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The welfare impact of marginal consumption tax reforms on young households in Japan

Kunio Urakawa

Abstract

This paper attempts to examine the welfare impact of marginal consumption tax reforms on young households in Japan, explicitly considering their heterogeneity. Specifically, this paper investigates how the marginal cost of raising the tax rate on each commodity differs across different types of household, based on the micro data from nationwide household surveys. Furthermore, this paper also discuss distributive outcomes of tax reforms based on the concept of concentration curves.

Key Words: marginal commodity tax reform, consumption tax, concentration curves
JEL classification codes: H21, H23

1. Introduction

Japan has the second largest GDP in the world, and its average living standard is much higher than those of many other nations. In recent years, however, poverty risk has been rising remarkably, as evidenced by an increase of households who receive public assistance and/or have no savings. Indeed, OECD (2011) revealed that the relative poverty ratio, which is the share of households below the poverty line, was 15.7 percent in Japan, largely surpassing 11.1 percent of the OECD average in the late 2000s.

Income inequality and poverty have been most remarkable among the elderly, but the latest data from official statistics show that these issues have become more serious among the young. For example, the 2009 National Survey of Family Income and Expenditure found a substantial increase in the Gini coefficient from its 1999 Survey among households whose heads were younger than 30 years old[1)]. The Surveys on Income Redistribution also reveal upward trends in inequality and poverty indices among young households

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from the mid-1990s to the early 2000s (Tachibanaki and Urakawa, 2006).

Another feature of income distribution in Japan is that inequality is above the average for OECD members in terms of redistributed income after tax and social security, but not in terms of market income before redistribution (Förster and Mira d'Ercole, 2005). In addition, a substantial portion of income redistribution is accounted for by income transfer from the young to the elderly (Oshio, 2006). These facts point to a limited degree of income redistribution through the current tax and social security programs especially among young households (Abe, 2006).

Meanwhile, many policymakers in Japan now are explicitly arguing for an increase in consumption tax rates to finance social security spending, which is expected to continue mounting over the coming decades. In fact, the consumption tax rate is now five percent in Japan, which is much lower than the average of approximately twenty percent for the value-added tax rates of European countries.

However, there are several issues to be addressed when we utilize consumption tax to finance mounting social security spending. Above all, its regressive nature is often criticized from an equity viewpoint, because propensity to consume is higher for low-income households than higher-income ones. In fact, many preceding studies have attempted to design an optimal commodity tax system that balances equity and efficiency, following Diamond and Mirrlees (1971). Also in Japan, there have been a large number of empirical and theoretical analyses on an optimal tax system and its distributive impact, including Kaneko and Tajika (1989), Oshio (1990), Murasawa, Yuda, and Iwamoto (2005), and Asano and Fukushima (2006).

However, these preceding studies in Japan have relied entirely on aggregated data from official statistics such as the Family Income and Expenditure Survey (FIES), which is compiled by the Ministry of Internal Affairs and Communications. To the author's knowledge, there have been almost no attempts to explore the impact of tax reforms on social welfare using micro data with heterogeneous households. In addition, as emphasized by Feldstein (1975), it is not realistic to assume that the government can easily adjust indirect tax rates to obtain the targeted tax revenue. As stressed by Armad and Stern (1981), it is important to investigate how marginal tax reforms, departing from the existing tax system, affect household behaviors and social welfare.

Considering both the risk of widening income inequality among young households and the likelihood of increases of consumption tax rates, this paper attempts to compare the welfare costs of marginal consumption tax reforms across different types of young household in Japan. To this end, we use micro data from the Japanese Panel Survey of Consumers (JPSC), which is compiled by the Institute for Research on Household Economics. This empirical analysis is based on the theoretical framework of marginal

1) The Gini coefficient for the disposable incomes for these young households rose from 0.220 in 1999 to 0.228 in 2009, while the value for elderly households decreased (e.g. 0.336 to 0.327 for households whose head's age is 60s).

commodity tax reforms, which was initially proposed by Armad and Stern (1981), and was followed by various empirical studies in many countries outside Japan[2]. The main issue to be addressed by this analysis is marginal cost in terms of the social welfare of raising an extra unit of revenue by increasing the tax on a specific commodity group. This study also discuss distributive outcomes of tax reforms based on the concept of *concentration curves*, which was proposed by Yitzhaki and Slemrod (1991).

The remainder of the paper is constructed as follows. Section 2 provides the basic model of marginal commodity tax reforms. Section 3 provides the basic characteristics of the sample in the JPSC. Section 4 calculates the marginal cost of raising the tax rate on each commodity group. Section 5 compares the marginal costs of taxation across heterogeneous household groups. Section 6 summarizes the estimation results and presents future research topics.

2. Theoretical background

2.1 Marginal cost of taxation

This section provides the basic model on which the empirical analysis is based, following Ahmad and Stern (1984). In this analysis, it is assumed that there are H households and N commodity groups, and that the social welfare function is given by

$$W(V_1(q, y_1), ..., V_H(q, y_H)), \tag{1}$$

where V_h and y_h are indirect utility function and income, respectively, of household h ($h=1, ..., H$) and $q=(q_1, ..., q_N)$ consumer prices. It's assumed that the producer prices of all commodity groups, p_i, are fixed, and that the government collects tax revenue R through commodity taxes. Letting x_i^h, X_i, and t_i denote the amount of commodity i purchased by household h, total consumption and tax on commodity i, respectively, we have

$$R=\sum_{i=1}^{N} t_i X_i=\sum_{i=1}^{N}\sum_{h=1}^{H} t_i x_i^h. \tag{2}$$

The marginal cost of increasing the tax on commodity i, which is denoted by λ_i, is defined as the impact on social welfare of an extra unit of revenue generated by increasing the tax on commodity i. Hence, λ_i is expressed as

2) Ray (1997) and Santoro (2007) provided a comprehensive survey of empirical studies on marginal tax reforms.

$$\lambda_i \equiv -\frac{\partial W/\partial t_i}{\partial R/\partial t_i}, \tag{3}$$

The numerator and denominator in (3) represent change of social welfare and change of tax revenue, respectively, in response to an additional rise of tax on commodity i. If $\lambda_j > \lambda_i$, the government can enhance social welfare by raising t_i ti and reducing t_j, while keeping aggregate tax revenue constant. In other words, the tax system is optimal if the marginal cost is equal across all commodity groups.

We can rewrite the formula (3) as

$$\lambda_i = \frac{\sum_{h=1}^{H} \beta^h x_i^h}{X_i + \sum_{k=1}^{N} t_k \dfrac{\partial X_k}{\partial t_i}} = \frac{\sum_{h=1}^{H} \beta^h s_i^h}{\alpha_i}, \tag{4}$$

where

$$\alpha_i \equiv 1 + \frac{1}{X_i} \sum_{k=1}^{N} t_k \frac{\partial X_k}{\partial t_i},\ \beta^h \equiv \frac{\partial W}{\partial V^h} \frac{\partial V^h}{\partial y^h},\ \text{and}\ s_i^h \equiv \frac{x_i^h}{X_i}.$$

Here, α_i is the reciprocal of the marginal efficiency cost of raising public funds by taxing commodity i. β^h is the social valuation of one unit of income accruing to household h to take into account distributional considerations. And s_i^h is the share of the consumption of commodity i of household h. $\sum_{h=1}^{H} \beta^h s_i^h$ can be interpreted as the *distributional characteristic* of commodity i; the higher it is, the more highly the commodity is evaluated in terms of equity.

In addition, by multiplying both the numerator and denominator by q_i, equation (4) can be rewritten as:

$$\lambda_i = \frac{\sum_{h=1}^{H} \beta^h q_i x_i^h}{q_i X_i + \sum_{h=1}^{N} \varepsilon_{ki} t_k^* q_k X_k} \tag{4}'$$

where ε_{ki} is the uncompensated elasticity of demand for commodity k with respect to a change in the consumer price of commodity i and $t_i^* \equiv t_i/q_i$.

Equation (4) or (4)' indicates that the marginal cost of taxation has both efficiency and equity aspects. On the one hand, the denominator reflects the efficiency aspect; a commodity that has a higher own price elasticity (in absolute value terms) generates a higher social cost when it is taxed. On the other hand, the numerator reflects the equity aspect; a commodity that is highly evaluated in terms of equity generates a higher social cost when it is taxed.

Equation (4)' indicates that what a researcher need for an empirical analysis are:

(i) aggregate spending on each commodity ($q_i X_i$);

(ii) the spending of each household (or in practice, the spending of each income class) on each commodity ($q_i x_i^h$);

(iii) existing (effective) tax rate on each commodity (t_i^*);

(iv) uncompensated price elasticities of aggregate demand (ε_{ij}); and,

(v) welfare weight of each household (β^h).

In this analysis, we calculate (i) $q_i X_i$ and (ii) $q_i x_i^h$ from JPSC, use the estimated results of Uemura (2007) for (iii) t_i^*, and estimate (iv) from FIES. As for (v) β^h, we follow Ahmad and Stern (1984), who assume

$$\beta^h \equiv \left(\frac{y^1}{y^h} \right)^{\sigma}, \tag{5}$$

where y^1 is the expenditure of the lowest income class and β^1 is normalized as unity and σ is the inequality aversion parameter. We assume $\beta^1 \geq \ldots \geq \beta^H$, meaning that the welfare of lower-income households is more highly evaluated. The higher σ is, the smaller the welfare weight of a higher income household is. In the special case of $\sigma = 0$ —that is, if there is no equity consideration—the distributional characteristic is equal to one for all commodity groups. Again, it is a straightforward task to obtain β^h from the household survey and with the exogenously given value of σ.

This study next compare and rank the marginal costs λ_i among commodity groups. If the government is required to raise total tax revenue for some policy purpose, it should raise the tax rate on a commodity with a lower marginal cost more than on a commodity with a higher one. The results are likely to be affected by the assumed value of welfare weight or inequality aversion.

2.2 Concentration curves

The impact on social welfare of marginal tax reform can be interpreted graphically using concentration curves and differences among them. Now, consider the marginal tax reform of marginally subsidizing commodity j and marginally taxing commodity i under fixed tax revenue; that is, $a_i X_i dt_i + a_j X_j dt_j = 0$, $dt_i > 0$ and $dt_j < 0$. Then, simple calculations based on this revenue neutrality condition and Roy's identity show that a change of social welfare is given by

$$dW = \sum_{h=1}^{H} \beta^h dy^h = -X_j dt_j \sum_{h=1}^{H} \beta^h (s_j^h - \alpha_{ji} s_i^h) \tag{6}$$

where $\alpha_{ji} = \alpha_j / \alpha_i$ indicates the ratio of the efficiency cost incurred by raising an extra unit of public funds by taxing commodity i to that by taxing commodity j. Because $dt_j < 0$, the necessary and sufficient condition for an increase of social welfare is given by

$$\sum_{h=1}^{H}\beta^h(s_j^h-\alpha_{ji}s_i^h)\geq 0, \tag{7}$$

This condition (7) is equivalent to $\lambda_j\geq\lambda_i$, because from (4) we have:

$$\lambda_j-\lambda_i=\frac{1}{\alpha_j}\sum_{h=1}^{H}\beta^h(s_j^h-\alpha_{ji}s_i^h).$$

Now, we can discuss the relationship between welfare improvement and concentration curves. Yitzhaki and Slemrod (1991) showed that recalling $\beta^1\geq\ldots\geq\beta^H$, the sufficient condition for (7) is given by

$$\sum_{h=1}^{k}s_j^h-\alpha_{ji}\sum_{h=1}^{k}s_i^h\geq 0,\ for\ k=1,\cdots,H \tag{8}$$

which means that the concentration curve of commodity j with respect to income is at least as high as that of commodity i multiplied by a constant (α_{ji}) at each point in the income distribution.

Yitzhaki and Slemrod (1991) focused on differences among concentration curves (DCC), which correspond to LHS in (8). A DCC curve is depicted as representing cumulative distribution income on the horizontal axis. Three things are worth mentioning regarding this DCC curve. First, if the entire curve is above (below) the horizontal axis, then commodity j (i) dominates i (j), while if it intersects the horizontal axis, neither commodity dominates the other. Second, the efficiency gain from the tax reform can be seen from the height of the DCC curve at the right end of the income distribution—that is, $1-\alpha_{ji}$. If it is positive, then the tax reform brings about an efficiency gain for society as a whole. This is because (7) holds if $\alpha_{ji}<1$ and β^h is identical for all households (with no equity consideration). Third, distributive gains can be seen from the curvature of the DCC curve. If the curve is increasing (decreasing), then a household gains (loses) from the reform from the viewpoint of income distribution. Hence, even if $\alpha_{ji}\geq 1$, there is a possibility of a tax reform being welfare-improving.

3. Data description

This empirical analysis is basically based on two datasets. The first is aggregated data from FIES, which is one of the major household surveys in Japan and is compiled by the Ministry of Internal Affairs and Communications. This study uses quarterly data for spending on major commodity groups (for households with two or more members) over the period from 1985Q1 to 2007Q4 to estimate the price elasticities of demand of major commodity groups.

The second is JPSC, which is one of the major panel household surveys and is compiled by the Institute for Research on Household Economics. This survey was first carried out in 1993 with females

aged 24-34 years old at that time and has been conducted every year. In 1997 and 2003, it added females aged 24-34 years old in each year to the sample as new waves. This study uses pooled data from the 1998 to 2003 surveys because the survey started to ask respondents about their households' monthly expenditures on major commodity groups in the 1998 survey. The sample size in the 2003 survey was 2,139 females, about eighty percent of whom had stayed in the sample over the six years. This study uses the pooled data as repeated cross-sectional data and do not utilize panel information.

The original sample size of the JPSC dataset is 9,615, and the author conduct the following data cleaning. First, this study removes respondents who are not married and reside with parents. These respondents, who share about one-fourth of the total sample, depend heavily on their parents in terms of household spending; indeed, a substantial portion of them answer zero or extremely low for the amount of spending on food & beverages and fuel, light & water charges. Second, this study removes respondents who did not answer with the amount of spending on at least one major commodity group. Third, this study removes respondents who answered that they spent zero on food & beverages, considering that it indicates their answers lack reliability. After removing these three kinds of respondent, there exist 7,394 respondents, 76.9 percent of the original sample.

This study estimates the social marginal costs of tax rate changes for young households. The impact of tax reforms should be, however, substantially different across young households that are heterogeneous in various aspects, such as married or not, having children or not, and living with or apart from parents. In this paper the author examines how tax rate changes variously affect heterogeneous households by dividing young households into four groups:

Group 1 : married; wife being a regular employee; with children;

Group 2 : married; wife being a non-regular employee or not working; with children;

Group 3 : married; with no children

Group 4 : single; residing apart from parents.

"Single" in group 4 means unmarried, divorced, or separated. By removing respondents who did not answer questions necessary to define their group numbers, this study uses 7,238 respondents in total.

Tables 1 summarizes the key attributes of these four household groups and Table 2 compares spending patterns across them, both based on data over the period 1998-2003. Most notably, the share of education is highest for groups 1 and 2, who have children, than for groups 3 and 4. The share of food is highest for group 4, probably reflecting a higher propensity to eat out. It should be also noted that the households in group 4 have 0.7 children on average, reflecting the fact that single-mother households share about 35 percent in this group.

The rightmost column in the table 2 reports the concentration ratio of each commodity group, which grasps the degree of inequality of spending across households of different income levels. This ratio, denoted by θ_i, is calculated as $\theta_i = 2\mathrm{cov}[s_i,\ F(y)]$, where s_i is the share of spending on commodity group

Table.1 Basic characteristics by household group

Household group	1	2	3	4	Average
Share	12.3	67.1	11.1	9.5	—
Age of the respondent	36.0	34.9	31.7	32.8	34.5
Number of household members	4.9	4.6	2.4	1.8	4.1
Number of children	2.0	2.0	0.0	0.7	1.7
Single-person (%)	0.1	0.0	0.7	62.2	6.0
Residing with parents	48.3	33.5	19.6	0.0	30.6
Living in urban areas (%)	16.7	22.6	32.3	38.8	24.4
Respondent as a college graduate (%)	15.6	9.3	22.7	22.5	12.8
Respondent as a regular employee (%)	100.0	0.0	32.6	60.1	21.6
Respondent as a non-regular employee (%)	0.0	32.1	32.9	23.8	27.5
Husband as a college graduate (in married couples, %)	32.6	36.4	41.8	—	—
Husband as a regular employee (in married couples, %)	89.7	83.2	87.8	—	—
Total monthly spending ('000 yen)	306.4	249.8	212.3	124.6	240.6

(Note) 1. Group 1: married; a wife being a regular employee; with children;
Group 2: married; a wife being a non-regular employee or not working; with children;
Group 3: married; with no children
Group 4: single; residing apart from parents
2. Calculated from the pooled data for 1998-2003.

Table 2. Spending patterns by household group

Household group	1	2	3	4	Average	Concentration ratio (θ)
1. Food & beverages	25.2	27.2	23.8	28.8	26.7	0.15
2. Fuel, light & water charge	7.2	8.6	7.8	9.5	8.4	0.10
3. Furniture & household utensils	1.9	2.3	3.2	2.8	2.4	0.37
4. Clothes & footwear	4.5	4.1	4.1	9.1	4.5	0.28
5. Medical care	2.9	3.0	3.1	3.6	3.1	0.28
6. Transportation & communication	10.7	12.1	15.2	15.0	12.5	0.25
7. Education	9.0	9.0	0.6	3.5	7.5	0.26
8. Culture & recreation	3.8	4.7	4.3	7.5	4.7	0.32
9. Others	34.7	29.1	37.8	20.2	30.2	0.35
Total	100.0	100.0	100.0	100.0	100.0	0.25

(Note) 1. See the Note on Table 7 for the definitions of household groups.
2. Calculated from the FIES pooled data for 1998-2003.

i by each decile income group and $F(y)$ is the cumulative distribution of income. The higher this ratio is, the more consumption of the commodity is concentrated on higher-income households.

From this table we can find that spending on furniture & household utensils, culture & recreation and others are highly concentrated, indicating that higher income groups spend a bigger share on these items. By contrast, the degree of concentration is lower for food & beverages, fuel, light & water charges, and transportation & communication. Generally, it is desirable to raise the tax rate on commodity groups with a higher concentration and reduce it on those with a lower concentration from an equity viewpoint. At the same time, however, the efficiency aspect of tax reforms should be taken into account—how households respond to tax rate changes. This study adds the latter issue in the empirical analysis in the next section

to estimate the marginal cost of tax reforms.

4. Estimation of social marginal costs of taxation

4.1 Effective tax rates, price elasticities, and distributional characteristics

In this paper the social marginal cost of raising the tax rate on each commodity group, λ_i, which is defined in (4)' is estimated. For this purpose, we need price elasticities of demand, effective tax rates, and distributional characteristics of each commodity group.

As for effective tax rates, we use the results of Uemura (2006), which are calculated from time-series data of the FIES and Annual Reports of the National Tax Agency. Table 3 reports the effective tax rates for major commodity groups in 1998 and 2003, quoted from Uemura (2006). The effective tax rates vary substantially across commodity groups, while their average lies in a narrow range between 6.32 and 7.09 over the estimation period. For example, the tax rates on food & beverage and transportation & communication are higher than those on other commodity groups, reflecting additional taxes such as liquor and gasoline taxes. By contrast, the tax rates on medical care and education are lower due to tax-exempt items included in their categories. Any tax reform that reduces spending on commodity groups of higher effective tax rates is costly, in that tax revenues cannot be raised easily.

As for the price elasticities of demand for commodity groups, this study estimates the values based on the almost ideal demand system (AIDS) proposed by Deaton and Muellbauer (1980). The quarterly data over the period from 1985Q1 to 2007Q4 of FIES for estimating elasticities are used.

This study uses a linearly approximated version of AIDS (LA/AIDS; see Deaton and Muellbauer, 1980), and estimate parameters ϕ_i, γ_i and κ_i in the budget share function for commodity i:

$$w_i^t = \phi_i + \sum_j \gamma_{ij} \ln p_j^t + \kappa_i \ln\left(\frac{y^t}{P^t}\right) + \xi_i^t \qquad (9)$$

where w_i^t ($\equiv p_i^t x_i^t / y^t$) is the budget share of commodity i, P^t is the overall price index, and ξ_i^t is the error term,. For P^t, we use Stone's price index:

$$\ln P^t = \sum_i w_i^t \ln p_i^t$$

to avoid the problem of multi-colinearity among explanatory variables. Furthermore, the demand theory requires that the following constraints be placed on the parameters in (9):

$\sum_i \phi_i = 1$, $\sum_i \gamma_{ij} = 0$, $\sum_i \kappa_i = 0$ (adding up to total expenditure);
$\sum_j \gamma_{ij} = 0$ (homogeneity of degree zero in prices and total expenditure);

and $\gamma_{ij}=r_{ji}$ (symmetry).

To assess the impact of marginal tax reforms, the key input obtained from the estimated demand system is a set of uncompensated price elasticities, ε_{ij}, which determines the marginal efficiency cost of taxing. The uncompensated price elasticities are calculated as:

$$\varepsilon_{ij}=-\delta_{ij}+\frac{\gamma_{ij}}{w_i}-\frac{\kappa_i w_j}{w_i}, \tag{10}$$

where δ_{ij} (the Kronecker delta) is equal to unity for $i=j$ and to zero for $i\neq j$, and w_i and w_j are evaluated at their means over the period of 1998 and 2003.

Table 4 shows the matrix of estimated uncompensated price elasticities (evaluated at average spending during 1985Q1 and 2007Q4), based on the estimated results of a seemingly unrelated regression. As seen in this table, all commodity groups have negative uncompensated own price elasticities, which is consistent with the theory arguing that compensated own price elasticity should be negative. Food & beverages, and fuel, light & water charges have the smallest elasticities in absolute terms, while furniture & household utensils, culture & recreation, and others have elasticities above one. To estimate λ, this study also calculates cross price elasticities for each commodity.

Finally, Table 5 shows the estimated distributional characteristics of nine commodity groups based on JPSC results for different values of inequality aversion parameters. It is noteworthy that the distributional characteristics of fuel, light & water charges, and food & beverages are higher with a higher σ, which is in line with the results of Urakawa and Oshio (2008), who used aggregated spending data for society as a whole. This is because the shares of spending on these commodity groups are relatively high for the lowest income class.

Table 3. Effective commodity tax rates

(percent)

Commodity group	1998	1999	2000	2001	2002	2003
1. Food & beverages	8.08	7.93	7.10	7.07	6.96	7.10
2. Fuel, light & water charge	5.48	5.47	5.36	5.36	5.37	5.36
3. Furniture & household utensils	4.76	4.76	4.76	4.76	4.76	4.76
4. Clothes & footwear	4.76	4.76	4.76	4.76	4.76	4.76
5. Medical care	2.08	2.13	2.17	2.15	2.10	2.09
6. Transportation & communication	12.77	12.49	10.73	10.87	10.66	10.70
7. Education	1.23	1.29	1.20	1.18	1.11	1.09
8. Culture & recreation	5.24	5.18	5.08	5.07	5.07	5.07
9. Others	8.93	9.15	7.97	7.99	7.94	8.65
Total	7.09	6.36	6.37	6.32	6.50	6.50

(Source) Uemura (2006).

4.2 Social marginal costs of taxing by household group

Based on parameters calculated in the previous sections and spending patterns, this study estimates the marginal costs of raising tax rates and compare them by household group. The estimation results are summarized in Table 6, which compares values of λ for $\sigma=1$, 2, and 5, with their ranks by household group. It should be noted that we use common values for price elasticities across households, meaning that households differ solely by spending patterns in this study[3)].

The ranking of social marginal costs varies across household groups, reflecting differences in the share of spending on each commodity group by household group. Hence, the case cannot be ruled out that a tax reform, which is proposed on the basis of the average spending pattern of young households, may not necessarily be beneficial to all groups. For example, consider a tax reform that calls for a lower tax rate on medical care and a higher tax rate on furniture & household utensils as in the case of $\sigma=1$. This reform is justified for young households as a whole and is also beneficial to groups 2, 3, and 4, judging by the rankings of λ. It is not, however, beneficial to group 1. This outcome also holds in the cases of $\sigma=2$ and $\sigma=5$. If the tax on medical care is chosen to finance the subsidy on clothes & footwear, groups 1 and 2 gain and groups 3 and 4 lose in the cases of $\sigma=1$ and $\sigma=2$. In the case of $\sigma=5$, only group 1 gains.

Taxing education is another interesting example that illustrates how tax reforms variously affect different types of household group. Education ranks around the middle for groups 1 and 2, both of which have children, while it tends to rank lower for group 3 (married and with no children) and higher for group 4 (single). For married couples, it is thus reasonable that the impact of raising the tax rate on education is smaller for households without children than those with children. Its higher social marginal cost for group 4 suggests that single-parent households face relatively heavy educations costs.

4.3 Comparing DCC curves by household group

The next step is to address the impact of marginal tax reforms by income class, using differences

Table 4. Price elasticities of demand for each commodity group (ε_{ij})

	i=1	2	3	4	5	6	7	8	9
j=1. Food & beverages	−0.27	0.11	1.06	−1.13	0.22	−0.15	−1.60	−0.20	−0.11
2. Fuel, light & water charge	0.01	−0.17	−0.51	−0.09	−0.16	−0.11	0.34	0.06	−0.15
3. Furniture & household utensils	0.15	−0.24	−1.24	0.02	−0.43	−0.18	−0.83	0.30	0.18
4. Clothes & footwear	−0.13	0.06	0.14	−0.95	−0.17	0.23	−0.93	0.08	0.15
5. Medical care	0.04	−0.07	−0.47	−0.20	−0.48	0.05	0.13	−0.10	−0.01
6. Transportation & communication	−0.10	−0.19	−0.78	0.34	0.18	−0.74	1.10	−0.99	0.16
7. Education	−0.28	0.44	−1.33	−1.10	0.30	0.57	−0.44	−0.40	−0.07
8. Culture & recreation	−0.02	0.21	0.99	0.00	−0.23	−0.64	0.35	−1.42	0.32
9. Others	−0.07	−0.43	1.43	0.27	−0.08	0.35	−0.78	0.67	−1.34

(Note) 1. Estimated from the AID-System based on the quarterly data from FIES over the period from 1985Q1 to 2007Q4.
2. Evaluated at the average spending on each commodity group over the period from 1985Q1 to 2007Q4.

Table 5. Distributive characteristics

Commodity Group	$\sigma=0$	$\sigma=1$	$\sigma=2$	$\sigma=5$
1. Food & beverages	1.000	0.447	0.239	0.087
2. Fuel, light & water charge	1.000	0.463	0.255	0.097
3. Furniture & household utensils	1.000	0.373	0.172	0.048
4. Clothes & footwear	1.000	0.403	0.197	0.059
5. Medical care	1.000	0.403	0.198	0.063
6. Transportation & communication	1.000	0.413	0.211	0.073
7. Education	1.000	0.408	0.204	0.066
8. Culture & recreation	1.000	0.387	0.181	0.049
9. Others	1.000	0.379	0.175	0.046

(Note) Calculated from the FIES pooled data for 1998-2003.

among concentration curves (DCC). The values of λ reported in Table 9 indicate the marginal welfare cost for each household group, but it do not show the different ways tax reform affects each income class for each household group. The DCC, which is calculated as

$$\sum_{h=1}^{k} s_j^h - \alpha_{ji} \sum_{h=1}^{k} s_i^h, \quad i,\ j=1,\cdots,9;\ k=1,\cdots,10,$$

can graphically compare distributive gains of tax reforms. To draw the DCC curves, we need to calculate the ratio of the efficiency loss of taxation $\alpha_{ji}=\alpha_j/\alpha_i$, which scales the concentration curve of a commodity to be compared (commodity i). In our calculation, this ratio is assumed to be the same across household groups, and is calculated based on the spending pattern of average young households. Hence, the analysis of the DCC curves here focuses entirely on the redistributive outcome of tax reforms.

Of thirty-six pairs of commodity groups available for comparisons, we choose food & beverages as the base commodity; that is, set $j=1$. Food & beverages has the largest share of household spending (see Table 2), and is usually considered to comprise necessity goods, so tax reform debates often focus on tax rates for this category. In fact, Great Britain, France, Germany, and other countries have lower commodity tax rates on food & beverages. Furthermore, food & beverages has a relatively low concentration ratio (see Table 2), a high distributive characteristic (see Table 5), and one of the highest marginal costs of taxation for a higher inequality aversion (see Table 6). Hence, any tax reform is likely to incorporate an absolute and/or relative reduction of the tax rate on food & beverages.

Figure 1 depicts DCC curves for four selected commodity groups-fuels, light & water charges, clothes & footwear, transportation & communication, and education-for young households as a whole. Figures 2 to 5 show their DCC curves for each household group. The Base commodity group in all figures is food & beverages. We can depict the DCC curves of other commodity groups in the same manner, but we omit

3) For $\sigma=0$, λ takes the same values for all household groups as reported in the column below $\sigma=0$ in Table 5.

Table 6. Social marginal cost by household group

Household group	1		2		3		4		Average	
	λ_i	rank	λ_i	rank	λ_i	rank	λ_i	rank	λ_i	rank
(1) $\sigma=1$										
1. Food & beverages	0.603	2	0.481	2	0.423	2	0.383	3	0.449	2
2. Fuel, light & water charge	0.620	1	0.497	1	0.434	1	0.418	1	0.466	1
3. Furniture & household utensils	0.543	7	0.400	9	0.347	7	0.282	8	0.370	9
4. Clothes & footwear	0.569	4	0.437	4	0.381	4	0.290	7	0.401	6
5. Medical care	0.529	8	0.435	5	0.391	3	0.312	6	0.403	5
6. Transportation & communication	0.600	3	0.444	3	0.377	5	0.356	4	0.416	3
7. Education	0.555	5	0.434	6	0.311	9	0.389	2	0.409	4
8. Culture & recreation	0.553	6	0.426	7	0.363	6	0.278	9	0.390	7
9. Others	0.525	9	0.424	8	0.344	8	0.321	5	0.383	8
[Rank correlation]		(0.833)		(0.933)		(0.650)		(0.817)		
(2) $\sigma=2$										
1. Food & beverages	0.418	2	0.269	2	0.219	2	0.186	3	0.240	2
2. Fuel, light & water charge	0.439	1	0.285	1	0.229	1	0.219	1	0.257	1
3. Furniture & household utensils	0.353	6	0.197	9	0.151	7	0.105	8	0.170	9
4. Clothes & footwear	0.379	4	0.228	4	0.178	5	0.105	7	0.196	6
5. Medical care	0.334	8	0.228	5	0.187	3	0.122	6	0.199	5
6. Transportation & communication	0.417	3	0.239	3	0.180	4	0.158	4	0.213	3
7. Education	0.370	5	0.226	6	0.150	8	0.190	2	0.205	4
8. Culture & recreation	0.349	7	0.214	7	0.163	6	0.097	9	0.183	7
9. Others	0.328	9	0.212	8	0.147	9	0.124	5	0.176	8
[Rank correlation]		(0.800)		(0.933)		(0.767)		(0.817)		
(3) $\sigma=5$										
1. Food & beverages	0.236	3	0.098	2	0.080	2	0.069	2	0.087	2
2. Fuel, light & water charge	0.255	1	0.109	1	0.087	1	0.091	1	0.098	1
3. Furniture & household utensils	0.180	6	0.059	9	0.038	8	0.025	6	0.047	8
4. Clothes & footwear	0.199	5	0.074	6	0.051	6	0.018	9	0.059	6
5. Medical care	0.163	7	0.077	4	0.055	5	0.029	5	0.063	5
6. Transportation & communication	0.240	2	0.086	3	0.061	4	0.048	4	0.074	3
7. Education	0.205	4	0.075	5	0.076	3	0.065	3	0.067	4
8. Culture & recreation	0.159	8	0.061	7	0.043	7	0.019	8	0.049	7
9. Others	0.158	9	0.061	8	0.037	9	0.024	7	0.046	9
[Rank correlation]		(0.900)		(0.967)		(0.983)		(0.833)		

(Note) 1. "Rank correlation" indicates the coefficient of correlation of the ranks between each household group and average.
2. Calculated from the FIES pooled data for 1998-2003.

them to prevent the figures from becoming too complicated. The height of the right end of each curve corresponds to the efficiency gains of the tax reform, but we focus here more on the curvature of the curve, which illustrates the distributive outcome.

Figure 1 indicates that the DCC curves of clothes & footwear, education, and transportation & communication increase from the bottom decile income class to the seventh-ninth decile income class and then decline, indicating the distributional outcome that top-high-income classes lose and lower-income classes gain. This means that an increase of the tax rates on these commodity groups, combined with a reduction of the tax rate on food & beverages, leads to distributive gains. By contrast, raising the tax rate

on fuel, light & water charges is not justified in terms of equity, because it makes lower-income classes worse off and higher-income ones better off.

Comparing Figures 2 to 5 shows that the patterns of distributive outcomes differ somewhat across household groups. A higher tax rate on education makes most income classes better off in groups 1 to 3, which is in line with its high concentration ratio (see Table 2). In particular, this tax reform is most effective for group 3, which consists of households of married couples with no children, judging by the steep upward slope of the DCC curve. In contrast, the DCC curve in Figure 5 lies below the horizontal line for most income classes, and its curvature indicates a regressive outcome. A higher tax rate on education is likely to make lower-income, single-parent households worse off. This example suggests that household heterogeneity should be seriously considered when assessing the distributional outcome of any consumption tax reform.

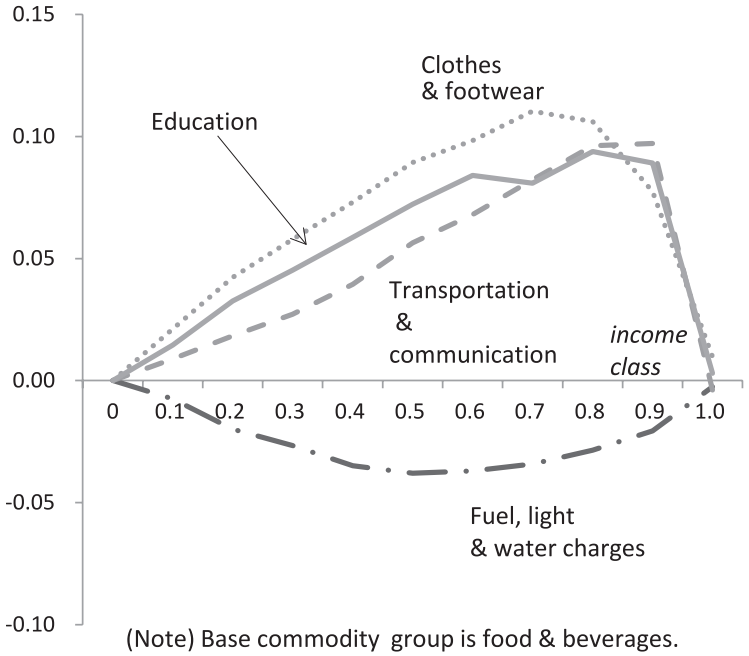
5. Conclusion

This study investigated the welfare impact of consumption tax reforms on young households in Japan, based on the theoretical framework of marginal commodity tax reforms proposed by Armad and Stern (1981) and using micro data from the Japanese Panel Survey of Consumers. This study explicitly considered the heterogeneity of young households and examined how the social marginal costs of raising the tax rate on commodity groups differ across different types of young household.

According to the estimated results, the social marginal costs differ significantly across young household groups with different attributes. Hence, the case cannot be ruled out that the tax reform, which is proposed on the basis of the average spending pattern, may not be beneficial to all household groups. In addition, the analysis of differences among concentration curves reveals that the distributional outcomes of tax reforms differ substantially across heterogeneous households. In particular, the welfare impact of a change of the tax rate on education differs substantially across different types of household.

To be sure, this study has many limitations. Most of all, it is limited to young households because the respondents of the JPSC are limited to females aged 25-44 years old. In addition, this study uses common price elasticities for all households. The social marginal costs of taxation and their ranks among commodity groups should be quite different across households with different socioeconomic attributes. Hence, we should be cautious when interpreting the findings.

However, this estimation results clearly suggest that we have to explicitly take into account household heterogeneity when considering any consumption tax reform. It is widely recognized that the impact of consumption tax rate changes differs across different incomes. As implied by this study, however, household attributes other than income are also important and should be considered more seriously, especially if consumption tax is used as a tool to finance social security, which has a strong distributive



(Note) Base commodity group is food & beverages.

Figure 1 DCC curves : young househokds as a whole

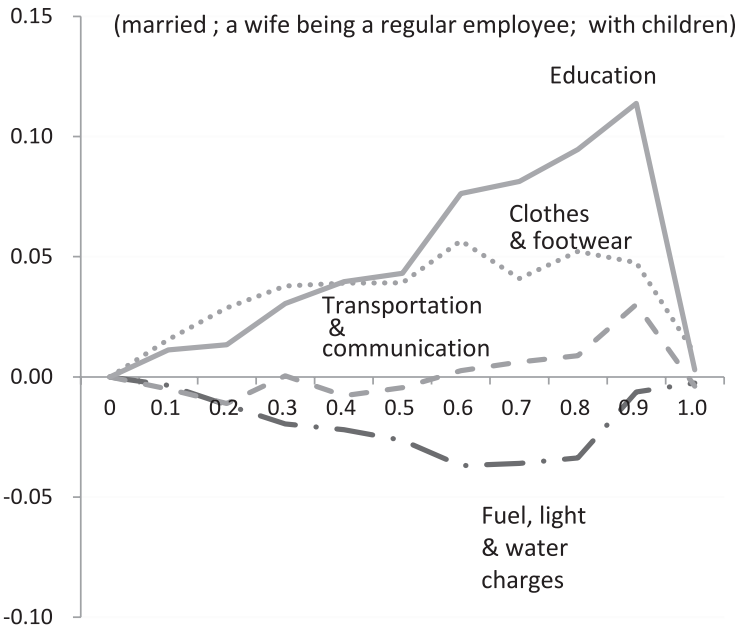


Figure 2 DCC curves : group 1

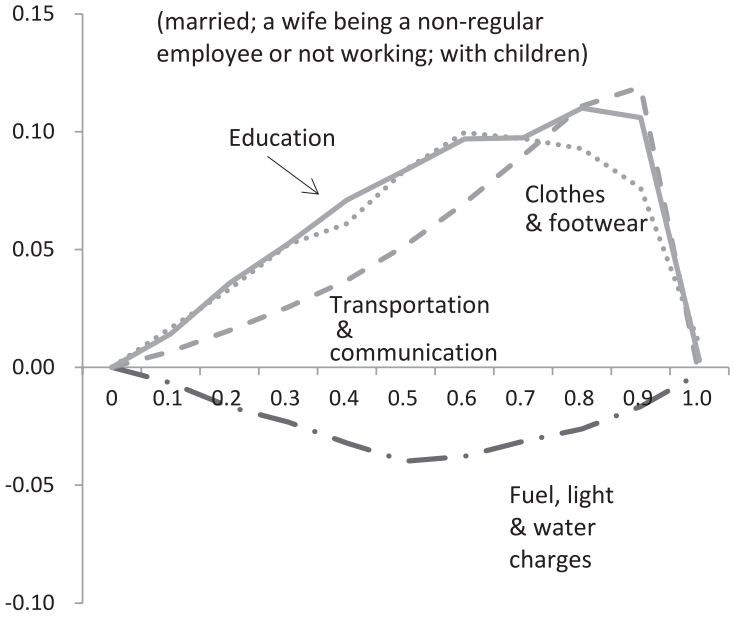


Figure 3　DCC curves : group 2

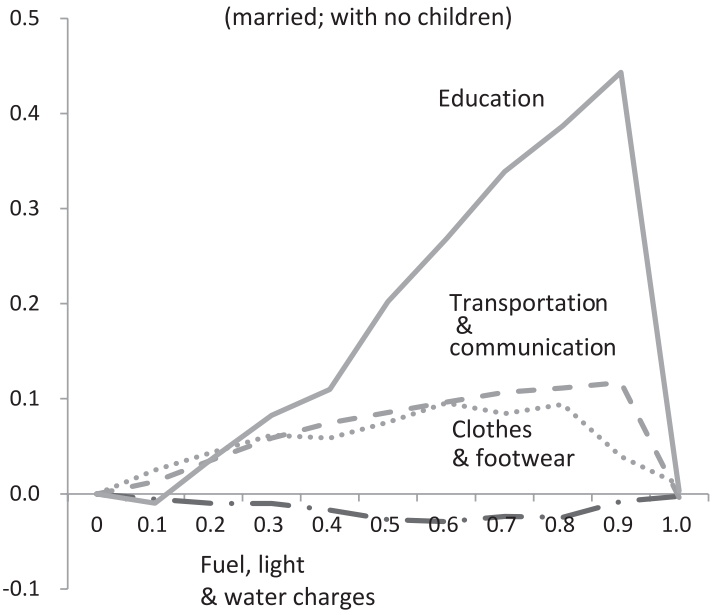


Figure 4　DCC curves : group 3

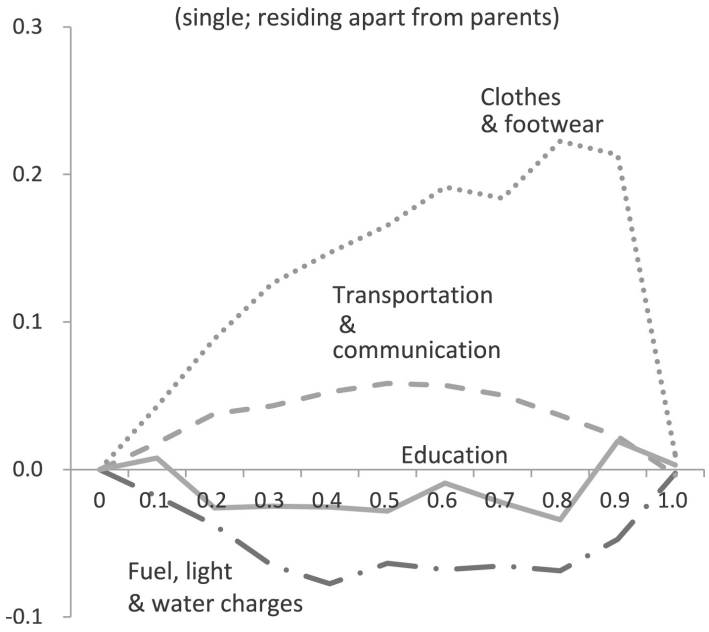


Figure 5 DCC curves : group 4

impact.

This study can be extended this study in various directions. For example, we can obtain more precise estimates of marginal costs of taxation by estimating the demand system for each household group. For example, data on the area where each respondent lives enable to do this type of analysis by matching them with data on prefecture-level consumer prices. Second, we can explicitly consider the impact of tax reforms on poverty, an issue that has become more serious in Japan. In fact, Liverati (2003) and Makdissi and Wodon (2002) presented a useful framework for this analysis. As implied by this estimation results, poverty-reducing tax reforms also depend heavily on the heterogeneity of households.

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