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The inter-cohort distributional effects of Japan's indirect tax reforms

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The inter-cohort distributional effects of Japan's indirect tax reforms

Takeshi Kogawa *

Abstract

This study attempts to estimate how Japan's consumption tax reforms affected the welfare of different cohorts of households, using long-term household level panel data including age of head, income and expenditure of each household in Japan. In order to evaluate distributional effects of tax reform, this study compares lifetime Equivalent Variations, which are calculated from estimated value of lifetime share of expenditure on food. As a result, it is shown that, the consumption tax reform in 2019, in which tax rates on non-food items was hiked from 8% to 10%, reduced utility by 1.29% to 1.55% in terms of the EVs in the income ratio, with relatively large effects on the younger, higher-income groups. Furthermore, a simulation analysis of the effect of a tax reduction when the consumption tax rate on food products is set at 0% in 2025 was conducted suggests that the reduced tax rate system could have a certain positive economic effect on the lower-income groups but that the older, higher-income groups could be disproportionately affected.

JEL classification number: D12, H24, H31
Keywords: Value Added Tax, Tax reform, Distributional effects, Equivalent Variations, Japan

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1. Introduction

A consumption tax, one kind of value-added tax (VAT), has been one of the most important financial resources for social security in Japan since its introduction in 1989. Since then, the revenue of the consumption tax has become increasingly essential as a financial resource for Japan's social security, and its reforms have been implemented several times. However, the consumption tax has been one of most sensational political and economic issues in Japan for the last 30 years. In Japan, for a long time, many have asserted that the consumption tax is regressive, which means that, because the consumption tax is levied uniformly on luxury goods and necessities (such as foodstuffs) alike, the burden of the consumption tax as a percentage of income is heavier on those with lower incomes and lighter on those with higher incomes. For this reason, many people have opposed raising the tax rate because it would cause serious economic damage, especially to low-income households. In fact, the consumption tax reform that aimed to raise the tax rate from 8% to 10% was postponed twice (first from October 2015 to April 2017, then from April 2017 to October 2019) because of slow recovery from the serious economic damage caused by the 2014 tax hike from 5% to 8%.

In practice, the question arises how the past reform of the consumption tax rate economically affected different cohorts of households. In particular, the effect may be

different for different cohorts depending on income, the age of the household head, the number of children, etc., because the cohorts' patterns of consumption also vary. Furthermore, it is essential for policy makers to implement appropriate policies that relieve economic damage on household cohorts with heads of household with specific ages and incomes based on an evaluation of the economic impact of consumption tax reform.

However, despite the fact that the consumption tax is one of the most topical economic and political issue in Japan, there exists a limited amount of research that empirically investigates the impact of previous consumption tax reforms with a focus on the heterogeneity of households. This is mainly because household-level panel data about consumption and income in Japan has not been accessible for a long time. It was not until the 2000s that the attempt to accumulate household-level panel data began in some institutes in Japan, and since then, they have successfully collected micro-level panel data that follows the same households for the last 15 years.

The purpose of this study is to analyse the distributional impact of the consumption tax reform, especially in 2019, on different cohorts of households using household-level, micro-level panel data, including data on each household's expenditure, income, and age of household head. In addition, a key point to note in this analysis is that the

consumption patterns of individual households vary by time period and age. For example, with the spread of the internet into households triggered by the IT revolution of the early 2000s, the proportion of household spending on communications, computers, and mobile phones is likely higher today than it was 20 years ago, and the proportion of spending on medical care and communications is likely to be vastly different for the age of head of household, even withing the same period of time. Another point to note is that different consumption decisions are made at different points in time. Therefore, the economic impact of a change in the consumption tax rate not only occurs at the time of the reform but also lasts for a period afterwards. It is essential in the analysis of tax effects that these effects, which last for multiple periods, be evaluated and compared on some uniform scale.

To analyse the distributional effects of changes in consumption tax rates on households, this study adopts Equivalent Variation (EV) as a measure of welfare effects, which has been estimated in many previous studies analysing the welfare effects of taxes on households. EV is a measure of how much consumers are willing to pay before a price increase to avoid a price increase. EV is based on Hicksian demand, which is a change in wealth that has the same effect on consumer welfare as a change in price, at

current prices, without changing income. This is a useful tool when current prices are the best method to make comparisons.

This study makes four academic contributions to the analysis of the economic impact of the consumption tax reform in Japan. First, this study is the first to use large micro-level household panel data and to focus on the heterogeneity of individual households. Second, as will be discussed in Section 3, most of the previous studies have conducted analyses based solely on aggregate data from government statistics; Yashio and Hasegawa (2008) analysed the impact of the increase in the consumption tax rate from 5% to 10% on the consumption tax burden for different income groups, but they ignored heterogeneity among households in the same income group, such as the age of the head of household, due to limited accessibility of data. Third, this study takes into account the substitutability of consumption between different points in time. Yashio and Hasegawa (2008) conducted a simulation analysis of changes in the tax burden due to an increase in the consumption tax rate based on consumption by income group at a specific point in time, but they did not incorporate changes in consumption patterns between different points in time. Fourth, this is the only study that uses the latest household panel data to analyse the reduced consumption tax rate, which was introduced for the first time in Japan in 2019. Most previous studies in Japan focusing

on the consumption tax, including that of Yashio and Hasegawa (2008), have used aggregate data from the government's National Survey of Family Income and Expenditure. Yashio and Hasegawa (2008) argue that the introduction of a reduced tax rate on income in Japan will have a significant impact on the consumption tax. They simulated changes in tax burdens by income group due to the introduction of a reduced tax rate system in Japan, but because their analysis used data from the 1999 National Survey of Family Income and Expenditure, they did not consider the consumption patterns of households in 2019, when the reduced tax rate system was actually introduced. This study, however, uses individual data from the Japan Household Panel Data Survey (Keio University), which is conducted every year, as household consumption data. By using data from every year from 2009 to 2019, it is possible to conduct an analysis that incorporates the consumption patterns of households at the time of the introduction of the reduced tax rate system.

The remainder of this dissertation is structured as follows. Section 2 provides an overview of the history of the consumption tax system in Japan and changes in economic conditions as the background for the research. Section 3 presents previous studies focusing on the consumption tax system in Japan and around the world. Section 4 describes the data used in the analysis of this study. Section 5 describes the empirical

methods used in our analysis. Section 6 reports the results of the analysis, and finally, Section 7 presents the conclusions.

2. Consumption tax reform in Japan

2.1. History of consumption tax reform in Japan

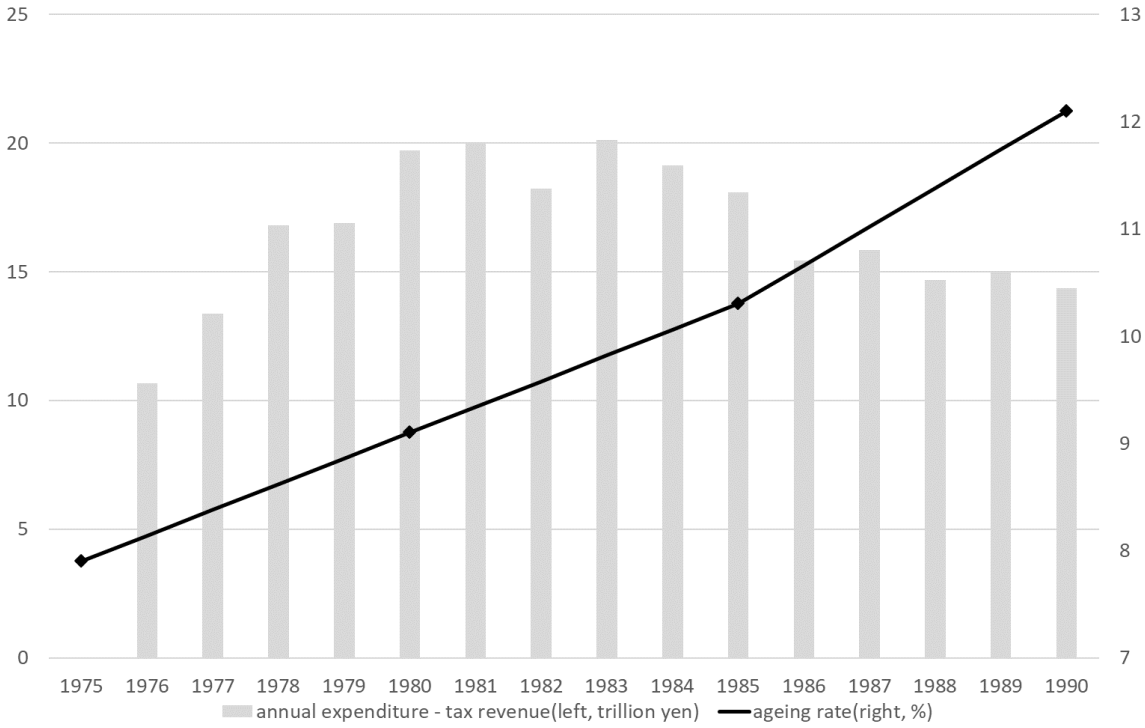
This section provides an overview of the introduction of the consumption tax and its reform in Japan as the background for this study. The foundation of the modern Japanese tax system was established in 1950 by the Report on Japanese Taxation by the Shoup Mission. This report, compiled by Dr Shoup of Columbia University in the United States, included recommendations for a simpler tax system in Japan based mainly on direct taxes. Based on this report, a tax system built primarily on income tax was established.

The momentum for the introduction of a consumption tax in Japan began to build in the late 1970s, when the country's social security system was enriched with the achievement of universal health insurance for all citizens in 1961 and free medical care for citizens over 70 in 1973. As a result, expenditure pressures on national finances increased. At the same time, Japan's population was ageing, and the proportion of the total population aged 65 years and over continued to rise from 7.9% in 1975 to 10.3% in

1985 (Figure 1). As society aged, it became difficult to secure financial resources to meet the expenditure pressures associated with the expansion of the social security system under an income-tax-based tax system that required only the working generation to bear the burden.

Therefore, the momentum to introduce a VAT, which could be levied on the purchase of goods and services regardless of generation, grew as a new means of raising funds. Then, in April 1989, a consumption tax, with a flat rate of 3%, was introduced for the first time in Japan. Subsequently, in April 1997, the tax rate was raised to a flat 5%, and in April 2014, to a flat 8%. Finally, the consumption tax rate hiked to 10% in October 2019. When the tax rate was raised to 10%, based on the reflection that the uniform increase in tax rate to 8% in April 2014 had a negative long-term impact, mainly on consumption by low-income groups, the reduced tax rate system was introduced for the first time in Japan, leaving the tax rate levied on food at 8%.

Figure 1. Japan's ageing rate and fiscal situation from 1975 to 1990



Notes: Ageing rate = population of people of age over 65 / total population (%)
Source: Annual expenditure and tax revenue has been sourced from the Homepage of Ministry of Finance, Japan.
Ageing rate has been sourced from the Population Census, Japan.

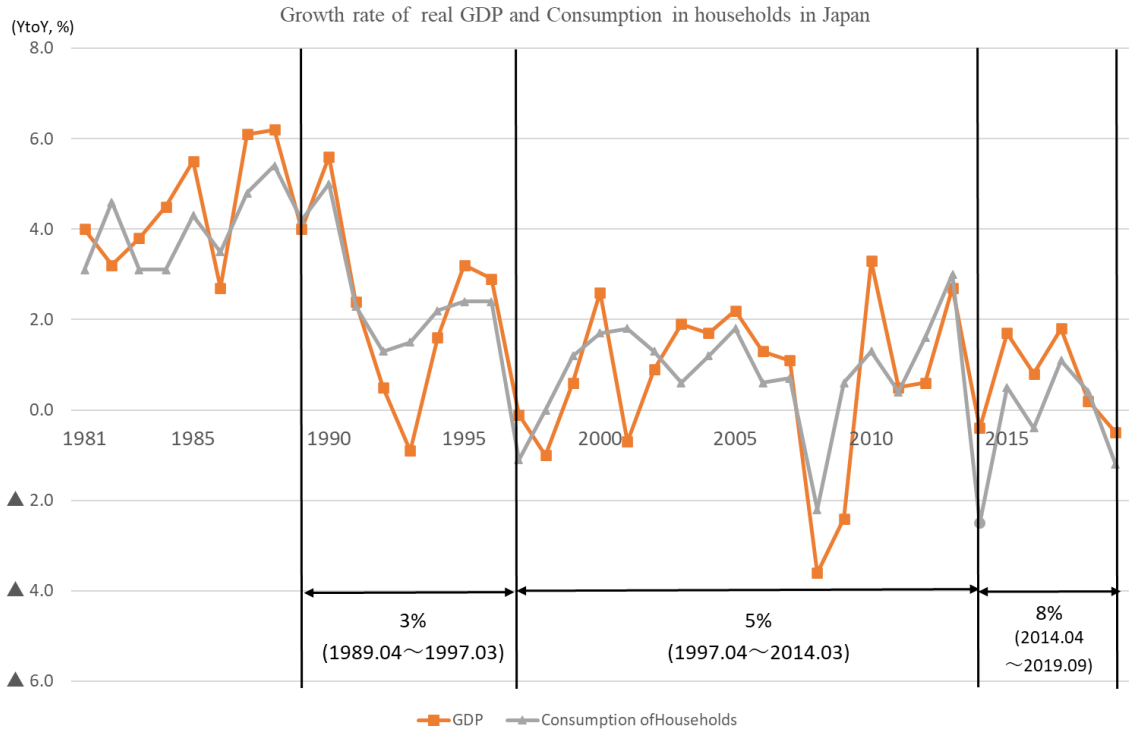
Table 1. History of consumption tax reform in Japan

Date	Detail of reform (change of tax rate)
01, April, 1989	Introduction of consumption tax(3%)
01, April, 1997	Raised from 3% to 5%
01, April, 2014	Raised from 5% to 8%
01, October, 2019	Raised from 8% to 10% except for food and newspaper (Tax rate for food and newspaper stays at 8%)

2.2. Economic situation and public opinion of the consumption tax

In this section, as a preliminary analysis before proceeding to the empirical analysis from Section 5 onwards, we outline the economic situation in Japan from the time when the consumption tax was introduced to the present. The growth rates of the gross domestic product (GDP) and private final consumption expenditure in 1981–2020, shown in Figure 2, were positive in 1989, the year in which the consumption tax was introduced, but were at a lower level than in the previous year. In each of the three subsequent years in which the tax rate was raised, both the GDP and household consumption declined compared to the previous respective years. In particular, when the tax rate was raised from 5% to 8% in 2014, household consumption fell by a substantial 2.6%. This fall remains the largest in the last 30 years, even larger than that during the Great Recession of 2009. Thus, the macro-level economic data shown in Figure 2 suggest that the introduction of the consumption tax and the hike in its tax rate may have had a significant negative impact on the macroeconomy, particularly on household consumption.

Figure 2. Graph of the GDP and household consumption from 1981 to 2020



Source: SNA (the national accounts of Japan)

The Annual Report on the Japanese Economy and Public Finance 2015 (Cabinet Office, Japan, 2015) analyses the background of the sharp decline in household consumption in 2014 using individual data from the Household Survey (Ministry of Internal Affairs and Communications, Japan). The Annual Report on the Japanese Economy and Public Finance 2015 points out that (1) consumption expenditure of low-income households remained at a relatively low level after the consumption tax rate was raised, and (2) among low-income households, the slow recovery in consumption

among households whose heads are working age. i.e. under the age of 60 was one of the major reasons why the overall recovery of consumption was weak.

Next, we will briefly outline the history of the consumption tax from a political perspective, with reference to descriptions in the reports of the Showa Fiscal History and the Heisei Fiscal History (Ministry of Finance). As mentioned above, the consumption tax was first introduced in Japan in 1989, but the idea of introducing a VAT as a new fiscal resource had existed the since the 1970s: in 1978, the then Prime Minister (PM) Masayoshi Ohira announced a general consumption tax that was to be introduced the following year, but he was forced to abandon the idea due to a fierce public outcry. Later, in 1987, the then PM Yasuhiro Nakasone submitted a bill to the Diet for the introduction of a sales tax, a type of indirect tax, but it was again scrapped because of public opposition. More than a decade passed between the consumption tax's conception and introduction.

It was noted earlier that private consumption fell sharply when the tax was raised from 5% to 8% in 2014, but against the backdrop of a weak economy, public opposition to a further consumption tax hike grew stronger. According to public polls conducted by newspapers in autumn 2014, 70% of respondents said that the consumption tax hike from 8% to 10%, scheduled for the following October, should be postponed, while only

30% said it should be implemented. In fact, the then PM Shinzo Abe postponed the timing of the tax reform twice, first from October 2015 to April 2017, and then from April 2017 to October 2019, citing weak economic conditions. As described above, the consumption tax is an item of great relevance to people's lives in Japan, and it has attracted significant political attention, which has sometimes forced the government to change its decisions.

3. Relevant literature

In the previous section, we reviewed the history of consumption tax reform, the economic situation, and public opinion in Japan and confirmed that the consumption tax has important economic and social implications. In this section, we discuss what kind of academic research has been conducted in Japan on the economic impact of the consumption tax and its reform on households. We also present some of the analyses that have been carried out overseas of VAT reform and its economic impact.

3.1 Research on the consumption tax in Japan

So far, academic interest in the consumption tax in Japan has exclusively concentrated on the ‘regressivity of the consumption tax burden on income’, that is, the

problem that the proportion of the consumption tax burden on income is greater for lower-income households, and how regressivity should be mitigated. However, in the case of Japan, it has been difficult to analyse the consumption tax burden over a lifetime for two reasons: first, as Hashimoto (2010) points out, the consumption tax was first introduced in Japan in 1989, so it is impossible to calculate the lifetime consumption tax burden individuals born before that date; second, as Tashiro (2011) mentions, it is difficult to access long-term, individual-level panel data in Japan. In contrast to the data collected by the Panel Study Income Dynamics (PSID) in the US, which continuously follows specific individuals to study their lifetime income and consumption behaviour, such panel data is not sufficiently available in Japan. Therefore, estimating future consumption has depended on arbitrarily assuming various parameters to analyse the consumption tax burden over a lifetime.

Hashimoto (1993) estimated future consumption based on a utility function and analysed the consumption tax burden over a lifetime. However, one problem with this study is that the conclusions on the consumption tax burden differ depending on the value of the parameters in the setting of the utility function. Later, Hashimoto (2010) estimated future income by dividing individuals within the same generation by company size or educational background, while estimating future consumption by applying age-

group data from the National Survey of Family Income and Expenditure in 2004 based on future income earned. They concluded that the consumption tax burden over the lifetime of a generation is regressive, but to a much lesser extent than in the short term. Otake and Obara (2005), however, compiled data on consumption by age group from the National Survey of Family Income and Expenditure in 1999 and, for each age group, calculated the average income and consumption tax burden and added these two averages to estimate the lifetime consumption tax burden. Their results show that the consumption tax is rather progressive over a lifetime. Thus, the lack of long-term individual-level panel data in Japan means that different data, assumptions, and methods can lead to opposite results regarding the consumption tax burden over a lifetime.

Since late in 2000s, some research using micro-level data has been conducted. Yashio and Hasegawa (2008) used cross-sectional data on household income and family structure from the National Survey of Family Income and Expenditure 2001. Using micro data on income and family structure at the household level from the National Survey of Living Essentials 2001 and aggregate data on consumption for each income group, they calculated the consumption tax burden for ten different income groups. They also simulated how the tax burden would change for each income group if the consumption tax rate was raised from 5% to 10%. As a result, they found that the tax

burden would increase by 2.5% on average. Specifically, they found that the tax burden would increase by 11.9% for the lower-income groups and by only 1.4% for the higher-income groups.

3.2 Relevant studies on VAT in foreign countries

This section presents relevant studies on VAT and its economic impact on households in other countries. Unlike Japan, in the United States, the PSID, which is a survey of lifetime income and consumption behaviour conducted by continuously following specific individuals, has been available since 1968. Casperson and Metcalf (1994) used the PSID to estimate the burden of consumption taxation over the course of a lifetime. Specifically, they conducted regressions on age, gender, education, and region of origin to estimate lifetime income, and then measured the regressivity of the consumption tax over the lifetime of the individual, showing that the degree to which the consumption tax is regressive over one's lifetime is weaker than that over one year.

So far, we have referred to studies that focus on the lifetime burden of consumption taxes on individuals, but when evaluating economic impact of tax reform, analyses that compare consumer surplus before and after a change in price using the concepts of

equivalent and compensating variations in microeconomics as measures of the ‘welfare effect’ have also been popular.

Gaarder (2018) investigated the distributional impact of VAT reform in Norway. Using household expenditure data, he modelled and estimated a demand system equation in which changes in household income and the price of each good affect each household's expenditure share. Gaarder also applied the estimation results to estimate the compensating variation caused by price changes due to tax reform. The results show that the 2001 tax reform, which reduced the VAT rate on food from 24% to 12% in Norway, improved consumer welfare inequality by allowing households to adjust their spending patterns.

4. Data

This section describes the dataset that will be used in this study. As mentioned in Section 3, in Japan there had not existed government statistics that continuously track specific individuals in panel data surveys for a long time. The National Survey of Family Income and Expenditure is a government survey of the annual income and consumption expenditure of individuals. However, this survey is conducted every five years, and the respondents are different each time, so the information gathered can be used only as cross-

sectional data from a specific point in time; it cannot be used to analyse the dynamic behaviour of the same individuals by focusing on unobservable heterogeneity.

The academic community in Japan has strongly demanded the implementation of a survey that follows specific individuals on a continuous basis, such as the PSID in the US and the European Community Household Panel in Europe. To meet this demand, in 2004, the Panel Data Research Center at Keio University started to conduct the Keio Household Panel Survey (KHPS) as the first large-scale, long-term, micro-level household panel data survey in Japan. Since then, this nationwide survey has been implemented once a year on 4,000 randomly selected households and 7,000 individuals who are aged 20 years and over. The data provided by the KHPS cover a wide range of topics, including the age, education level, and employment status of each member of the household; the number of household members; and the income of each household. Thereafter, in 2009, the Panel Data Research Center at Keio University started the Japan Household Panel Survey (JHPS), which targets 4,000 men and women nationwide. In addition to information collected by the KHPS, the JHPS gathers information about the consumption behaviour of households. This dissertation will make use of data obtained from the JHPS from 2009 to 2019. Since some of these sample households were missing due to death or non-response during the period covered, this study focuses on data from sample households

that responded for the entire period from 2009 to 2019. As a result, the sample size used in this study is 13,800.

Next, we describe the details of the dataset used for estimation. First, this study uses data regarding expenditure, i.e. the amount of each household's expenditure in January of each year. In addition to total expenditure, the survey items on expenditure are broken down into more than ten categories, such as food, eating out,[2] medical care, utilities, transportation, and communication. Therefore, by combining these data, we can calculate the share of expenditure on each category. Second, we use the data regarding age, i.e. the age of the head of each household as at 1st January each year. Finally, we use data regarding income, i.e. the annual total of income of all family members.

5. Empirical strategy

As mentioned in Section 1, the purpose of this study is to estimate the economic impact of changes in the consumption tax rate on households. There are various measures of economic impact, such as the consumption tax burden and the Gini coefficient, but in this study, as in Gaarder's (2018), we adopt the concept of compensating and equivalent

[2] It is important to note that the study separates spending on groceries from spending on eating out. The reason for this is that under the current reduced tax system in Japan, food is taxed at 8%, while eating out is taxed at 10%, so it is essential to separate these two expenditure items in order to estimate the economic effects of the introduction of the reduced tax system.

variation and estimate them to assess the consequences of the consumption tax reform.

When estimating the change in consumer welfare due to tax reform, it is possible to compare consumer surplus before and after a change in the price of goods. That is, if we consider the case of a price increase, the consumer's willingness to accept (Compensating Variation) as compensation if the price change occurs, and the willingness to pay if the change does not occur (Equivalent Variation, EV). The EV is an adjustment of income to make the consumer's change in utility equivalent to the utility it would have had if the event had occurred.

In the case of a positive economic change such as a fall in prices, the EV is the increase in income that gives the consumer the same additional utility as if the price had fallen. In the case of a negative economic change, the EV is the amount of income taken away to reduce the consumer's utility to the level it would have been if the change had taken place.

The specific empirical strategies are described below. First, as a starting point for the discussion, we assume that people purchase two goods: food (F) and other goods (N). In addition, we assume that consumer preferences are represented by a utility function of the Cobb–Douglas type:

$$U(F,N) = F^{\alpha}N^{1-\alpha}$$

Then, the demand value share of food shF is α, and the expenditure share of food is expressed as α and the other share as $1-\alpha$. These demand shares are independent of the price and tax rate and remain unchanged even if the tax rate changes.

Suppose now that the expenditure share of food for an individual of age a in year t is obtained as shF_{at}. If the price of food is p and the tax rate on food is τ_f under the assumption of Cobb–Douglas-type preferences (after integrating and standardising the prices of goods other than food), then the expenditure function is

$$E(U_{at}, p_f(1+\tau_f)) = U_{at}\left\{\frac{p_f(1+\tau_f)}{\alpha}\right\}^{\alpha}\left(\frac{1}{1-\alpha}\right)^{(1-\alpha)}$$

Then, when the tax rate changes from $\tau_{0,f}$ to $\tau_{1,f}$ in year t, the equivalent variation of the household at age a is

$$EV = -\left\{E\left(U_{0,at}, p_f(1+\tau_{1,f})\right) - E\left(U_{0,at}, p_f(1+\tau_{0,f})\right)\right\}$$

and the ratio of the equivalent variation to the income M_{at} can be written as

$$\frac{EV}{M_{at}} = \frac{-\left\{E\left(U_{0,at}, p_f(1+\tau_{1,f})\right) - E\left(U_{0,at}, p_f(1+\tau_{0,f})\right)\right\}}{E\left(U_{0,at}, p_f(1+\tau_{0,f})\right)}$$

$$= -\left(\frac{1+\tau_{1,f}}{1+\tau_{0,f}}\right)^{shF_{at}}$$

In other words, the ratio of EV to the income before the tax rate change can be expressed only in terms of the tax rate before and after the change and the ratio of expenditure on food.

Next, to make estimates in line with the objectives of this study, more detailed assumptions are made in the model. First, to model the reduced tax rate introduced in Japan in 2019 (only the tax rate on groceries is 8%, while the tax rate on other items is set at 10%), which is the main focus of this study, we denote the tax rate on non-food items as τ_n. In this case, when the tax rate on foodstuffs changes from $\tau_{0,f}$ to $\tau_{1,f}$ and the tax rate on non-food items changes from $\tau_{0,n}$ to $\tau_{1,n}$ in year t, the ratio of the equivalent variation to the income of a household of age a changes as follows.

$$\frac{EV}{M_{at}} = 1 - \left(\frac{1+\tau_{1,f}}{1+\tau_{0,f}}\right)^{shF_{at}} \left(\frac{1+\tau_{1,n}}{1+\tau_{0,n}}\right)^{(1-shF_{at})}$$

This utility function,

$$U = F^{shF_{at}} N^{(1-shF_{at})}$$

by a logarithmic transformation (monotonic transformation), corresponds to the fact that

$$lnU = shF_{at} lnF + (1 - shF_{at}) lnN$$

Furthermore, assuming intertemporal substitution for consumption (the elasticity of intertemporal substitution being equal to one), the intertemporal utility (after log transformation) of a population of age a with interest rate r is

$$lnU = \sum_{t} \left(\frac{1}{1+r}\right)^{(t-a)} \{shF_{at} lnF_{at} + (1 - shF_{at}) lnN_{at}\}$$

and the equivalent lifetime variation (as a percentage of income) for age a when the tax rate is permanently changed at time z is

$$1 - \left(\frac{1+\tau_{1,f}}{1+\tau_{0,f}}\right)^{shF_a} \left(\frac{1+\tau_{1,n}}{1+\tau_{0,n}}\right)^{(1-shF_a)}$$

where

$$shF_a = \left\{\sum_{t=z} \left(\frac{1}{1+r}\right)^{(t-a)} shF_{at}\right\} / \left\{\sum_{t} \left(\frac{1}{1+r}\right)^{(t-a)}\right\}$$

5.2 Estimation of expenditure ratio

As derived in Section 5.1, to calculate the EV resulting from a change in the tax rate, it is necessary to estimate the proportion of expenditure on food for age a in a given year t. Therefore, using the household panel data from the KHPS for the period 2009–2019, we estimate the following formula.

$$ln\ shF_{it} = \alpha_0 + \alpha_1 ln(t-2009) + \alpha_2\{ln(t-2009)\}^2 + \alpha_3 ln\ a_{it} + \alpha_4 (ln\ a_{it})^2$$

$$+ \alpha_5\ ln(t-2009) * l\,n\ a_{it} + \alpha_6 lnincome_{it} + \varepsilon_{it}$$

The dependent variable is the ratio of expenditure on foodstuffs to the total expenditure of household i in year t. On the right-hand side, $t-2009$ represents the passage of time since 2009, the starting point of the panel data. This takes into account changes in people's spending patterns on different items over time, for example, the increase in communication costs due to the recent spread of the internet. Similarly, to consider changes in expenditure patterns due to changes in age, a_{it}, which represents the age of household i in year t, is also added as an explanatory variable. In addition, to take into account the possibility that these explanatory variables and the explained variable have a non-linear relationship, the squared and crossed terms of each variable have been incorporated into the estimation formula. The income of household i in year t is also

added as an explanatory variable to compare the effects of tax rate changes across different income groups in the subsequent section.

Table 2 reports the descriptive statistics of the dataset used in the estimation.

Table 2. Descriptive statistics

Variable	Count	Mean	Std.Dev.	Max	Min
Expenditure on food (thousand yen per month)	16,358	62.73	37.43	840	0
Total expenditure (thousand yen per month)	16,227	294.23	234.82	6735	0
Share of expenditure on food	16,156	0.24	0.12	0.86	0.00
Age of head of household	17,050	53.34	14.72	92	20
Income (ten thousand yen per year)	15,633	655.01	461.37	9,999	0

Notes: Share of expenditure on food = expenditure on food / total expenditure

6. Results

6.1 Estimation of the share of expenditure

Table 3 reports the results of the estimation of the share of food expenditure illustrated in Section 5.2.

Among the explanatory variables used in the estimation, the coefficient of the variable

representing the passage of time ($t - 2009$) (after log transformation) and its square are negative, but none of them satisfy the 10% level of dominance. The coefficient on the natural logarithm of age is negative, and the coefficient on the square of the natural logarithm of age is positive, but this also does not meet the 10% level of dominance. The coefficient of the cross term between the variable for the passage of time and age is positive. Finally, the coefficient of the natural logarithm of income is negative and significant at the 5% level. Adjusted R-square of the estimated model is 0.454.

Table 3. Estimation results of share of expenditure on food

VARIABLES	lnshf
lntime	-0.206
	(0.169)
lntime_2	-0.0318
	(0.0323)
lnage	-0.997
	-2.324
lnage_2	0.313
	(0.387)
lntime_lnage	0.0520
	(0.0446)
lnincome	-0.0269**
	(0.0105)
Constant	-2.253
	(3.456)
Fixed effect	Yes
Observations	13,800
R-squared	0.515
Adj R-squared	0.454

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.2 Calculating the share of expenditure on foodstuffs

Next, we use the results presented in Section 6.1 and the formula given in Section 5.2 to calculate the share of all lifetime expenditure on food.

$$shF_a = \left\{ \sum_{t=z} \left(\frac{1}{1+r} \right)^{(t-a)} shF_{at} \right\} / \left\{ \sum_{t} \left(\frac{1}{1+r} \right)^{(t-a)} \right\}$$

The interest rate r in the formula uses the average annual interest rate of savings deposits in the most recent edition (July 2021) of 'Average Interest Rates Posted at Financial Institutions by Type of Deposit' published by the Bank of Japan. For the purposes of the following calculations, it is assumed that the head of each household survives to age 80. To compare the effects of the tax reform among cohorts of different ages and incomes in a later section, we calculate in this section the share of expenditure on foodstuffs for different generation and income groups.

Table 4 reports the results of the calculation of the percentage of lifetime expenditure on food for different generation and income groups. The columns represent each case of annual incomes of ¥2.5 million, ¥4.0 million, ¥7.0 million, and ¥10.0 million, and the rows represent each case of different generation cohorts as of 2019, the year the consumption tax reform was implemented. Overall, the proportion of expenditure on food

products ranges from 0.166 to 0.297 in these sample household cases. By income, the proportion of expenditure on groceries is higher in the relatively lower-income group and decreases as income increases. In terms of generation, the proportion of expenditure on food is relatively low in the young generation and increases as the older generation.

Table 4. Estimated lifetime share of expenditure on food by income and generation

	Income(M, t=2019)			
	250	400	700	1000
Generation(age of head of household as of 2019)				
25	0.166	0.164	0.162	0.160
30	0.181	0.178	0.176	0.174
40	0.213	0.210	0.207	0.205
50	0.251	0.248	0.245	0.242
60	0.297	0.293	0.289	0.286

6.3 Impact of the 2019 consumption tax reform on between cohorts

We will now analyse the impact of the consumption tax reform in 2019 based on the calculation results regarding the expenditure share on food by generation and income provided in Section 6.2. First, a brief overview of the consumption tax reform in 2019: until September 2019, a flat 8% consumption tax rate was applied to all items, but starting in October 2019, the consumption tax rate was increased to 10%. At that time, to mitigate

the economic impact of the increase on low-income groups, a reduced tax rate system was introduced in which only the tax rate on foodstuffs (excluding expenditure on eating out) would remain at 8%. In this study, we would like to analyse not only the economic impact of the consumption tax rate hike itself in 2019, but also the economic impact of the introduction of the reduced tax rate system. Therefore, we will analyse the impact of two cases of consumption tax rate increases: (1) a case in which foodstuffs remain at the 8% tax rate, while all other items have a 10% tax rate (actual reform case), and (2) a case in which the tax rate is uniformly raised to 10% for all items (hypothetical case in which the reduced tax rate system is not introduced). In other words,

$$\frac{EV}{M_{at}}\left(\tau_{0,f}=0.08,\tau_{1,f}=0.08,\tau_{0,n}=0.08,\tau_{1,n}=0.1\right) - \frac{EV}{M_{at}}\left(\tau_{0,f}=0.08,\tau_{1,f}=0.1,\tau_{0,n}=0.08,\tau_{1,n}=0.1\right)$$

is the effect of the introduction of the reduced tax rate system that we derive in this study.

First, Table 5 reports the effect of the consumption tax reform in 2019, i.e. the share of the equivalent variation in the income ratio. As can be seen from the table, since the consumption tax reform in 2019 meant an increase in the consumption tax rate, EV, which is a measure of the change in utility before and after the increase, evaluated at the price level before the increase, is negative for all cohorts. Looking at the results by generation group, it is clear that the decline in utility is greater for the younger generation groups

compared to the older generation groups. This indicates that the impact of the 2019 consumption tax reform, which increased the tax on non-food items, will be significant, since, based on the information in Section 6.2, the younger generation groups spend a smaller proportion of their expenditure on food items than the older generation groups. By income, the decline in the absolute value of the equivalent variation is larger for the higher-income groups. This also corresponds to the fact that the higher-income groups spend a higher proportion of their income on non-food items than the lower-income groups, as stated in Section 6.2. Among the analysed groups, the decrease in consumers' utility due to the consumption tax reform in 2019, when evaluated using EV, is 1.298%~1.553% of income.

Next, we analyse the effect of the introduction of the reduced tax rate system. In addition, we need to derive the equivalent variant in the case where the tax rate is raised to 10% for all items (a hypothetical case where the reduced tax rate system is not introduced). However, in the case of (2) above, it is necessary to derive the equivalent variation over a lifetime. However, in case (2), the equivalent lifetime variance (income ratio) is

$$1-\left(\frac{1+\tau_{1,f}}{1+\tau_{0,f}}\right)^{shF_a}\left(\frac{1+\tau_{1,n}}{1+\tau_{0,n}}\right)^{(1-shF_a)}=1-\left(\frac{1.1}{1.08}\right)=-0.01852$$

which is –1.852% regardless of the proportion of expenditure on foodstuffs. This is because in case (2), the tax rate was increased uniformly for all items, and the price ratio between food and non-food items did not change before and after the reform. Based on the results of this calculation, Table 6 reports the effect of the introduction of the reduced tax rate on the reduction in the equivalent variation (income ratio), that is, the effect of the improvement in utility. The table shows that the improvement in utility is greater for the older generation groups, which spend a higher proportion of their income on foodstuffs, and that the improvement in the group of 60 years old as of 2019 is approximately 0.533% to 0.553% of income. Nevertheless, for the younger generation groups, the improvement in utility is smaller due to the lower proportion of expenditure on food, which ranges from about 0.299% to 0.310% of income in the group of 25 years old as of 2019. In terms of income, the improvement in utility is greater for the lower-income groups in all generation groups.

Table 5. Estimated proportion (%) of EVs to income during the tax reform of 2019

	Income(M, t=2019)			
	250	400	700	1000
Generation(age of head of household as of 2019)				
25	-1.541	-1.545	-1.550	-1.553
30	-1.515	-1.519	-1.524	-1.527
40	-1.455	-1.460	-1.465	-1.469
50	-1.383	-1.389	-1.396	-1.400
60	-1.298	-1.305	-1.313	-1.319

Table 6. Estimated change of proportion of EVs to income before and after the introduction of the reduced tax rate system

	Income(M, t=2019)			
	250	400	700	1000
Generation(age of head of household as of 2019)				
25	0.310	0.307	0.302	0.299
30	0.337	0.333	0.328	0.325
40	0.397	0.392	0.386	0.383
50	0.469	0.463	0.456	0.452
60	0.553	0.547	0.538	0.533

6.4 Simulation analysis of the consumption tax reform

While the previous section mainly focused on the consumption tax reform in 2019, this section provides an additional simulation analysis, which is distinct from the past reform

and current consumption tax system in Japan. As an example of a simulation, this study estimates the welfare impact of reducing the tax rate on foods from current 8% to 0% in 2025. The exemption of foodstuffs from VAT has been adopted in other countries, such as the UK and Australia, and can practically be compared to the current system in Japan. It is also assumed that when food is exempted from taxation, the tax rate on other items will remain at the current 10% and that no other tax reforms or other policies will be introduced. In tax reform, changes in the tax rate on one tax item are usually adjusted by making changes in other tax systems or by spending, but this study does not take any such adjustments into account. This is because the purpose of this study is to consider the welfare effect of the change in the consumption tax rate itself by cohort, and to provide a perspective for separately examining what kind of policy allowance is appropriate for which groups in consumption tax reform. In light of this research objective, it makes sense to estimate the welfare effect of a change in the consumption tax rate alone in this simulation analysis.

Table 7 reports the estimated welfare effect of introducing a 0% tax rate on food (and leaving the tax rate on other items at its current 10%) on various generation and income groups. Because this reduces the tax rate on food and leaves the tax rate on non-food items unchanged, overall, it is a tax reduction. Therefore, the calculated equivalent

variation is positive for all groups, ranging from about 1.185% to 2.152% of income. In terms of generation, compared to the younger generation groups, the positive effect is greater on the older generation groups, which spends a larger proportion of their income on food. In terms of income, the effect is greater on those in the lower-income groups compared to those in the higher-income groups. However, the equivalent variation in the income ratio for the 25-year-old group with an annual income of ¥2.5 million is approximately 1.229%, while the equivalent variation in the income ratio for the 60-year-old group with an annual income of ¥10 million is approximately 2.074%. It should be noted that even if a 0% tax rate on foodstuffs is introduced for the purpose of fighting poverty, as has been discussed in Japan, the resulting policy effect on older, higher-income individuals may be larger than that on younger, lower-income individuals.

Table 7. Estimated proportion (%) of EVs to income in the case of 0% tax rate on food in 2025

	Income(M, t=2019)			
	250	400	700	1000
Generation(age of head of household as of 2019)				
25	1.229	1.214	1.196	1.185
30	1.331	1.315	1.295	1.283
40	1.563	1.543	1.520	1.506
50	1.834	1.811	1.784	1.767
60	2.152	2.125	2.094	2.074

7. Conclusion

The main purpose of this research is to analyse the distributional impact of the 2019 consumption tax reform in Japan on different cohorts of the population using household-level, micro-level panel data that has been recently gathered. When evaluating the welfare effect of tax reform, this research adopted the concept of EV, which is a measure of change in economic welfare associated with change in prices of goods. Furthermore, a Cobb–Douglas utility function of consumer was set up in a two-goods model consisting of food and non-food items. This assumption made it possible to calculate EV after a change in the consumption tax rate on food by using expenditure share of food. Then, to calculate lifetime EV associated with tax reform in different generation and income groups, the lifetime shares of expenditure on food were

estimated based on household panel data about age, income, and expenditure obtained from a micro-level, household-level panel data survey. Using the estimated food expenditure shares, we calculated both the distributional effect of the consumption tax reform in 2019 and the effects of introducing the reduced tax rate system on food. Finally, we conducted a simulation analysis of the welfare effect of reducing the tax rate on food from the current 8% to 0% for each generation and income group.

The study makes three academic contributions: (1) it is the first study to analyse the 2019 consumption tax reform in Japan; (2) it uses household-level panel data to analyse the welfare impact of the consumption tax reform, taking into account the heterogeneity of households in terms of generation and income; and (3) it considers not only the immediate impact of the reform but also the permanent lifetime impact of the reform. These novelties are possible largely because of the fact that, until recently, no research on consumption tax reform in Japan could be accessed because no long-term household surveys following the same individuals for a long period time had been conducted in Japan.

The analysis shows that the consumption tax reform implemented in 2019 reduced utility by 1.298% to 1.553% in terms of the EVs in the income ratio, with relatively large effects on the younger, higher-income groups. In addition, the reduced tax rate

system introduced in 2019, which keeps the tax rate on food at 8%, improved utility by approximately 0.2%–0.5% when evaluated as an equivalent variation in the ratio of income. The effect of improving utility will be particularly significant for older, low-income individuals, who spend a large proportion of their income on food. Finally, a simulation analysis of the effect of a tax reduction when the consumption tax rate on food products is set at 0% in 2025 was conducted, and the effect of an improvement in utility in the range of approximately 1.18% to 2.15% was shown by evaluating the EV of the income ratio. These results suggest that the reduced tax rate system could have a certain positive economic effect on the lower-income groups but that the older, higher-income groups could be disproportionately affected.

The study has two important policy implications: first, it suggests that the 2019 sales tax reform, which left the tax rate at 8% for food only and increased it from 8% to 10% for non-food items, may have had a relatively large negative impact on the lifetime utility of young people. This suggests that, if consumption tax rates on non-food items are increased in the future, it may be necessary to provide complementary economic support measures for young people. Second, the application and extension of a reduced consumption tax rate on food may benefit older, higher-income households rather than younger, lower-income households. In Japan, the reduced consumption tax rate was

introduced to reduce the burden on low-income groups in the wake of the consumption tax hike, but the original policy objective of supporting low-income groups was not fully achieved, and further expansion of the reduced tax rate system could damage the potential tax base.

This study does have a limitation, however. In setting the utility function, the study assumes a Cobb–Douglas-type utility function, which is a rather strong assumption. Cobb–Douglas preferences imply an uncompensated price elasticity of –1. If anything, evidence suggests that the price elasticity of food demand is less than –1. So, for a relative increase in the tax-inclusive price of food, estimates of welfare effects based on a Cobb–Douglas assumption would underestimate the true welfare effects. In other words, by assuming Cobb–Douglas preferences, this research obtains conservative (lower bound) estimates of welfare effects. Generalising preferences apart from Cobb–Douglas preferences requires estimating a demand system from joint observations on expenditure share and prices. Gaarder (2018) adopts the Almost Ideal Demand System as a flexible functional form that generalises Cobb–Douglas preferences to estimate the distributional effects of VAT policy in Norway. This study cannot apply the same methods as that of Gaarder (2018) because panel data from the JHPS has a large number of missing values regarding expenditure on each item category other than foodstuff due

to a lack of responses to the questionnaire. However, this study is adequately meaningful because it is the first to estimate the distributional effects of the consumption tax reform in Japan. In this field of study, further research wherein the assumption of preferences is more loosen will be possible if more data regarding household expenditure in Japan is accumulated.

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