_i. Nonetheless, the system of progressive taxation has many instruments. *If* such instruments are appropriately exploited, the system can be made less suboptimal. In that case, the spread of the weighted IMCFs would be tight. Moreover, since the distribution would change as the shape of the SWF changes, we would also be able to identify the SWF that makes the current tax system less suboptimal.

Figure 5, using estimates for $T = T_L$,[20] shows the distributions of $\beta_i \cdot IMCF_i$ for three different values of inequality aversion: θ = 0, 1, and 2. In order to render their values comparable, we take the logarithm of $\beta_i \cdot IMCF_i$s and normalize the logged values as a difference from their average divided by their standard deviation. As the figure shows, changing the degree of inequality aversion does change the shape of the distribution of the log-normalized weighted IMCFs. In particular, while the distributions for θ = 0 and 2 are quite ragged, the distribution for $\theta = 1$ is relatively smooth, clustering somewhere between −1.0 and 1.0, albeit with a relatively wide and thick right tail. This result may suggest that the current tax policy is (relatively) more consistent with the Nash SWF than other possible SWFs. Technically, since the Nash distributional weight is given as $\beta_i = 1/I_i$, the weighted IMCFs have a relatively well-behaved distribution, which reflects the distribution of full income. Nonetheless, in each of the three, ragged or smooth, the weighted IMCFs are far from being identical, thereby implying that the current system is less suboptimal.

Figure 5

4.2. Flat Tax vs. Progressive Tax

The suboptimality of the current personal income tax system is expected. If it is the complexity of the progressive system that makes it difficult to adequately exploit its policy parameters, we may prefer a simple alternative. A flat tax is simple enough to be characterized by only two parameters—an exemption income E_F and a flat rate m_F—which yield tax liability $R_i = \max\{0, m_F(W_i h_i - E_F)\}$. If optimally designed, the flat tax may thus outperform the current progressive tax. Dahlby (2008) provides us with a procedure that utilizes the SMCFs to obtain such an optimal system of flat tax. First, the SMCFs for changing E_F are given as

$$SMCF_E = \left[\sum_{i\in T}\beta_i \cdot m_F + \sum_{i\in K}\beta_i \cdot \left(1+\frac{1}{W_i}\frac{\partial u/\partial l_i}{\partial u/\partial x_i}\right)\right]\cdot\left[\sum_{i\in T} m_F \cdot \left(1-\phi_i\frac{m_F}{1-m_F}\right)\right]^{-1}, \tag{22}$$

where T and K refer to two sets of taxpayers, one with income greater than E_F and the other located at the kink point E_F; with the CES specification as (8), the income effect is given as

$$\phi_i = -\frac{w_i}{w_i + (w_i/\kappa_i)^{1/(1+\mu)}}.$$

Second, the analogous SMCF for increasing m_F is given as

$$SMCF_{m_F} = \left[\sum_{i\in T}\beta_i \cdot (Y_i - E_F)\right]\cdot\left\{\sum_{i\in T}\left[Y_i - E_F + \frac{m_F}{1-m_F}(-\eta_i Y_i + \phi_i E_F)\right]\right\}^{-1}. \tag{23}$$

where only those affected by an increase in m_F are considered. Third, since (22) and (23) are the social marginal costs of changing E and m_F respectively, we obtain the optimal values for E_F and m_F by finding their values that equate (22) and (23) for a given shape of SWF. In solving this equation, we assume such a pair of tax parameters (E, m_F) that generates the level of tax revenue collected by the current progressive income tax. Then, we can see how the optimal flat tax system fares against the current progressive system, setting the revenue from the flat tax at the level generated by households under the current progressive system. In the following account, we focus on single-male households (11,936 observations) and apply the estimates obtained in Section 3 to perform relevant calculations.

Table 3 lists the optimal values when $\theta = 1$ and $\theta = 2$. We do not list the case for $\theta = 0$, since it makes the optimal exemption level negative. The optimal flat tax for $\theta = 1$ comprises the marginal tax rate of 23.6 percent and the annual exemption level of JPN¥ .60 million (US$ 7,692) for T_L and the marginal tax rate of 25.1 percent and the annual exemption level of JPN¥ .81 million (US$ 10,384) for T_S. The smaller time endowment (T_S) results in slightly larger values of the two parameters, possibly due to the smaller wage elasticities of labor supply (recall Figure 3). With a higher degree of inequality aversion, $\theta = 2$, the optimal flat-tax is characterized by higher marginal rates and larger exemption levels. These marginal rates and exemption levels are 52.0 percent and JPN¥ 2.63 million (US$ 33,718), respectively, for T_L and 53.3 percent and JPN¥ 2.76 million (US$ 35,385), respectively, for T_S. Again, the smaller T results in slightly larger values for the two parameters.

For both T_L and T_S, the flat tax outperforms the current progressive tax when the degree of inequality aversion is larger (theta = 2), and vice versa for when it is smaller (theta = 1). Initially, these results may seem unexpected since the flat tax outperforms the progressive tax when the distribution concerns are larger. However, on further reflection, this impression is not correct. First, if we could optimally set a tax system, an optimal progressive tax would always outperform an optimal flat tax for any levels of inequality aversion, since the former has more policy parameters to control. Thus, we were unable to associate the optimal flat tax with a smaller degree of inequality aversion, when the progressive tax is also set optimally. Second, however, we are now comparing an optimal flat tax with an existing progressive tax that is plausibly suboptimal. Thus, the social welfare given by the progressive tax may or may not happen to be larger than the social welfare maximized by an optimal flat tax for a given level of distributional concern. In other words, it is possible that the optimal flat tax outperforms the existing progressive tax even when the degree of inequality aversion is large.

Table 3

Panels (a) and (b) in Figure 6 compare the average tax rates and average hours worked across income groups under different tax regimes. Income groups are classified according to annual income before taxation. Panel (a) compares the average rates. When $\theta = 1$, the flat tax system, for both T_L and T_S, yields slightly higher average tax rates than those in the current progressive tax system in the lower-middle and middle income groups in the ranges 2.5–5.0 and 5.0–7.5 (in JPN¥ millions ≈ US$ 12.5 thousands) but yields lower rates for the lowest-income and higher income groups. On the other hand, when $\theta = 2$, the flat tax system sets lower rates in the three lowest-income groups and higher rates in the other income groups, probably reflecting their higher degree of inequality aversion. Note that although T_S results in higher tax rates than T_L in all but the three lowest-income groups when $\theta = 1$, the differences are not conspicuous. The different time endowment is not of much significance in these cases.

Panel (b) compares results in annual average hours worked. The optimal flat tax with $\theta = 2$ naturally leads to lower values for labor than the flat tax with $\theta = 1$, except in the lowest income class, since the former has a higher flat rate and a higher exemption income level. When $\theta = 1$, the flat tax system leads to a greater average labor supply in all income groups except the lowest two groups, both for T_L and T_S. This result may be anticipated from Panel (a), particularly for the higher income groups, since the average rates for the flat tax system are lower than rates for the current progressive tax system and their differences increase with income level. Meanwhile, when the degree of inequality aversion is higher ($\theta = 2$), the flat tax system results in fewer hours in the ranges between JPN¥ 2.5 and 12.5 million (US$ 32,051 and 160,256) and more hours in the other ranges, again for both T_L and T_S. It is interesting that despite its higher average tax rates, this flat tax elicits more labor from the upper income groups than the current progressive tax does. Note that T_L results in larger numbers of hours worked than T_S except in the lowest four income groups, when $\theta = 2$. Again, the differences are not conspicuous. However, the differences increase toward higher income groups; in high-income groups, the differences are not so negligible.

Figure 6

5. CONCLUDING REMARKS

This study explored aspects of the SMCF utilizing a micro-data set. We characterized distributional weights derived from the CES utility and the CIA SWF and compared them to conventional distributional weights. Furthermore, we estimated the wage elasticities of labor supply and the corresponding IMCFs and examined their respective distributions. We also examined the distribution of the weighted IMCFs to show that the current progressive tax system in Japan is far from optimal. Finally, by utilizing the SMCFs of a flat tax system, we compared an optimal flat tax system with the current progressive tax system and shown that the former outperforms the latter. Since our sample is not representative of the entire Japanese population, the last exercise should be regarded as an example. Nevertheless, the procedure we employed is readily applicable to a full-fledged data set that warrants appropriate policy evaluation.

This study has not addressed all the issues that may be important in constructing marginal welfare measures. The following two deserve particular mention. First, we did not allow for extensive margins in labor supply. Kleven and Kreiner (2006) show that once extensive margins are incorporated, marginal welfare costs become higher. We could extend our procedure to allow for extensive margins using the discrete-choice model (Van Soest, 1995) that enables the estimation of fixed costs for labor participation. Second, we have not fully assessed the effects of different time endowments. We only examined two levels of time endowment (8,760 and 5,840 hours per year) and shown that the larger time endowment resulted in larger labor supply responses than the smaller time endowment, although the differences between the two did not yield large differences either in the SMCF estimates or in outcomes from the last tax evaluation exercise. Since these results may be due to our specific setup, further exploration of the effects of time endowments could be another topic of future research in addition to SMCF estimation with the discrete-choice model of labor supply that allows for extensive margins.

Endnotes

1. For a survey and synthesis, see Slemrod and Yitzhaki (1996) and Snow and Warren (1996).

2. The term "virtual income" refers to an intercept for the "linearlized" piece-wise budget line and does not necessarily coincide with non-labor income.

3. In our terminology, Dahlby (1998) expresses (4) as $\sum_i \beta_i Y_i d\bar{a}_i / (\sum_j Y_j d\bar{a}_j / IMCF_j)$ and interprets it as a ratio of two weighted sums of changes in individual tax burdens ($Y_i d\bar{a}$). The weights in the numerator β_i reflect distributional concerns and those in the denominator $1/IMCF_i$ mirror efficiency concerns.

4. With this formulation, if all individuals are identical, $SMCF = IMCF$ since $\beta_i/\beta_k = 1$ and $dR_i/dR = 1/n$.

5. Despite its convenient theoretical properties and popularity in quantitative studies (e.g., Andreoni and Miller 2002; Dawkins, Srinivasan and Whalley 2001; Dickens and Lundberg 1993), the CES specification is restrictive in the sense that it is additively separable and homothetic. First, the separability is often empirically rejected (e.g., Browning and Meghir 1991). Such empirical studies presume the consumption of *more than two goods* that include leisure and *multiple* commodities, and examine whether the consumption of leisure affects the marginal rate of substitution (MRS) between any two commodities (Deaton and Muellbauer 1980). However, note that the model here is defined over only two goods—leisure and a *single* composite good; thus, the independence of the MRS between *two* commodities from leisure consumption cannot be defined by construction. Second, homotheticity implies that all expenditure elasticities should be unity, which contradicts existing household budget studies (Deaton and Meullbauer 1980). However, note that there is only a *single* item for household expenditure in the current model. Nonetheless, it is important to recognize that the CES specification imposes restrictions on consumer preferences that might change estimation results (e.g., Blomquist, Eklöf, and Newey, 2001).

6. If the budget set is piecewise linear and convex, individuals may be bunched around the kink points. Studies rarely provide evidence for this bunching (Hausman 1983). In the US tax system, Saez (2010) finds bunching at the first kink point, but it is concentrated solely among the *self-employed*.

7. Roberts (1980) has indicated the price independence of the distributional weight when preferences are homothetic. However, this price independence fails if there are differences in w_i and κ_i.

8. Dodgson (1980) has derived $\omega_i = (Y_k/Y_i)^{\theta}$ in a setting where the CIA SWF is combined with individual utility that is a power function of income Y_i, $U_i = Y_i^{\sigma}$.

9. Limiting samples to a specific category of households is arguably common practice. For example, Blomquist, Eklöf, and Newey (2001) limit their sample to married or cohabiting men aged from twenty to sixty, Ziliak and Kniesner (2005) to male heads of household, and Eissa, Kleven, and Kreiner (2008) to single mothers.

10. The empirical studies on male labor supply response in Japan typically use the Japanese Panel Survey of Consumers. However, the sample this data source can provide is rather small. For example, the sample Yamada (2008) uses for his estimation of labor supply of married men is as small as 3,618.

11. Thus, our virtual income y_i varies only due to differences in institutional factors: marginal tax rates, social security contribution rates, tax deductions, and tax allowances. The deductions and credits can be elaborated in the following manner. Employment income allowance regressively deducts certain percentages of employment income. Social security contributions are deducted as well. The basic allowance applies to all households. The allowances for spouses are applicable when the taxpayer's spouse earns less than JPN¥ 1,030,000 (US$ 13,205). Allowances are also provided for dependent children aged from sixteen to twenty three who do not work. Despite this variety of institutional factors, the variations in our virtual income are smaller than they would be if we included non-labor income. On the one hand, our virtual income may be free from the measurement error that originates from non-labor income. In fact, the literature warns of measurement error in non-labor income as a serious source of bias (Blomquist 1996; Ericson and Flood 1997; Eklöf and Sacklén 2000).

12. Thus, the excluded observations comprise (a) self-employed workers (6.3 percent), (b) board members of private companies or nonprofit organizations (4.1 percent), (c) family workers (.3 percent), (d) those with unknown working status (.2 percent), (e) those who changed their jobs (5.0 percent), (f) those who had new births (6.2 percent), (g) those who indicated that they received non-labor income (5.0 percent), and (h) those observations that lack some of the variables required for the estimation (9.8 percent). The basis for percentages in parentheses is the initial 47,336 observations.

13. The intervals are (i), (ii) for h_i and (i), (ii) for Y_i, and expressed in monthly values. We translate these

values into annual values by multiplying them by twelve.

14. With the interval-coded data for gross wage rate W_i, we are able to perform an interval regression to estimate a wage equation using maximum likelihood estimation. For the detailed procedure for the estimation with interval-coded data (i.e., interval regression), see Wooldrigde (2010, 783–785). We use the fitted values from the estimated wage equation as the point data for W_i. Therefore, we regard the ML estimation of (18) as estimation with generated regressors, which should yield consistent estimates. The explanatory variables for the wage equation are all binary, comprising a set of 30 dummies for each of the ages from twenty-six to fifty-five and the same set of dummies used for $\boldsymbol{Z}_i$, which excludes age-related variables. Since the fitted values are generally not equal to actual gross wage rates, the discrepancies affect the budget set by changing the slope of the segments, locations of kink points, and virtual income. A Monte Carlo study by Ericson and Flood (1997) shows that estimation results are rather unaffected by use of fitted values, although their study considers the estimation methods other than the one we use here.
15. In fact, local taxes are based on income earned in the previous year. We assume the absence of any complications from this one-year lag.
16. Social security contributions include premiums for public pension insurance, public health insurance, and public unemployment insurance. The premiums differ with employers. Since our data does not contain information needed to calculate the exact amounts of the premiums, we use a representative scale where the premium is 11.3 percent in firms with fewer than 1,000 employees, 12.6 percent in firms with more than 1,000 employees, and 11.1 percent for public sector employees.
17. The results of the estimation and the test statistics can be provided on request.
18. We use the midpoints of the coded intervals for the labor hours in calculating the elasticities since the point data for h_i are unavailable and the estimated parameters do not provide fitted values for h_i. The variables w_i and y_i depend on h_i. Once the hours worked are given, we obtain estimates for the marginal tax rate m_i, average tax rates a_i, net wage rate w_i, virtual income y_i, and consumption $x_i = w_i h_i + y_i$.
19. Equation (15) yields the weight on leisure as $\kappa_i \equiv [(T - h_i)/w_i x_i]^{-(1-\mu)}$, which can differ among households *even if* their $\boldsymbol{Z}_i$ are identical, because the definition for κ_i (16) allows for unobservable elements ξ_i. We

interpret equation $\kappa_i \equiv [(T - h_i)/w_i x_i]^{-(1-\mu)}$ by stating that parameter κ_i affects the endogenous choice of h_i, which in turn determines both $w_i(h_i)$ and $x_i = w_i h_i + y_i(h_i)$, as in endnote 18. While we *define* κ_i as (16), we do not directly use it to obtain the values of κ_i. Instead, we take advantage of (15) to calculate the values of κ_i as $\kappa_i \equiv [(T - h_i) / w_i x_i]^{-(1-\mu)}$ by using the method explained in endnote 18. In this manner, we believe that it reasonably allows for the unobservable element ξ_i, as expressed in definition (16).

20. The results for $T = T_S$ are available on request.
21. Note that a cardinal comparison is not relevant here since the SMCF could be expressed in different units of measurement and any positively monotone transformation of the social welfare is valid here. What is significant here is which is larger between the two quantities and not the absolute difference between them.

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REFERENCES

Andreoni, James, and John Miller. 2002. Giving According to GARP: An Experimental Test of the Consistency of Preferences for Altruism. Econometrica 70(2): 737–753.

Bastani, Spencer, Sören Blomquist, and Luca Micheletto. 2010. Public Provision of Private Goods, Tagging and Optimal Income Taxation with Heterogeneity in Needs. CESifo Working Paper No. 3275 (Category 1: Public Finance).

Bloemen, Hans. G., and Arie Kapteyn. 2008. The Estimation of Utility-consistent Labor Supply Models by Means of Simulated Scores. Journal of Applied Econometrics 23(4): 395–422.

Blomquist, Sören. 1996. Estimation Methods for Male Labor Supply Functions: How to Take Account of Nonlinear Taxes. Journal of Econometrics 70(2): 383–405.

Blomquist, Sören, Matias Eklöf, and Whitney Newey. 2001. Tax Reform Evaluation Using Non-parametric Methods: Sweden 1980–1991. Journal of Public Economics 79(3): 543–568.

Blundell, Richard, and Thomas MaCurdy. 1999. Labor Supply: A Review of Alternative Approaches. In Handbook of Labor Economics (Volume 3A). Orley Ashenfelter, and David Card, eds., 1559–1695. New York: North Holland Publishing.

Boadway, Robin, and Neil Bruce. 1984. Welfare Economics. Oxford, UK: Blackwell.

Brent, Robert J. 1984. Use of Distributional Weights in Cost-benefit Analysis: A Survey of Schools. Public Finance Review 12(2): 213–230.

Browning, Martin, and Costas Meghir. 1991. The Effects of Male and Female Labor Supply on Commodity Demands. Econometrica 59(4): 925–951.

Dahlby, Bev. 1998. Progressive Taxation and the Social Marginal Cost of Public Funds. Journal of Public Economics 67(1): 105–122.

Dahlby, Bev. 2008. The Marginal Cost of Public Funds: Theory and Applications. Cambridge, MA: MIT Press.

Dawkins, Christina, T.N. Srinivasan, and John Whalley. 2001. Calibration. In Handbook of Econometrics (Volume 5), James J. Heckman and Edward Leamer, eds., 3653–3703. New York: North Holland Publishing.

Deaton, Angus, and John Meullbauer. 1980. Economic Theory and Consumer Behavior. Cambridge, England: Cambridge University Press.

Dickens, William T., and Shelly J. Lundberg. 1993. Hours Restrictions and Labor Supply. International Economic Review 34(1): 169-192.

Dodgson, John S. 1980. Social Welfare Functions, Income Distribution, and Welfare Weights in the United Kingdom. The Manchester School of Economic and Social Studies 48(1): 1–16.

Dodgson, John S. 1983. Expenditure Function Estimates of the Efficiency and Distributive Impact of Indirect Taxes in the United Kingdom. European Economic Review 20(1/3): 59–78.

Eissa, Nada, Henrik Jacobsen Kleven, and Claus Thustrup Kreiner. 2008. Evaluation of Four Tax Reforms in the United States: Labor Supply and Welfare Effects for Single Mothers. Journal of Public Economics 92(3/4): 795–816.

Eklöf, Matias, and Hans Sacklén. 2000. The Hausman-MaCurdy Controversy: Why Do Results Differ between Studies? Journal of Human Resources 35(1): 204–220.

Ericson, Peter, and Lennart Flood. 1997. A Monte Carlo Evaluation of Labor Supply Models. Empirical Economics 22(3): 431–460.

Flood, Lennart, and Nizamul Islam. 2005. A Monte Carlo Evaluation of Discrete Choice Labor Supply Models. Applied Economics Letters 12(5): 263–266.

Gahvari, Firouz. 2006. On the Marginal Cost of Public Funds and the Optimal Provision of Public Goods. Journal of Public Economics 90(6/7): 1251–1262.

Hausman, Jerry A. 1981. Labor supply. In How Taxes Affect Economic Behavior. Henry J. Aaron and Joseph A. Peckman, eds., 27–83. Washington D.C.: The Brookings Institution.

Hausman, Jerry A. 1983. Stochastic Problems in the Simulation of Labor Supply. In Behavioral Simulation in Tax Policy Analysis. Martin S. Feldstein, ed., 47–82. Chicago: University of Chicago Press.

Kaneko, Mamoru. 1981. The Nash Social Welfare Function for a Measure Space of Individuals. Journal of Mathematical Economics 8(2): 173–200.

Kaneko, Mamoru, and Nenjiro Nakamura. 1979. The Nash Social Welfare Function. Econometrica 47(2): 423–435.

Kleven, Henrik Jacobsen, and Claus Thustrup Kreiner. 2006. The Marginal Cost of Public Funds: Hours of Work versus Labor Force Participation. Journal of Public Economics 90(10/11): 1955–1973.

Liu, Liqun. 2004. The Marginal Cost of Funds and the Shadow Prices of Public Sector Inputs and Outputs. International Tax and Public Finance 11(1): 17–29.

Liu, Liqun. 2006. Combining Distributional Weights and the Marginal Cost of Funds: The Concept of Person-Specific Marginal Cost of Funds. Public Finance Review 34(1): 60–79.

Mayshar, Joram. 1990. On Measures of Excess Burden and Their Application. Journal of Public Economics 43(3): 263–289.

MaCurdy, Thomas, David Green, and Harry Paarsch. 1990. Assessing Empirical Approaches for Analyzing Taxes and Labor Supply. Journal of Human Resources 25(3): 414–490.

Musgrave, Richard, and Tun Thin. 1948. Income Tax Progression, 1928–48. Journal of Political Economy 56(6): 498–514.

Pencavel, John. 1986. Labor Supply of Men: A Survey. In Handbook of Labor Economics (Volume 1). Orley Ashenfelter and Richard Layard, eds., 3–102. New York: North Holland Publishing.

Poapongsakorn, Nipon, Kovit Charnvitayapong, Duangmanee Laovakul, Somchai Suksiriserekul, and Bev Dahlby. 2000. A Cost-benefit Analysis of the Thailand Taxpayer Survey. International Tax and Public Finance 7(1): 63–82.

Roberts, Kevin. 1980. Price-independent Welfare Prescriptions. Journal of Public Economics 13(3): 277–297.

Saez, Emmanuel. 2010. Do Taxpayers Bunch at Kink Points? American Economic Journal: Economic Policy 2(3): 180–212.

Sandmo, Agnar. 1998. Redistribution and the Marginal Cost of Public Funds. Journal of Public Economics 70(3): 365–382.

Shoven, John B., and John Whalley. 1992. Applying General Equilibrium. Cambridge, England: Cambridge University Press.

Slemrod, Joel, and Shlomo Yitzhaki. 1996. The Cost of Taxation and the Marginal Efficiency Cost of Funds. International Monetary Fund Staff Papers 43(1): 172–198.

Snow, Arthur, and Ronald S. Warren Jr. 1996. The Marginal Welfare Cost of Public Funds: Theory and Estimates. Journal of Public Economics 61(2): 289–305.

Van Soest, Arthur. 1995. Structural Models of Family Labor Supply: A Discrete Choice Approach. Journal of Human Resources 30(1): 63–88.

Yamada, Ken. 2008. Estimating Labour Supply and Time Allocation by Married Japanese Men and Unmarried Japanese Women. Applied Economics Letters 15(9): 659–666.

Yitzhaki, Shlomo. 2003. Cost-benefit Analysis and the Distributional Consequences of Government Projects. National Tax Journal 56(2): 319–336.

Zabalza, Antoni. 1983. The CES Utility Function, Non-linear Budget Constraints and Labor Supply: Results on Female Participation and Hours. Economic Journal 93(370): 312–330.

Ziliak, James P., and Thomas J. Kniesner. 2005. The Effect of Income Taxation on Consumption and Labor Supply. Journal of Labor Economics 23(4): 769–796.

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Tables

Table 1. Labor Supply Responses (uncompensated elasticity)

	Average	SD	Min.	25%	Median	75%	Max.
T = 8,760 (T_L)	–.008	.046	–.100	–.039	–.020	.025	.197
T = 5,840 (T_S)	–.026	.038	–.122	–.051	–.033	.005	.145

Table 2. Individual Marginal Cost of Public Funds

	Average	SD	Min.	25%	Median	75%	Max.
T = 8,760 (T_L)	1.005	.028	.982	.990	.995	1.011	1.223
T = 5,840 (T_S)	.997	.016	.978	.987	.991	1.002	1.150

Table 3. Optimal Flat Tax vs. Progressive Income Tax

		$\theta = 1$		$\theta = 2$	
		T = 8,760 (T_L)	T = 5,840 (T_S)	T = 8,760 (T_L)	T = 5,840 (T_S)
Marginal tax rate (%)		23.6	25.1	52.0	53.3
Exemption (JPN¥)		.60 million	.81 million	2.63 million	2.76 million
Social welfare level	Flat (optimal)	–7.420	–1.859	-5.733×10^{21}	-1.1655×10^{11}
	Progressive	–7.419	–1.856	-5.739×10^{21}	-1.1664×10^{11}

Note: The welfare levels are calculated as $(\ln S)/n$ for $\theta = 1$ and S/n for $\theta = 2$.

Figures

Figure 1. Plots of Uncompensated Elasticities for Different Time Endowments

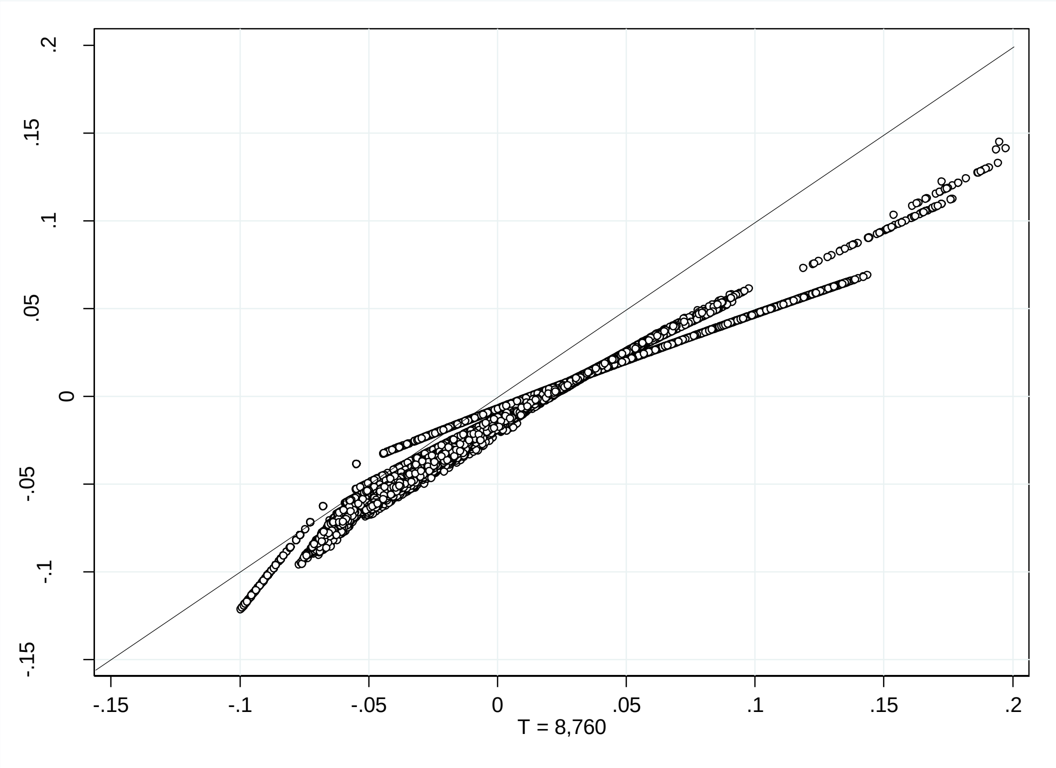

Figure 2. Uncompensated Elasticity vs. After-tax Income

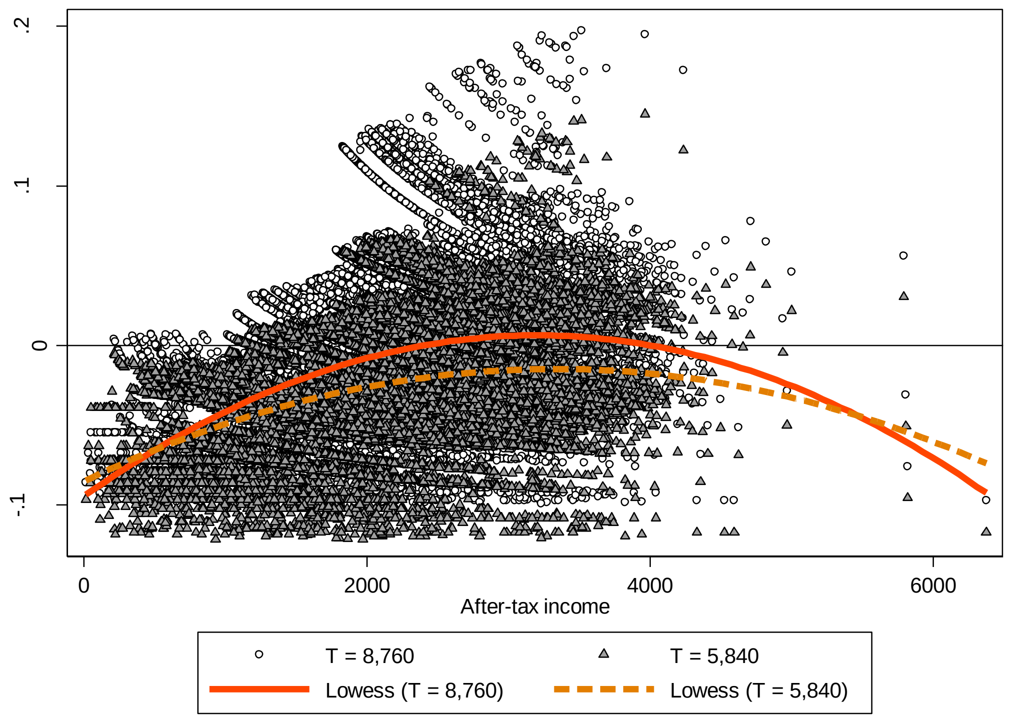

Figure 3. Distributions of the IMCFs

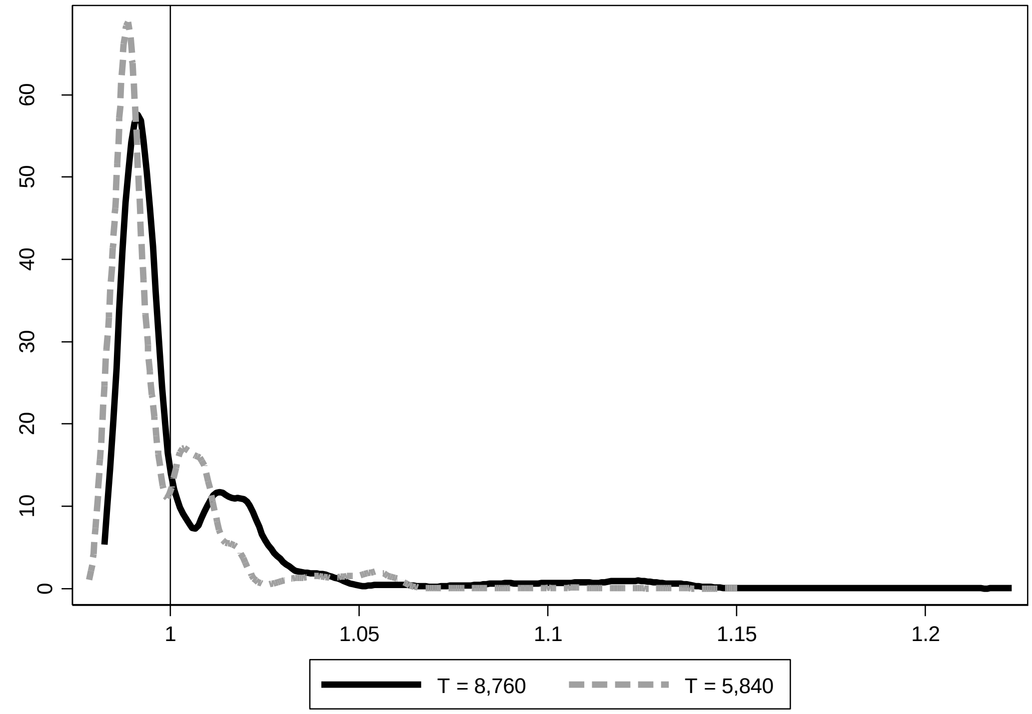

Figure 4. IMCF vs. After-tax Income

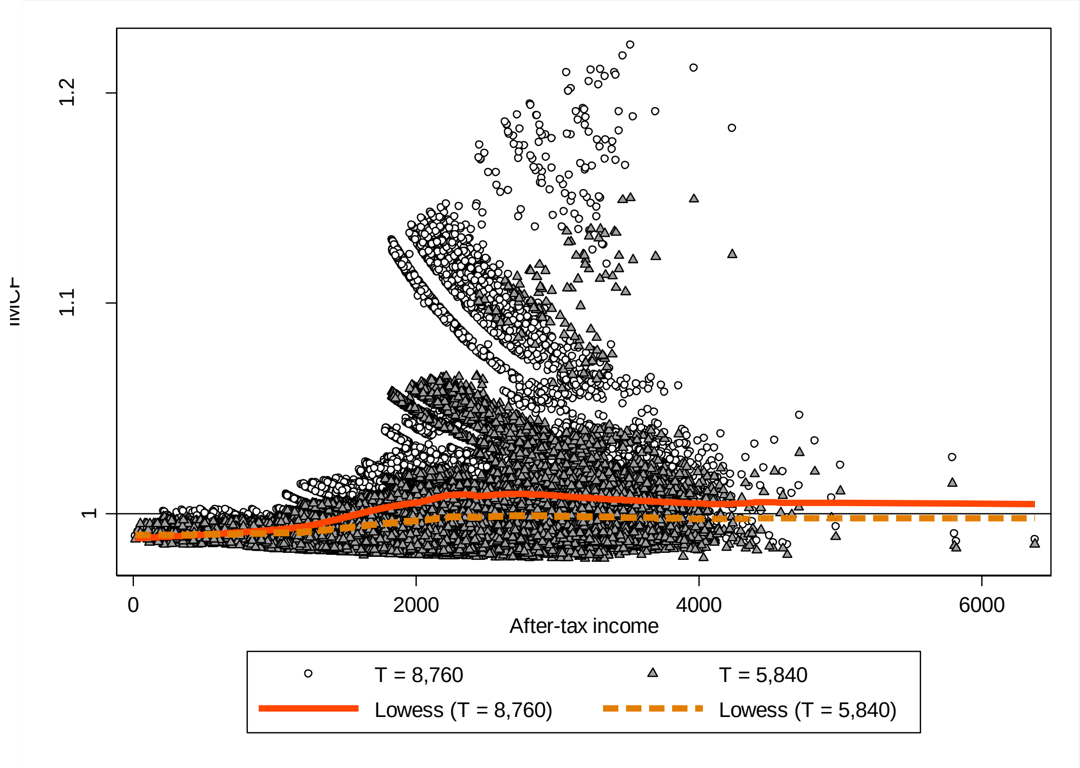

Figure 5. Distributions of the Distributionally Weighted IMCFs

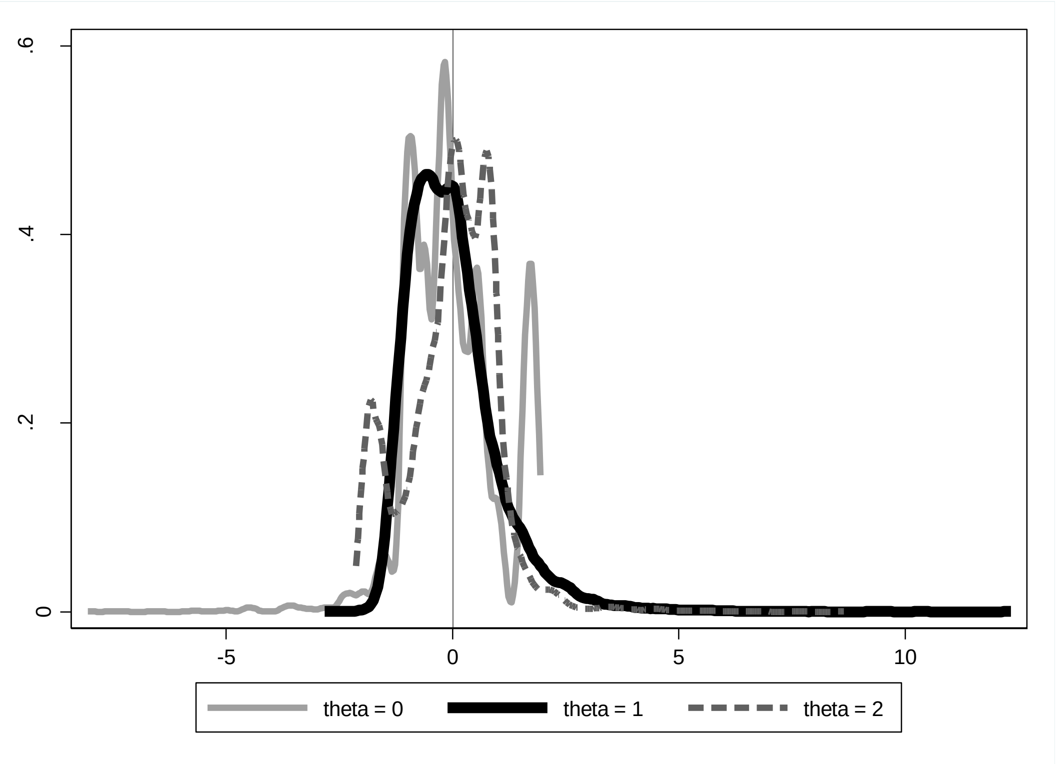

Figure 6. Simulation Results by Income Groups