The Effects of Tax Policy on Alcoholic Beverage Trends and Alcohol Demand in Japan

Makiko Omura*

Faculty of Economics, Meiji Gakuin University

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Abstract

This paper examines the evolution of alcoholic beverage sectors and the effects of tax policies on these sectors as well as the alcohol beverage demand systems in Japan utilising data from 1948 to 2011. In tax policy analyses, liquor tax policies are found to have differential effects on the production and consumption of different types of alcohol. Although sectoral growth and general economic performance in terms of final consumption expenditure per capita are found to be significant, with major positive effects, tax rates are found to have mixed effects, depending on the type of alcohol considered. The analyses suggest that preferential tax rates may be beneficial for boosting the sectoral performance of certain types of alcoholic beverages. The results, based on double-log and demand system equation estimations for five types of alcoholic beverages, suggest that all alcoholic beverages, except for *shōchu*, are normal goods with positive expenditure elasticities. Although the results suggest that *shōchu* may be the safest taxable subject in a Ramsey sense, the own-price elasticity estimates provide less coherent results depending on the model applied.

Keywords liquor/alcohol tax, panel analysis, time-series analysis, AIDS, QUAIDS, dynamic AIDs, Japan

JEL code H29, K34, N55

Introduction

In many countries, government policies have played major roles in the alcoholic beverage industry. The importance of liquor taxes has been examined by numerous researchers worldwide, largely to investigate two issues: (1) their role in mitigating the adverse effects and social costs of alcohol consumption, such as health problems and vehicle accidents (Cook and Moore, 2002; Chaloupka, Saffer and Grossman, 1993), and (2) their role in raising government revenues (Grossman, et al., 1993). Such studies appear to provide liquor taxes with sufficient justification for their existence and suggest that rate increases may be appropriate, although some studies cast doubt on the claimed effectiveness of such taxes (Kenkel, 1996; Mast et al. 1999). The major rationale for the liquor tax in Japan has always been on the tax revenue side.[1] However, regardless of the government's intentions in taxing alcohol, whether the tax has any effect on the production and consumption of alcohol is a matter of concern, as significant effects would suggest the possibility of using the liquor tax for various policy purposes.

It is also argued that excise taxes, especially taxes on such items as alcohol and tobacco, are less distortionary. According to the optimal consumption tax model proposed by Ramsey (1927), tax rates on goods should be inverse to the price elasticity of demand for such goods – thus, inelastically demanded goods should be taxed more heavily. Some studies suggest that alcohol consumption is price inelastic, particularly for heavy drinkers (Manning et al. 1995). By contrast, other studies suggest that alcohol consumption responds well to price changes, with negative own-price elasticities varying in degree depending on the type of alcoholic beverage considered, as observed by Cook and Moore (2002). Price elasticities are estimated to vary widely, with beer typically found to have the lowest elasticity. According to research conducted by Elder et al. (2010), who compile past studies of

[1] To mitigate the adverse effects of alcohol consumption, Japan has implemented other regulations, such as increased severity of punishment for drunk driving in terms of both criminal charges and social sanctions, rather than using taxes as a tool to curb consumption. Few studies estimating the social costs of alcohol-related problems in Japan find considerable costs to society, although these studies use base estimates from studies in the US, which can affect estimation results drastically (Nakamura et al., 1993; see also Kaji, 2013, for more information on various studies).

the effects of alcohol taxes, the price elasticity of demand for alcohol has median values of -0.50 for beer, -0.79 for spirits and -0.64 for wine, although they are measured in different ways.[2] However, some studies show variations in elasticity estimates. Applying static and dynamic Almost Ideal Demand System (AIDS) models, Eakins and Gallagher (2003) estimate the own-price elasticity of beer to be -0.42~-0.77, depending on the model applied, whereas the values for spirits and wine are found to be -0.68~0.84 and -0.36~-1.59, respectively. The authors also compile past studies showing wider ranges of elasticities, such as beer's own price elasticities varying from 0.09 to -0.95. Andrikopoulos and Loizides (2010) applying a dynamic AIDS (DAIDS) model found that beer was price-elastic with statistical significance in Cyprus, although wine and brandies were not. Obviously, estimates can vary depending on the data, estimated demand functions and formula used to calculate elasticities. The estimation of elasticities has been and continues to be an important topic, as it can have specific policy implications.

In Japan, the alcohol industry was once a major contributor to tax revenues. The Japanese government has implemented several significant legal changes regarding alcohol production and consumption, including changes in tax rates. There are, however, few studies of the effects of liquor taxes. One study estimates the price elasticity of *saké* at 0.58, *shōchu* at -0.15, beer at -0.63, whisky at -0.35 and low-malt beer (referred to here as fizzy drinks) at 0.61 (Takahashi et al. 2009), although the method used is rather ad hoc in the sense that elasticities are calculated based on the differences in consumed quantities of goods at currently prevailing prices and at hypothetical prices excluding the liquor tax.[3]

Given the gaps in the past literature, this paper examines the effects of tax policies on alcohol production and consumption and estimates alcohol beverage demand systems in Japan using data from 1948 to 2011. We first provide a brief overview of the liquor tax system in Japan. An empirical

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[2] No standard errors (SE) or statistical significance calculations for the elasticity estimates are provided in these studies (Elder et al., 2010; Eakins and Gallagher, 2003).

[3] Positive and negative signs are added by the author from their results table because these were not specified. No standard errors are provided.

model used to analyse the effects of taxes is then presented, followed by the estimation results, whereby estimations are conducted for panels of different alcoholic beverages and for each alcohol type. We then estimate the income (expenditure) and price elasticities of demand by applying the double-log model, the AIDS model and its several variants, which include household characteristics, quadratic AIDS (QAIDS) and DAIDS.

A Brief Overview of the Liquor Tax[4]

There have been several major changes in the liquor tax in recent decades. A summary of these changes is presented in Table1. Currently, there are primarily 10 types of alcoholic beverage being classified by the liquor tax law: (1) *saké*, (2) synthetic *saké*, (3) *shōchu* (Japanese spirits), (4) beer, (5) whisky and brandy, (6) wine, (7) spirits, (8) liquor, (9) fizzy drinks and (10) other alcoholic beverages. The evolution of liquor-specific (volume-based) production/consumption and taxes are shown in Graph1 and Graph2, respectively. The liquor-specific tax rate provided is the base rate for each category, and the actual tax rate is increased according to the ethanol content above the base degree.[5]

The liquor tax has a long history and has undergone numerous changes since 1872. The existing tax law was created in 1953 (*S28*),[6] with a significant revision in 1962 (*S37*) establishing the base for the current tax structure (Japan Cabinet Office, 2000). The general tendency of liquor taxes was for a higher tax rate to be applied to expensive alcohols via ad valorem and class-wise specific taxes. The ad valorem tax applicable to expensive *saké*, whisky and wine was abandoned in 1989 (*H1*). The specific tax rate in nominal terms generally decreased during the 1950s until the trend was reversed in 1968 for most alcohol types. The specific tax was then increased in several stages until a legal

[4] The information here is based on the liquor tax evolution table (1950-2006), which is available from the National Tax Agency.

[5] Currently, a one-degree increase in alcohol content above the standard is levied an additional JP¥10,000 or JP¥11,000 for *shōchu*, whisky and spirits. Note that there are sub-categories of tax rates for (9) fizzy and (10) other alcoholic beverages.

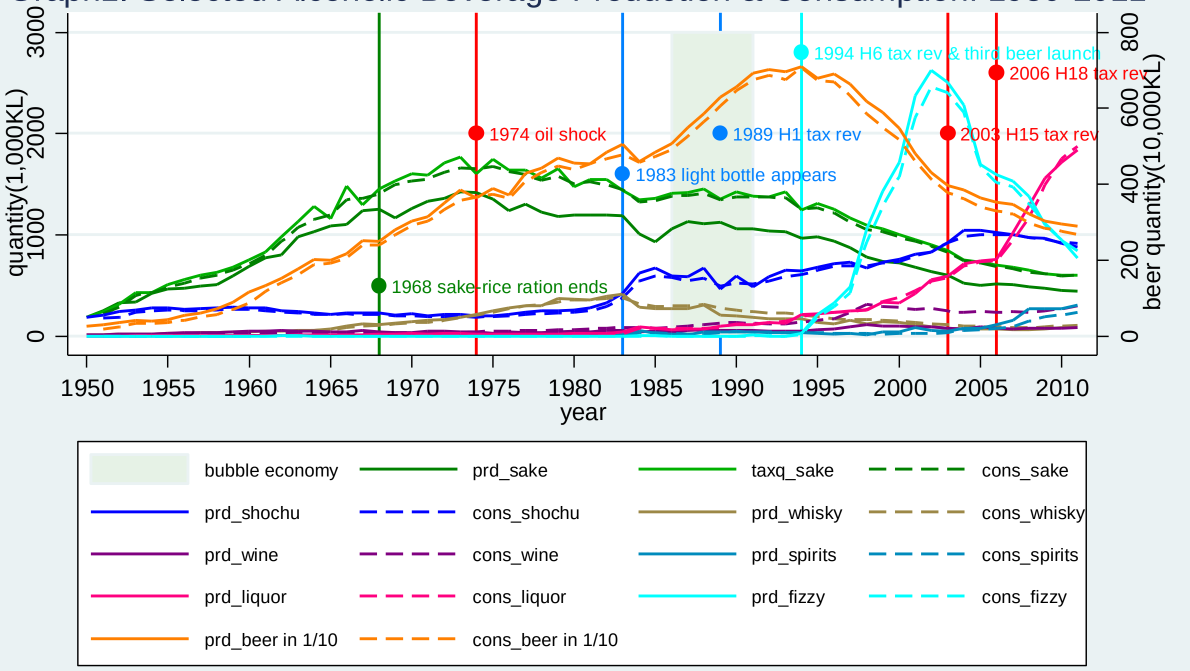
[6] The expression of *S#* and *H#* in parentheses signifies the year according to the Japanese-era name. We note this because all legal and official systems in Japan utilise this type of expression.

revision of April 1989 (*H1*) that implemented significant decreases in the tax rates for wine, whisky, beer and first-class *saké*.

According to the Japanese government, tax revisions, especially since 1989, have aimed to achieve 'neutrality, simplicity and fairness' in taxes across different alcohol types (Japan Cabinet Office, 2000). The *H1* revision, which abrogated a special *saké* classification and the class system for wine and whisky, was followed by a unified tax rate system for *saké* in 1992 (*H4*) and for *shōchu* in May 2006, as shown in Graph2. April 1989 also marked a significant environmental change, with the introduction of a consumption tax of 3%.[7]

[Table1]

Graph1. Selected Alcoholic Beverage Production & Consumption: 1950-2011



Note: 'taxq_sake reflect actual quantity as raw sake is diluted(prd_sake (except for some type) contains 18~21 degree of alcohol, yet sold and consumed at about 15 degree of alcohol); Wine, liquor and fizzy drink categorised data available since 1963 and previous year data are extrapolated using the aggregate data and corresponding categerical ratio data in 1963; liquor includes various beverages made with alcohol, sugar and extract of 2 degree or more; liquor and fizzy include different types of the third beer.
Data Source: Japan National Tax Agency (2013)

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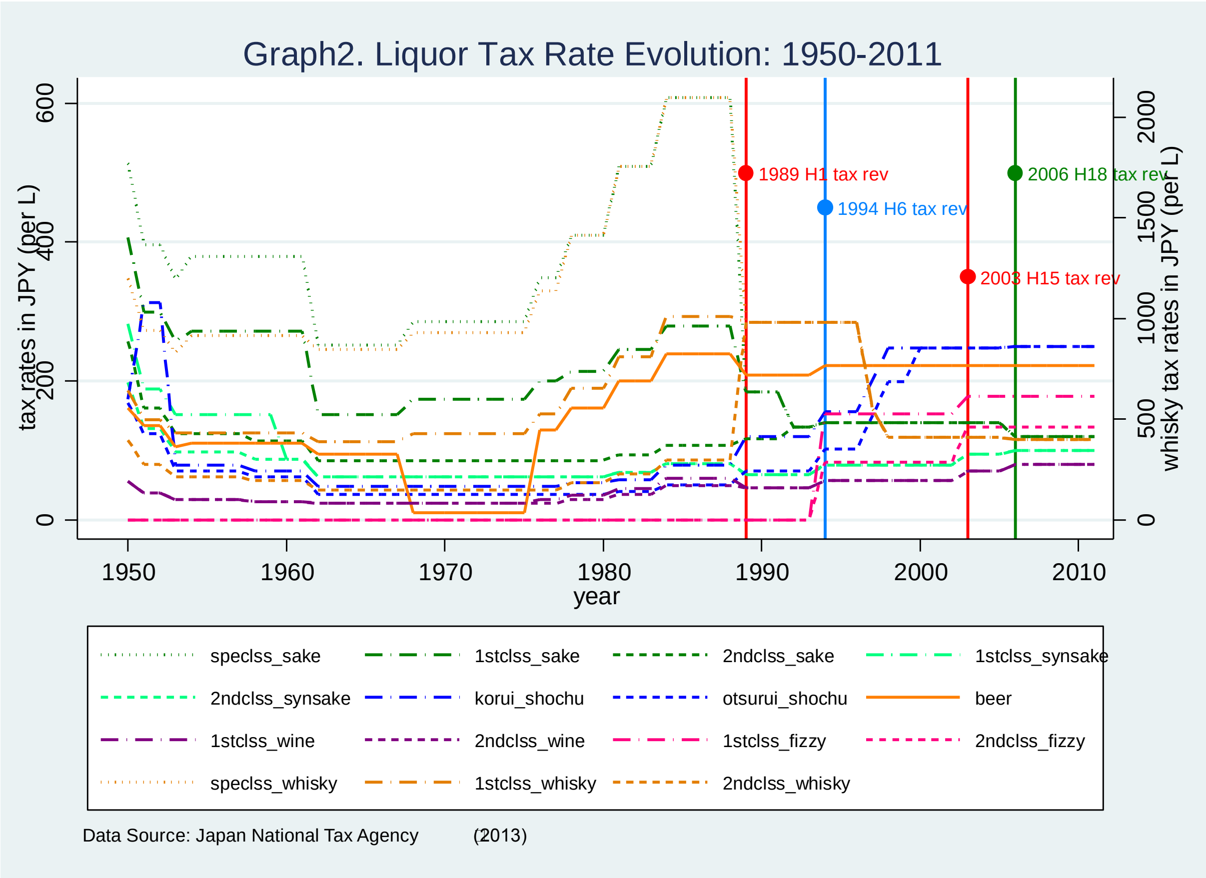
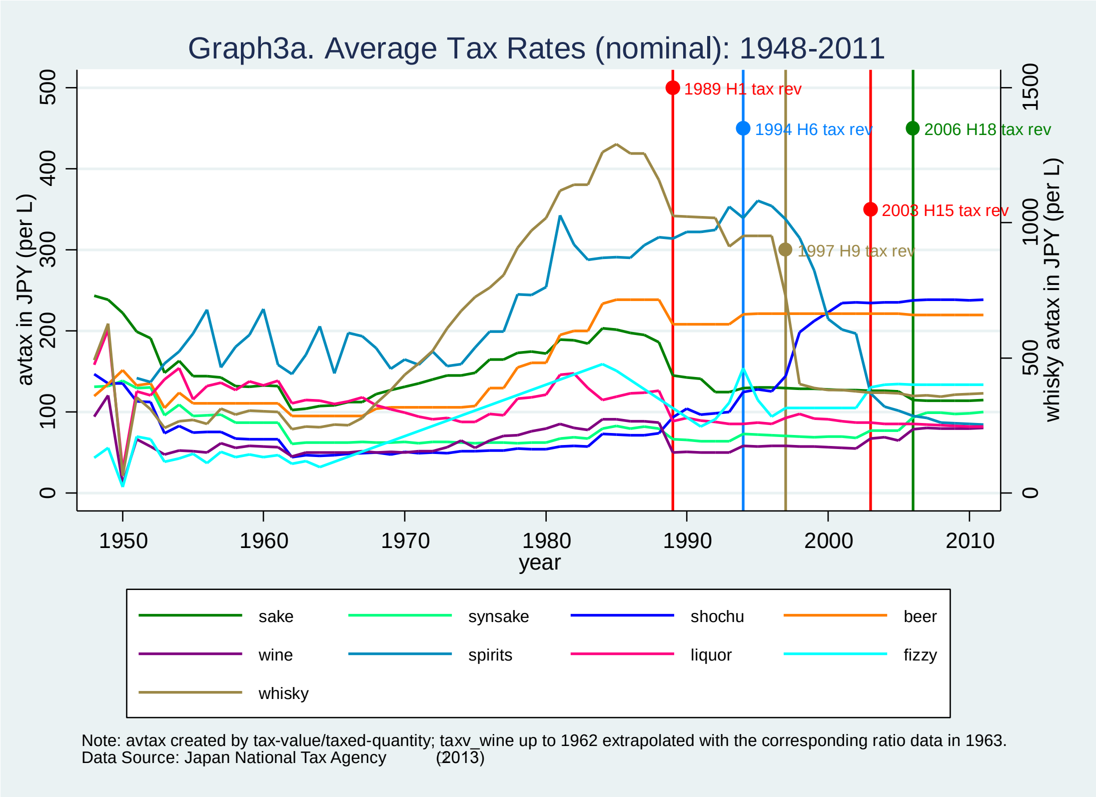
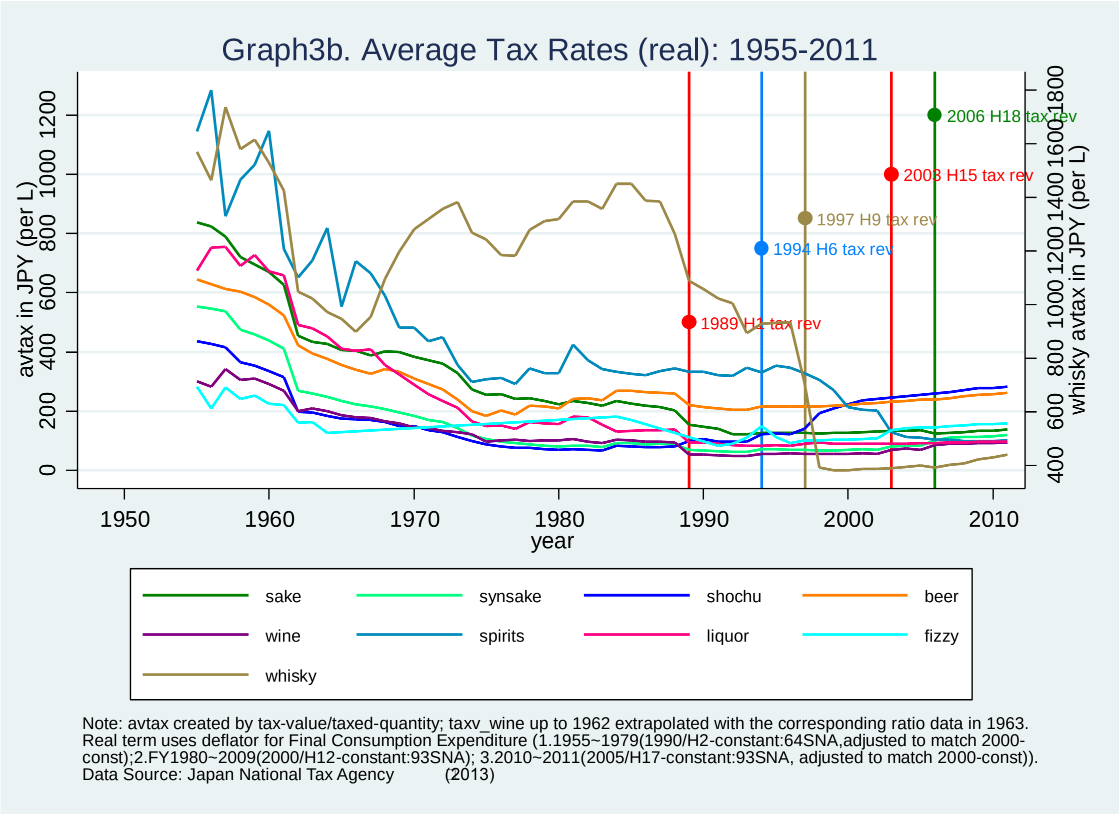
7 The ad valorem tax can be viewed as being replaced by the sales tax introduced in the same year. The sales tax, which was made applicable to all commodities in principle, was initially at 3% in 1989 (*H1*) and subsequently increased to 5% in 1997. Consistent with the argument of Chetty et al. (2009), the effect of sales tax may have been smaller than that of a price increase because sales tax was not initially included in the price tag. The inclusive sales tax, the 'salient tax' rule, was introduced in 2004 (*H16*) after 15 years.



The Tax Data

The actual amount of taxes levied on each alcohol type-class is complex because it depends on the actual ethanol content and because there have been different rules and exemptions characterising the applicable tax rates. The variation in tax rates according to the produced alcoholic content within each class for some types of alcohol means that products within the same class can be levied different taxes. Moreover, using the base degree plus the excess degree of alcohol means that a tax rate per 1° of ethanol is not necessarily uniform, even for the same type of alcohol. Additionally, given that we do not have data on class-wise production and consumption for each type of alcoholic beverage, we utilise a type-wise averaged tax rate (*avtax*) across classes as a proxy variable for the tax rate, derived by dividing the taxed value by the taxed quantity of each type. An aggregate taxed value encompasses an ad valorem tax and a specific tax. In Graph3a and Graph3b, we observe the *avtax* of all major beverage types in nominal and real terms, respectively. The *avtax* in real terms shows largely decreasing trends, except in the case of whisky, which exhibits a large increase roughly from 1970 to 1990. Although the tax rate is highest for whisky per kilolitre, the rate is highest for beer for 1° of alcohol and in terms of the proportion of tax to average commodity price (Table2). By far the lowest tax rate in all respects is the rate for wine. Recent tax revisions have attempted to make the tax burden more equitable across different alcohol types.



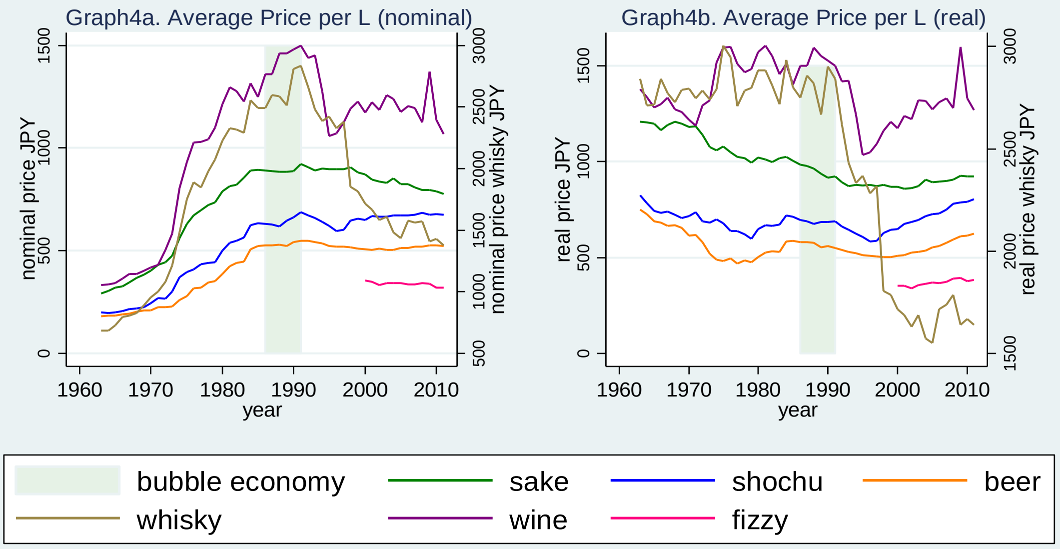


[Table2]

Reviewing the price and tax-price ratio (*taxratio*) calculated as a ratio of average real tax value per litre to the price per litre for *saké*, *shōchu*, beer, whisky and wine, we find that nominal prices are generally increasing with economic development, whereas real prices are decreasing for most alcohols (Graph4).[8] During the bubble economy (1986-1991), expensive commodities were sought, and the observed trends for whisky and wine are understood to reflect increased imports of high-priced items. Whereas the real price of whisky decreased fairly constantly after the bursting of the bubble through 2005, the real price of wine did not decrease as much but reverted to its increasing trends around the mid-1990s, reaching the polyphenol boom of 1997-1998.

[8] We utilise two data sets for household consumption expenditure for the 1963-2011 period for *saké*, *shōchu*, beer, whisky and wine. Expenditures are used to derive the average price per litre for each of these alcohols. Because of partially mismatched categorisation with our data sets, data on commodity prices are not used.

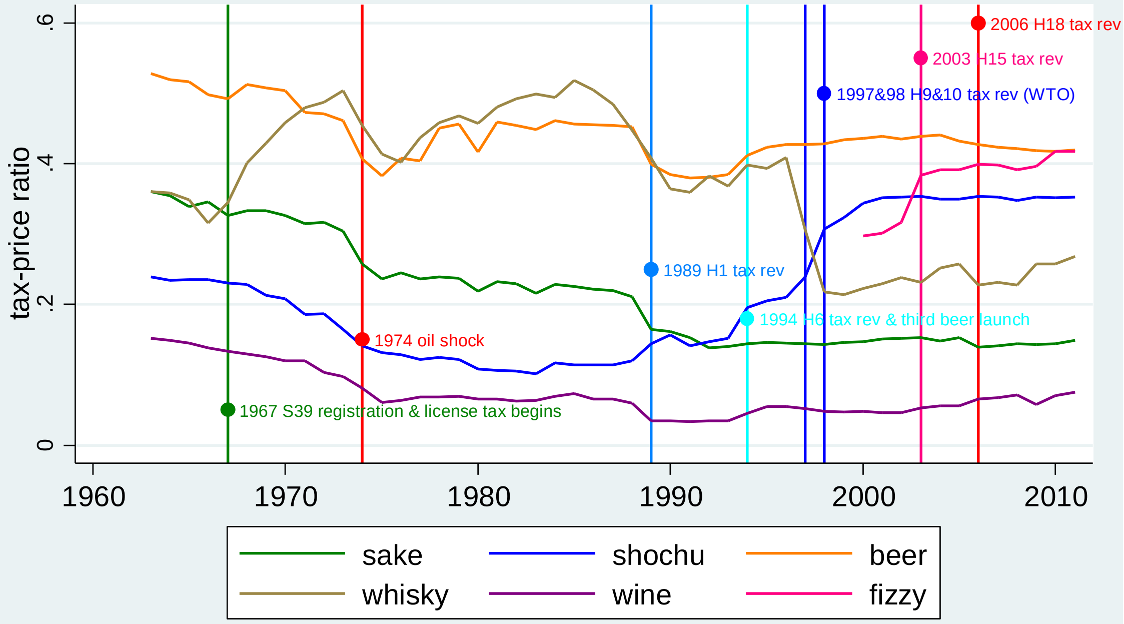
Graph4. Selected Alcoholic Beverage Average Price per L: 1963-2011 (nominal and real)



Note: Price calcuated from Average Expenditure data:(1) 1963-2007: 20-3-a Annual Household Expenditures and Quantity Purchased by Commodity (Non-agricultural,forestry and fishery Households with 2 or more, All Japan (1963-2007));(2) 2008-2010: 20-3-b Annual Household Expenditures and QuantityPurchased by Commodity (Households with 2 or more, including agricultural, forestry and fisheries households, All Japan (1963-2007));(3) 2011: Annual Household Expenditures and Quantity Purchased by Commodity (Households with 2 or more, All Japan(1990-2012))
Data Source: Japan National Statistical Bureau (2013)

With regard to the liquor *taxratio* shown in Graph5, several features are worth noting. Most *taxratio* values are relatively stable or slightly decreasing, except those for *shōchu* and whisky. The tax rate for *shōchu* was raised considerably in 1997 and 1998 (*H9* and *H10*) as a result of criticisms from other countries that the tax rate was too low compared with those for other spirits, such as whisky or brandy. For whisky, we observe a steep increase in the *taxratio* during the mid-1960s and then a steep decrease in the mid-1990s, both resulting from tax revisions. Two particularly high *taxratio* values are those for whisky and beer. The high *taxratio* for beer can be traced to an outdated view from the pre-war period, when beer was regarded as a luxurious imported commodity. In addition, the fact that beer is produced by large companies makes the collection of liquor taxes relatively easy for the government. Indeed, beer shows the highest *taxratio* in most periods.

Graph5. Selected Alcoholic Beverage Tax-Price Ratio: 1963-2011



Note: price data calculated from consumption expenditure data:(1) 1963 to 2007: 20-3-a Annual Household Expenditures and Quantity Purchased by Commodity(Non-agricultural,forestry and fishery Households with 2 or more, All Japan(1963-2007));(2) 2008 to 2010: 20-3-b Annual Household Expenditures and QuantityPurchased by Commodity (Households with 2 or more, including agricultural, forestry and fisheries households,All Japan (2000-2010));(3) 2011: Annual Household Expenditures and Quantity Purchased by Commodity (Households with 2 or more, All Japan(1990-2012))
Data Source: Japan National Statistical Bureau (2013)

Empirical Model: The Effects of Tax Policy

As we have observed, government policy appears to have significantly influenced the supply and demand of alcoholic beverages. We therefore attempt to estimate the likely effects of tax policy on the production and consumption of different types of alcohol, using 10 types of alcohol, (1) *saké*, (2) synthetic *saké*, (3) *shōchu*, (4) beer, (5) whisky and brandy, (6) wine, (7) spirits, (8) liquor, (9) fizzy drinks and (10) other alcohols. A summary of the variables used is provided in Table 2.

We define three dependent variables: taxed quantity (*taxq*), consumption (*cons*) and domestic taxed quantity ($taxq_{dome}$).[9] The *taxq* figures are highly similar to the quantities produced for most types of alcohol. However, because of the complicated system of measuring production and evolving regulations, *taxq* more accurately reflects the quantity traded in the market. To understand the effects of tax policy on domestic producers, we use $taxq_{dome}$ as one of the dependent variables, although we

[9] The correlation coefficients for these three variables are high: that for *taxq* and *cons* is 0.9995, that for *taxq* and $taxq_{dome}$ is 0.9678, and that for $taxq_{dome}$ and *cons* is 0.9686.

currently have data for a relatively short period, only since 1980.[10] Therefore, the estimated results will reflect recent trends.

The statement to achieve ‘neutrality, simplicity and fairness’ in liquor taxes, especially through revisions since 1989 (Japan Cabinet Office, 2000), may indicate that liquor tax policy has historically been used as a revenue-generating tool by the government. Thus, we may expect that tax policy has been influenced by market performance, such as sectoral growth, rendering the latter endogenous to the tax system, although not contemporaneously so. To avoid possible endogeneity arising from an omitted variable problem, such as the prospect for sectoral group by the National Tax Agency, we add a variable, the growth rate of the tax value in three-year moving average form ($\Delta lnMA(3)\_taxv_i$). Additionally, we consider final consumption expenditure per capita (*fcepc*) to capture general economic growth and several dummies to capture booms and other significant situational changes.

Given serially correlated and/or heteroskedastistic error terms, we conduct estimations using a feasible generalised least squares (FGLS) estimator, allowing for panel-specific autocorrelation and heteroskedasticity across panels. We estimate the following basic model with/without various independent variables.

(1) $IND_{it} = \alpha + \beta_1\, lnavtax_{it} + \beta_2\, \Delta lnMA(3)\_taxv_{it} + \beta_3 taxratio_{it} + \beta_4 lnfcepc_t + \boldsymbol{\gamma}\, \mathbf{D_{taxchng}} + \boldsymbol{\theta}\, \mathbf{D_{boom}} + u_{it},$

where $u_{it} = \rho\, u_{it-1} + \varepsilon_t$, $\varepsilon_t \sim \mathrm{IID}(0,\sigma_\varepsilon^2)$, $|\rho| < 1$,

where IND_{it} is $lntaxq_{it}$, $lncons_{it}$ or $lntaxq\_dome_{it}$

Of the three dependent variables for which we conduct estimations, $lntaxq_i$ is the log of the taxed quantity (*taxq*), $lncons_i$ is the log of consumption (*cons*) and $lntaxq\_dome_i$ is the log of the taxed quantity of domestic production ($taxq_{dome}$) of alcohol type *i*. With respect to the independent variables, $lnavtax_i$ (*avtax*) is the average real tax rate for alcohol type *i*; $\Delta lnMA(3)\_taxv_i$

[10] For most alcohol types, the proportions of imported alcohols are not large, although wine and whisky are exceptions. Wine has the highest share of imports, a proportion that has been constantly increasing, with imports accounting for more than 50% of wine consumption since 1994. For whisky, the proportion has been approximately 20% but has exhibited a continuously decreasing trend.

(*MA(3)grw_taxv*) is the growth rate of the three-year moving average of taxed value; $taxratio_i$ is the ratio of tax to the price of alcohol; $lnfcepc_t$ (*fcepc*) is the log of real financial consumption expenditure per capita; $\mathbf{D}_{\mathbf{taxchng}}$ is a vector of dummy variables denoting periods of important tax changes (*S37* (1962-1988); *H1* (1989-1993), *H6* (1994-211), *H15* (2003-2011) and *H18* (2006)); and $\mathbf{D}_{\mathbf{boom}}$ is a vector of dummy variables for important events, namely, the red-wine polyphenol boom (1997-1998) and the *shōchu* boom (2003-2005).

Given that different types of alcohol may respond differently to policy changes, we also conduct group-wise estimations for the following groups: (G0) *all alcohol types*; (G1) *dinner alcohol* (*saké*, synthetic *saké*, *shōchu* and wine with 12º~15º of alcohol), where *shōchu* is normally consumed in diluted form, (G2) *hard liquor* (*shōchu*, spirits and whisky, with approximately 25º~50º of alcohol) and (G3) *light alcohol* (beer, fizzy drinks and liquor with roughly 5º of alcohol). Additionally, we conduct time-series estimations for each alcohol type using an autoregressive moving-average (ARMA) model with a maximum likelihood estimator, which allows for an autocorrelated dependent variable (the AR component) and autocorrelated random disturbances (the MA component), both of which are set to order one. Thus, the disturbance structure is as follows: $u_t = \rho u_{t-1} + \varepsilon_t + \theta\varepsilon_{t-1}$.

Estimation Results: The Effects of Tax Policy

The estimation results are presented in Tables 3 for all alcohol types (G0). We omit tables for other groups' (G1~G3) results due to space constraints.. Note that the estimation results in the first column of each table, model (1), exhibit signs of multicollinearity, with relatively high variance inflation factors above 10. Nevertheless, these results are presented here, as they are generally comparable with other model results.

For G0, we observe significant positive effects of sectoral growth (*MA(3)grw_taxv*), tax-price ratio (*taxratio*) and final consumption expenditure per capita (*fcepc*) on production (*taxq*) and consumption, whereas we find significant negative effects of the average tax rate (*avtax*); all coefficients are significant at the 1% level. The findings are robust across different estimation models.

The positive significant effect of the tax-price ratio is consistent with the market dominance of beer, which has the highest tax-price ratio. For domestic production, for which data availability is limited to the past 20 years, the effect of sectoral growth is found to be negative and significant at the 1% level. This finding appears to reflect that this period largely coincides with the long recession after the bubble economy.

To briefly summarise the estimation results for the sub-groups of alcohol (G1~G3), sectoral growth and final consumption per capita are generally found to have significant positive effects on production and consumption, although the significance of sectoral growth is not observed for consumption in G3. The magnitude of the effect of sectoral growth is consistently larger for production than for consumption in all estimations. The tax rate appears to exert fairly different effects on different types of alcohol. Several tax change dummies are found to be significant and robust. In particular, in G1, *S37tax* and *H1tax* are found to have significant positive effects on production and consumption, although *H15tax* is found to have a negative effect on domestic production. The first two tax revisions entailed major reductions in liquor taxes for most alcohol types, whereas the most recent revision increased the tax on synthetic *saké* and wine. There is little evidence that booms had any significant effect across different alcohol types.

[Table3]

The results of the ARMA estimations for each alcohol type are provided in Table4. Possible heteroskedasticity is also considered by employing the Huber-White sandwich estimator in the standard error (SE) calculations. Two estimation results are presented for the production and consumption of each type of alcohol, one with the tax rate (*avtax*) and one with final expenditure per capita (*fcepc*). We present the results of the AR estimations or, ARMA estimations whenever the MA component is found to be significant. Both specifications, with/without MA, produced similar results. In Table4, we observe that sectoral performance has significant and positive effects on both production and consumption, except in one specification for *shōchu* consumption and whisky production. The effect of the tax rate is found to be significant and negative in the cases of *saké* production and consumption, beer production and consumption, and wine production, whereas the effect is found to be significant and positive in one of the *shōchu* consumption estimations. This finding for *shōchu* may appear to be peculiar; however, we observe in the graphs that the tax rate for *shōchu* increased considerably during the 1990s (Graph2), although both production and consumption increased during this period (Graph1). Given the historically low tax rate for *shōchu*, the rate increase itself may not have affected the consumption of *shōchu*, as it was still the least expensive means of obtaining ethanol (see Table2). *Fcepc* is found to have positive and significant effects on the production and consumption of all alcohol types except *shōchu*, and the magnitudes are particularly high for beer. Beer production and consumption, both of which rank at the top in terms of quantities, indeed appear to correspond well to general economic performance (Graph1). The non-significance of *fcepc* for *shōchu* suggests that *shōchu* may be an inferior good whose major boom and price increase occurred after the bubble burst. We find a positive and significant effect of *S37tax* (major tax reduction) on *saké* and whisky production. We observe a significant negative effect of the *H1tax* of 1989 on *shōchu*, causing production to decline by approximately 36%. Indeed, *shōchu* was the only alcoholic beverage whose tax rate increased at that time – and significantly so, by 30% and 44% in nominal terms (as noted above, there are two types of *shōchu*). With respect to the *H6tax* of 1994, which increased the tax rates on *saké*, synthetic *saké*, *shōchu*, beer and wine, a significant negative coefficient is estimated for *saké* consumption, *shōchu* production and consumption, and whisky consumption. Finally, we observe significant positive effects of the polyphenol boom on wine, both in production and consumption, with magnitudes of 16%~21%.

[Table 4]

Expenditure Elasticity and Price Elasticity of Demand

The estimation results presented in the previous section suggest that tax policies have significant effects on the production and consumption of alcoholic beverages in general. Meanwhile, the differing effects of economic growth, tax rates and tax-price ratios suggest that the income and price elasticities of demand are likely to vary among alcohol types. Given that both the liquor and sales taxes are currently invisible to consumers, we investigate the effects of price changes on alcohol expenditures.[11] As the theory of optimal consumption taxation proposed by Ramsey (1927) suggests that welfare loss is minimised if the tax rate is set higher for inelastically demanded goods, we estimate the expenditure and price elasticities of demand for alcoholic beverages by applying the double-log model and, following Deaton and Muellbauer (1980), the AIDS model and its variants, namely, AIDS with demographic characteristics, QUAIDS and DAIDS. We utilise annual household expenditure data for the 1963-2011 period.

Double-Log Estimations

To estimate elasticities, we first calculate the expenditure and constant price elasticities of demand in log-log multiplicative form, $q_{it} = \alpha \cdot X_t^{\beta_1} p_t^{\beta_2} \cdot e^{\gamma_1 t}$, translated into log-linear form, utilising aggregate longitudinal data on commodity-wise household expenditures across alcohol types (panel estimation) and per alcohol type (time-series estimation). Thus, the estimated equation is as follows:

(2) $lnq_{it} = ln\alpha + \beta_1 lnX_{it} + \beta_2 lnp_{it} + \gamma_1 t = \alpha' + \beta_1 lnX_{it} + \beta_2 lnp_{it} + \gamma_1 t,$

where *lnq* is the log of the quantity purchased in ml, *lnX* is the log of the total household consumption expenditure (as a proxy for income), *lnp* is the log of the average real price of a type of alcoholic beverage and *t* accounts for time effects. The estimated coefficients β_1 and β_2 are the partial expenditure and price elasticities of demand, respectively. The model is estimated with and without time effects and other household characteristics for which data are available in average terms across households in any given year. The latter consist of the number of family members (*hhmem*), the age of the household head (*agehh*) and the number of working members (*wkmem*), as shown in Table5.

[11] Note, however, that historical tax rates have not necessarily translated well into alcohol prices in the cases of some items. For available data between 1963 and 2011, partial correlations between tax rates and the real average prices of *saké*, *shōchu*, beer, whisky and wine are 0.358, 0.697, 0.980, 0.871 and 0.498, respectively.

As noted above, the panel estimation is performed with FGLS, permitting panel-specific autocorrelation and/or heteroskedasticity across panels, and type-wise time-series estimation is performed with AR(1) using the Huber-White sandwich variance estimator. Summaries of the variables and the estimated results are provided in Table5 and Table6, respectively.

[Table5 & Table6]

Based on consumer demand theory, income/expenditure elasticities are expected to be positive for normal goods, whereas own price elasticities are expected to be negative. The results in Table6 show significant positive expenditure elasticities in the panel estimation and in most of the time-series estimations. A notable exception is *shōchu*, which has significant *negative* coefficients in all three estimations, suggesting that *shōchu* is an inferior good. In terms of magnitudes, we observe that *shōchu*, beer and whisky are elastic with respect to total household consumption expenditure. The time variable *t* is found to be significant in all estimations; negative in the panel regression for *saké*, beer and whisky; and positive for *shōchu* and wine. With respect to the own-price elasticities, we find significant negative inelastic coefficients for all alcohol types except *shōchu*, which has significant positive and highly elastic estimates. This result suggests that while other alcoholic beverages are normal goods, *shōchu* may be a Giffen good, or it could be that the quality of *shōchu* has improved, accompanied by increases in both price and demand. As we do not have information on quality, it is not possible to provide a conclusive interpretation. Another possible reason for this finding is that *shōchu* still remains inexpensive relative to the other alcohol types. For household characteristics, only *agehh* is found to be significant, with negative coefficients in estimations without *t*.

Almost Ideal Demand System (AIDS), Quadratic Almost Ideal Demand System (QUAIDS) and Dynamic Almost Ideal Demand System (DAIDS) Estimations

Although the results for the double-log model appear to be plausible, the model has been criticised as crude and inconsistent with utility theory except in special cases (Deaton, 1997). Thus, we estimate a conditional demand function and elasticities of demand that are consistent with utility theory, applying Deaton and Muellbauer's (1980) (1) Almost Ideal Demand System (AIDS) and its three variants: (2) quadratic-AIDS (QUAIDS); (3) AIDS/QUAIDS, incorporating socio-demographic factors; and (4) dynamic-AIDS (DAIDS). We provide brief descriptions of each model and then proceed to interpret the estimation results.

In AIDS models, demand systems are specified in terms of expenditure shares of different types of commodities, in this case, alcoholic beverage expenditure shares of different types of alcoholic beverages. A household's expenditure share for good i is defined as $w_i \equiv p_i q_i X^{-1}$, where p_i is the price of alcohol type i, q_i is the quantity of alcohol type i purchased or consumed and X is total expenditure on all alcoholic beverages in the demand system. With this definition of X, we have $\sum_{i=1}^{K} w_i = 1$, where K is the number of alcoholic beverages in the system. Using an indirect utility function, with utility expressed in terms of price p and total expenditure X, we can express the expenditure share equations as follows:

(3) $$w_i = \alpha_i + \sum_{j=1}^{K} \gamma_{ij} lnp_j + \beta_i \ln\{\frac{X}{P(\mathbf{p})}\},$$

where **p** is the vector of all prices and $P(\mathbf{p})$ is a price index defined as follows:

(4) $$lnP(\mathbf{p}) = \alpha_0 + \sum_{i=1}^{K} \alpha_i lnp_i + 1/2 \sum_{i=1}^{K} \sum_{j=1}^{K} \gamma_{ij} lnp_i \, lnp_j$$

Because the expenditure function is linearly homogeneous of degree zero in prices and total expenditure, the following conditions must hold: (1) adding up: $\sum_i^K \alpha_i = 1$, $\sum_i^K \gamma_{ij} = 0$, $\sum_i^K \beta_i = 0$; (2) homogeneity: $\sum_j^K \gamma_{ji} = 0$; and in addition, (3) Slutsky symmetry: $\gamma_{ij} = \gamma_{ji}$, for any $i \neq j$. As stated by Deaton and Muellbauer (1980), α_0 is generally difficult to estimate and is thus assigned a value a priori as the minimum level of expenditure required for subsistence when all prices are unity. Accordingly, α_0 is set at 4.9 throughout the analyses.[12] Based on the estimates, the expenditure (as a

[12] Noting that alcohol may not be a necessity and that some households may not consume it at all, our data are only in aggregate form, with above-zero alcohol consumption. Additionally, AIDS does not allow for corner solutions in which all commodities are consumed in positive amounts (Deaton 1997: 304).

proxy for income) and the price elasticities are calculated. The expenditure elasticity is given by e_i=1+ β_i w_i^{-1}, and the own/cross price elasticity is given by η_{ij} = – δ_{ij} + { γ_{ij} – β_i(α_j +$\sum_{i=1}^{K} \gamma_{ij} lnp_i$)} w_i^{-1}, where δ_{ij} is the Kronecker delta, with δ_{ij} =1if i=j and δ_{ij}=0 otherwise.[13] These elasticities can be derived in a straightforward manner by differentiating the log of the purchased quantity of item *i* with respect to the log of expenditure ($dlnq_i/dlnX$) and by differentiating the log of the purchased quantity of item *i* with respect to the log of the price of item *i* ($dlnq_i/dlnp_i$), respectively, applying the chain rule in both cases. These forms of elasticity have been presented by numerous authors, including Ray (1980) and Green and Alston (1990).

The QUAIDS model was devised by Banks et al. (1997) to make the Deaton and Muellbauer (1980) AIDS model consistent with a more realistic Engel curve. An additional term for the quadratic log of expenditure enables the demand function to differentiate responses to goods based on income level, such that goods can be luxuries or necessities, depending on income level. The functional form is as follows:

(5) $$w_i = \alpha_i + \sum_{j=1}^{K} \gamma_{ij} lnp_j + \beta_i \ln\left\{\frac{X}{P(\boldsymbol{p})}\right\} + \frac{\lambda_i}{b(\mathbf{p})}[\ln\left\{\frac{X}{P(\boldsymbol{p})}\right\}]^2,$$

where the final term, added to the original AIDS equation (3), is the quadratic log of expenditure divided by the price index, with $b(\mathbf{p})$, the Cobb-Douglas price aggregator, $b(\mathbf{p}) = \prod_{i-1}^{N} p_i^{\beta i}$, and the additional term λ_i which requires that $\Sigma^{k}_{i=1}\lambda_i$ = 0 (see Banks et al. 1997 for details). Checking for likely model fit, we conduct nonparametric kernel regressions with Gaussian specification, as in Banks et al. (1997) (see Appendix). The results indicate that the shares of item expenditures vis-à-vis the log of consumption expenditures take a quasi-linear form for *saké* (downward) and beer (upward), a concave form for whisky and a cubic form for *shōchu* and wine. These observations suggest that QUAIDS may not be ideal for the last two items but may perform better than the AIDS model, which is contained in the QUAIDS model as a special case when λ_i = 0 for all *i*.

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[13] The presented price elasticities are Marshallian or uncompensated elasticities, in which Hicksian or compensated elasticities, which solely represent price/substitution effects, can be obtained directly from the Slutsky equation, η_{ij}^{C} = η_{ij} + X_{i_mean} w_i

An AIDS model with socio-demographic factors incorporates demographic characteristics using the scaling technique introduced by Ray (1983). Application of a scale allows for incorporation of household characteristics (**z**) into expenditure analysis across households that vary. The scaling function m_0 is composed of two multiplicative factors, a basic component and a price- and utility-varying component, $m_0(\mathbf{p}, \mathbf{z}, u) = \overline{m}_0(z) \cdot \varphi(\mathbf{p}, \mathbf{z}, u)$, where the first component captures increases in a household's expenditures as a function of a vector of household characteristics **z** and the second component φ represents the dependence of the general scale on the structure of relative prices and utility, capturing changes in consumption patterns as a function of **z**. The estimable equation of the expenditure share takes the following form:

(6) $$w_i = \alpha_i + \sum_{j=1}^{K} \gamma_{ij} lnp_j + (\beta_i + \vartheta'_i \mathbf{z}) \ln \left\{ \frac{X}{\overline{m_0}(\mathbf{z}) P(\boldsymbol{p})} \right\},$$

where ϑ_i indicates the effects of price and utility variations on scale, for which the adding-up condition requires that $\Sigma^{k}_{i=1}\vartheta_{ri} = 0$ for $r = 1 \ldots s$. The basic scale of the household characteristics vector **z** is set at $\overline{m}_0(z) = 1 + \sigma'\mathbf{z}$, where σ is a vector of estimable parameters representing a 'basic' equivalent scale (Ray, 1983). For QUAIDS with demographic characteristics, the expenditure share equation, with additional terms (Poi, forthcoming), is as follows:

(7) $$w_i = \alpha_i + \sum_{j=1}^{K} \gamma_{ij} lnp_j + (\beta_i + \vartheta'_i \mathbf{z}) \ln \left\{ \frac{X}{\overline{m_0}(\mathbf{z}) P(\mathbf{p})} \right\} + \frac{\lambda_i}{b(\mathbf{p}) c(\mathbf{p},\mathbf{z})} [\ln \left\{ \frac{m}{\overline{m_0}(\mathbf{z}) a(\mathbf{p})} \right\}]^2.$$

The expenditure and own/cross price elasticities for this functional form in the QUAIDS version are as follows:

(8) $$e_i = 1 + [\beta_i + \vartheta'_i \mathbf{z} + \frac{2\lambda_i}{b(\mathbf{p}) c(\mathbf{p},\mathbf{z})} \ln \left\{ \frac{m}{\overline{m_0}(\mathbf{z}) a(\mathbf{p})} \right\}] w_i^{-1}$$

(9) $$\eta_{ij} = -\delta_{ij}, + [\gamma_{ij} - [\beta_i + \vartheta'_i \mathbf{z} + \frac{2\lambda_i}{b(\mathbf{p}) c(\mathbf{p},\mathbf{z})} \ln \left\{ \frac{m}{\overline{m_0}(\mathbf{z}) a(\mathbf{p})} \right\}](\alpha_j + \sum_{i=1}^{K} \gamma_{ij} lnp_i) - \left\{ \frac{(\beta_i + \vartheta'_i \mathbf{z}) \lambda_i}{\bar{b}(\mathbf{p}) c(\mathbf{p},\mathbf{z})} \right\}$$
$$[\ln \left\{ \frac{m}{\overline{m_0}(\mathbf{z}) a(\mathbf{p})} \right\}]^2] w_i^{-1}$$

As in the double-log estimations, household characteristics include the annual average values of the aggregate number of family members (*hhmem*), the age of the household head (*agehh*) and the number of working members (*wkmem*), as shown in Table 5.

Finally, we consider a dynamic AIDS (DAIDS) model presented by Ray (1984) that incorporates past expenditure terms, following the linear habit formation models of Phlips (1972) and Pollak (1970). The estimated expenditure share equation and the price index become the following:

(10) $w_{it} = \alpha_i + \sum_{j=1}^{K}(\gamma_{ij} + \theta_{ij}X_{t-1})lnp_{jt} + (\beta_i + \eta_i X_{t-1})\ln\{\frac{X_t}{P_t(\mathbf{p})}\}$,

(11) $lnP_t(\mathbf{p}) = \vartheta_0 + \sum_{i=1}^{K}\delta_i X_{i,t-1} + \sum_{i=1}^{K}\alpha_i\, lnp_{it} + 1/2\sum_{i=1}^{K}\sum_{j=1}^{K}(\gamma_{ij} + \theta_{ij}X_{t-1})lnp_{it}\, lnp_{jt}$,

where adding-up restrictions require that for all *j*: $\sum_i^K \alpha_i = 1$, $\sum_i^K \gamma_{ij} = \sum_i^K \theta_{ij} = 0$ and $\sum_i^K \beta_i$=$\sum_i^K \eta_i = 0$. The homogeneity restrictions require that for all *i*: $\sum_i^K \gamma_{ij} = \sum_i^K \theta_{ij} = 0$. The symmetry restrictions require that for all *i* and all *j*: $\gamma_{ij} = \gamma_{ji}$, $\theta_{ij} = \theta_{ji}$. Here, θ_{ij} and η_i capture the degree to which past total group expenditure affects current expenditure. Whereas θ_{ij} is defined in subsistence utility terms, η_i is defined in additional utility terms, that is, in terms of what Deaton and Muellebauer (1980) call 'bliss'. By contrast, δ_i, called the 'memory coefficient' by Pollack (1970), captures the effects of previous purchases of individual items.[14] Allowing for autocorrelated disturbances with autocorrelation coefficients ρ_i, where the estimation equation's disturbances are assumed to take the form, $u_{it} = \rho_i u_{it-1} + \varepsilon_t$, with ε_t ~ IID $(0, \sigma^2)$, we observe that the expenditure share equation becomes the following:

(12) $w_{it} = \rho_i w_{it-1} + \alpha_i(1-\rho_i) + \sum_{j=1}^{K}(\gamma_{ij} + \theta_{ij}X_{t-1})lnp_{jt} + (\beta_i + \eta_i X_{t-1})\ln\{\frac{X_t}{P_t(\mathbf{p})}\}$

$-\rho_i\sum_{j=1}^{K}(\gamma_{ij} + \theta_{ij}X_{t-2})lnp_{jt-1} + \rho_i(\beta_i + \eta_i X_{t-2})\ln\{\frac{X_{t-1}}{P_{t-1}(\mathbf{p})}\}$.

Although Ray (1984) restricts ρ_i to be identical across all items in his estimations, he also recognises that this assumption is not realistic. We estimate two versions of the demand systems, with a single ρ and with ρ_i. The corresponding expenditure and own/cross price elasticities of demand are as follows:

(13) $e_i = 1+(\beta_i + \eta_i X_{t-1})\, w_i^{-1}$

(14) $\eta_{ij} = -\delta_{ij} + \{(\gamma_{ij} + \theta_{ij}X_{t-1}) - (\beta_i + \eta_i X_{t-1})\,(\alpha_j + \sum_{i=1}^{K}\gamma_{ij} + \theta_{ij}X_{t-1})\, lnp_i\}\, w_i^{-1}$,

[14] To achieve stability, Pollack assumes that δ_i is the same for all *i* and that δ_i =[0,1). However, if such restrictions are applied, then certain parameters become inestimable within the equation systems used in the present paper.

where, as before, the Kronecker delta δ_{ij} =1if i=j and δ_{ij}=0 otherwise.

Estimation of the AIDS function fits a system of nonlinear equations using iterative feasible generalised nonlinear least squares (IFGNLS). Table7 presents the estimation results and the corresponding expenditure and own price elasticities of five models: (1) AIDS, (2) AIDS-hh, (3) QUAISD-hh, (4) DAIDS-a with a single autocorrelation coefficient (ρ) and (5) DAIDS-b with item-wise autocorrelation coefficients (ρ_i).[15] We observe that the estimated coefficients differ among the models. For example, we obtain negative estimates of β_i, implying that a good is a necessity, at the 5% significance level, for *saké* in the AIDS and AIDS-hh models, whereas we obtain a negative estimate of β_i for *shōchu* in the AIDS-hh, QUAIDS-hh, DAIDS-a and DAIDS-b models. Significant positive estimates of β_i, implying that a good is a luxury, are observed for beer, whisky and wine in the AIDS model, for beer and wine in the AIDS-hh model, and for beer in the QUAIDS model. The finding that beer is a luxury appears to be consistent with the historical view of beer as an imported expensive good but may also be applicable to the current period – beer is regarded as a luxury relative to less expensive alternatives, such as the recently invented non-malt and law-malt beers (*fizzy drinks* and *liquor*), and the price of beer in terms of 1º of ethanol is the highest among alcoholic beverages, as we have seen (Table 2).

Regarding the additional parameter in the QUAIDS-hh estimations, we obtain significantly positive estimates of λ_i for beer and wine and significantly negative estimates of λ_i for whisky. These results to some degree match expectations based on the nonparametric kernel regressions discussed above. Whereas ϑ_i and σ are both found to be significant at the 1% level in the AIDS-hh and QUIADS-hh models, the signs are the opposite for *saké*, beer and wine, depending on the estimation model used. However, given that ϑ_i indicates the effect of the relative price of i on the scale effect of σ, the opposite signs for ϑ_i and σ actually imply effects of the demographic variables that are in the same direction. If we examine only the household member scale effect σ, then the results are inconclusive. The negative value of σ in the AISD-hh model appears to be more reasonable with an additional

[15] We present the results with *hhmem* but also estimated with other demographic variables.

household member, who is likely to be a child, inducing 20% less alcohol consumption.[16]

With respect to the DAIDS model, some estimated coefficients for δ_i and θ_{ii} are significant withextremely small numbers with five to six zeros following the decimal point, indicating that there can be minute previous individual-item purchase effects (δ_i) on *saké*, *shōchu* and beer as well as minute previous total expenditure effects (θ_{ii}) of the subsistence utility terms on *shōchu*. These findings may be reasonable, given the consumption patterns for these alcohol types, which have been more widely consumed for longer periods compared with whisky or wine. With respect to η_i, the estimation results are suggested to be in appropriate, being too large. Thus, we present DAIDS elasticities calculated with the AIDS elasticity functional form, setting $\eta_i = \theta_{ii} = 0$. The autocorrelation coefficient ρ_i is not found to be significant in the DAIDS-a model, but it is found to be significant and positive for *shōchu* and wine in the DAIDS-b model, although the effects are minute.

The estimated expenditure elasticities calculated at the means, also shown in Table7, differ among the models, particularly between the static AIDS model and the others. The only item found to be robustly elastic is beer – the most popular alcoholic beverage in Japan. This finding coincides with the tax policy regression results finding that beer consumption is especially strongly affected by the level of final consumption per capita. It is suggested that an increase in expenditure is likely to increase the consumption of beer, whisky and wine, although the effects on *saké* and *shōchu* are less clear.

With regard to the own price elasticities, calculated at the means, we have 'positive' estimates for *saké*, *shōchu* and wine in the AIDS and AIDS-hh estimations, although all estimates are statistically nonsignificant in the AIDS-hh model. The positive and elastic own-price elasticity for *shōchu* matches the results of the earlier double-log estimations. Positive elasticity for *saké* was also found by Takahashi et al. (2009), cited above, although the value was inelastic. Beer and whisky have

[16] Recall that the data apply to households of at least two persons who are likely to consist of two adults. An AIDS model with demographic characteristics thus appears to be more appropriate for our estimations than a QUAIDS model.

negative price elasticities, although none are significant at the 5% level. For the QUAIDS-hh model, we obtain a significant positive elasticity for *saké*, which is elastic, and significant negative elasticity for beer, which is inelastic. The other items are nonsignificant, implying that the elasticities are not significantly different from zero.

With respect to the price-elasticity estimates in the DAIDS models, all coefficients have negative signs except for *shōchu* in the DAIDS-b model. These results are more consistent with other findings in the literature that alcoholic beverages are normal goods, although the estimates for *saké* and *shōchu* are not statistically significant in either estimation. Although we must be cautious about using the results from the DAIDS models because it was necessary to change the elasticity formula to that of the AIDS model, the results suggest that it would be particularly inefficient to impose excise taxes on whisky or wine but efficient to impose such taxes on *saké* and *shōchu.* The estimated cross-price elasticities suggest that *saké* and beer are complements in both DAIDS models; such results are also found in the AIDs estimations. *Shōchu* is found to be a substitute for *saké*, and wine is found to be a substitute for whisky in the DAIDS-a model, both at the 5% significance level.

Finding few robust estimation results across the models, we must note the possible instability of the AIDS model in application to alcoholic beverages in Japan. In particular, the complexity of the extended AIDs models considered here, although intended to be more realistic, appears to impose a certain strain on the estimations. Our results may indicate the importance of distinguishing ‘subsistence’ from ‘bliss’ within a given category of goods in an AIDS analysis.

[Table7]

Conclusions

Utilising data from 1948 to 2011, we observed that liquor tax rates were once discriminative towards expensive alcoholic beverages through ad valorem taxes and class systems, although such a system was abolished by early 1990. The liquor tax policy revisions have had differing implications for each alcohol type, as observed in the tax policy regressions investigating the effects of tax policies on alcoholic beverage production and consumption through panel and time-series analyses.

In the tax policy analyses, sectoral growth is found to have significant positive effects on production in general, except for domestic production. The effects of final consumption per capita are found to be positive and statistically significant in most cases, with the notable exception of *shōchu*, which suggest that *shōchu* is an inferior good. The results of the demand system analyses provide supporting evidence for this finding: increases in expenditures raise the level of consumption of most alcoholic beverages, but not that of *shōchu*. *Shōchu* is also found to have significant positive and elastic own-price elasticities, indicating that it would be the most ideal subject for taxation. Tax rates are found to have mixed effects, depending on the type of alcohol considered. They are found to have particularly significant negative effects on *saké* and beer but significant positive effects on *shōchu*, possibly suggesting that *shōchu* may be a Giffen good, with income effects that exceed its substitution effects. Nonetheless, there may be other relevant factors that are not evident in the available data, such as quality improvements and price increases during periods of recession. The analyses suggest that preferential tax rates may boost the sectoral performance of certain alcohols, and based on the estimated results that we have available, the safest taxable item appears to be *shōchu*..

Nonetheless, taken together with the alcohol trend and tax policy analyses presented here, there may be quality and other issues at work in the background of these elasticity findings. In addition, the application of the AIDS model to the alcoholic beverage data used here might not be appropriate. The results signify the importance of distinguishing qualities within the same categories of goods in demand system analyses.

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Table 1 Summary of the Liquor Tax Evolution (1962~2013)

Year	Major Change (in terms of nominal rate)	General Tax Trend
1962 (S37)	Major tax rate reduction for all & subsequent increase	↓ ↑
1989 (H1)	Abolishment of special class for *saké*, class for wine, whisky Abolishment of ad valorem tax Major tax rate reduction for all except for *shōchu* Major tax rate increase for *shōchu* Other: introduction of consumer tax (3%, increased to 5% in 1997)	↓ ↑
1992 (H4)	Abolishment of class for *saké*	↑
1994 (H6)	Increased tax for *saké*, synthetic *saké*, *shōchu*, beer, wine Revised definition of fizzy drinks (third beer), other alcohols	
2003(H15)	Increased tax for synthetic *saké*, wine, fizzy drinks, other alcohols	↑
2006(H18)	Reduced tax for *saké*, synthetic *saké*, beer, whisky Increased tax for *shōchu*, wine, other alcohol	↓ ↑

Source: *Saké no Shiori, H25* and other documents, National Tax Agency (2013)

Table 2. Summary Statistics (for Tax Impact Estimation)

Variable	Obs	Mean	S.D.	Min	Max	Obs	Mean	S.D.	Min	Max
Taxed quantity (in 1,000 kl)						Consumption (in 1,000 kl)				
Saké	64	1082.2	459.7	127	1766	61	1099.4	411.8	220	1675
Synth. Saké	64	60.0	39.4	20	139	61	55.9	35.5	20	129
Shōchu	64	451.0	276.9	39	968	61	461.3	283.1	175	1005
Beer	64	3492.1	2124.7	79	7086	61	3541.2	2006.7	196	7057
Whisky	64	134.8	102.5	5	379	61	159.5	108.8	9	377
Wine	64	58.5	34.6	4	158	61	59.5	38.1	7	313
Spirits	64	33.0	64.9	0	297	61	30.5	49.1	1	233
Liquor	64	233.0	424.6	1	1819	61	232.7	424.3	1	1871
Fizzy	58	414.9	754.4	0	2600	61	374.5	706.7	0	2465
Other	64	98.6	269.0	0	1058	61	1089.0	279.2	0	1032
Average tax rate (JPY per litre)						Real Average Tax Rate per L (in JPY) (1955-2011)[a]				
Saké	64	147.02	33.69	102.47	243.35	57	288.6	199.1	122.5	837.8
Synth. Saké	64	79.36	20.38	60.43	138.75	57	160.9	136.5	62.4	552.9
Shōchu	64	109.89	70.11	44.40	238.42	57	180.1	101.5	68.0	435.5
Beer	64	166.10	54.37	94.98	238.82	57	295.9	124.5	183.8	643.6
Whisky	64	593.18	347.29	64.86	1291.02	57	1024.4	412.9	381.1	1735.9
Wine	64	63.66	16.69	11.67	120.25	57	126.0	78.3	48.9	342.8
Spirits	61	213.15	82.01	84.91	360.74	57	425.8	284.4	99.4	1284.7
Liquor	64	107.60	25.99	29.00	202.00	57	239.0	208.0	83.2	755.3
Fizzy	40	88.64	42.56	8.00	159.00	33	155.3	54.9	82.7	281.9
Other	36	85.25	21.37	41.00	148.33	36	95.0	25.3	63.9	166.7
Tax-Price Ratio (1963-2011)[b]						Real ethanol price (JPY per 1 degree of alcohol)[c]				
Saké	49	0.21	0.07	0.14	0.36	49	66.3	7.8	57.2	80.6
Shōchu	49	0.22	0.09	0.10	0.35	49	27.7	2.3	23.4	33.0
Beer	49	0.44	0.04	0.38	0.53	49	112.6	13.4	93.9	149.8
Whisky	49	0.37	0.10	0.21	0.52	49	60.9	12.6	38.8	75.1
Wine	49	0.07	0.03	0.03	0.15	49	105.0	11.8	79.7	123.5
Fizzy	12	0.38	0.04	0.30	0.42					
Real final consumption per capita (in million JPY)										
Fcepc	57	1.58	0.70	0.36	2.63					

Notes: a) Fizzy drinks and others data available from 1978 and 1975, respectively. Average tax rates for whisky, wine, sprits, liquor during (1948-1962) extrapolated with the corresponding ratio data in 1963 as figures are available only in an aggregate form for these types; b) Fizzy drinks data available since 2000 only. To calculate average prices of alcohols, three data sets are utilised: (1) *1963 to 2007* from 20-3-a Annual Household Expenditures and Quantity Purchased by Commodity (Non-agricultural, forestry and fishery Households with 2 or more; 1963-2007 All Japan); (2) *2008 to 2010* from 20-3-b Annual Household Expenditures and Quantity Purchased by Commodity, (Households with 2 or more, including agricultural, forestry and fisheries households; 2000-2010 All Japan); (3) *2011* from Annual Household Expenditures and Quantity Purchased by Commodity (Households with 2 or more) - All Japan(1990-2012); c) Not used in the estimation. Because there are divergences in alcoholic contents of each type, the most generic alcoholic contents are assumed: saké 15º, shōchu 25º, beer 5º, whisky 40º, and wine 13º. Real prices are calculated by using a combined the deflators for Final Consumption Expenditure.

Data Source: A) Alcohol Related Data: Long-Term Time Series Data (1948-2011) and Liquor Tax information from the National Tax Agency (2013); B) Real Tax Values calculated using Deflator for Final Consumption Expenditure (1) FY1955~1979 (1990/H2-constant: 64SNA, adjusted to match (2)); (2) FY1980～2009 (2000/H12-constant: 93SNA); (3) 2010～2011(2005/H17-constant: 93SNA, adjusted to match (2); C) Final Consumption Expenditure Per Capita used Final Consumption Expenditure, for (1) 1963-2007: 20-3-a Annual Household Expenditures and Quantity Purchased by Commodity (Non-agricultural, forestry and fishery Households with 2 or more; 1963-2007 All Japan); (2) 2008-2010: 20-3-b Annual Household Expenditures and Quantity Purchased by Commodity (Households with 2 or more, including agricultural, forestry and fisheries households; 2000-2010 All Japan); (3) 2011: H2~H22 Yearly Amount of Expenditures, Quantities and Average Prices per Household (1990-2012 all Japan), and Total Population of Japan (2013) from the Statistical Bureau of Japan (2013).

Table 3. Panel Estimation Results: All Alcoholic Beverages: G0 All (*Saké* ~ Other Alcohols, 10 types)

	Production/Supply						Consumption					Production (Domestic Only)			
	1955-2011		1966-2011 a)				1955-2011		1966-2011 a)			1991-2011 b)			
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)
MA(3) growth rate tax value	0.786***	0.843***	0.772***	0.849***	0.772***	0.796***	0.387***	0.444***	0.399***	0.410***	0.361***	0.473***	0.650***	-0.266	-0.431
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.38]	[0.16]
ln average tax rate (real)	-0.381***	-0.488***	-0.721***	-0.852***				-0.221**	-0.605***	-0.571***			-0.209***		
	[0.00]	[0.00]	[0.00]	[0.00]				[0.01]	[0.00]	[0.00]			[0.01]		
ln Tax ratio a)			0.923***	0.921***	0.223***	0.138			0.611***	0.545***	0.101			0.820***	0.916***
			[0.00]	[0.00]	[0.01]	[0.11]			[0.00]	[0.00]	[0.15]			[0.00]	[0.00]
ln final consumption pc	0.854***		0.512***		0.849***	0.666***	1.008***				0.731***	1.601**			-1.502***
	[0.00]		[0.00]		[0.00]	[0.00]	[0.00]				[0.00]	[0.01]			[0.01]
S37tax	0.004	0.024			0.099*		0.054	0.056	0.046			.	.	.	
	[0.94]	[0.70]			[0.09]		[0.24]	[0.39]	[0.38]			.	.	.	
H1tax	-0.061	-0.022			0.087**		0.105	0.127	0.044			0.036	-0.016	0.140***	
	[0.49]	[0.81]			[0.04]		[0.11]	[0.18]	[0.24]			[0.46]	[0.74]	[0.00]	
H6tax	-0.032	0.044			.		0.131*	0.234**	.			.	.	.	
	[0.75]	[0.67]			.		[0.09]	[0.03]	.			.	.	.	
H15tax	0.011	0.112			-0.143**		-0.047	0.144	-0.052			0.009	0.095	-0.115	
	[0.91]	[0.24]			[0.04]		[0.54]	[0.14]	[0.40]			[0.92]	[0.25]	[0.15]	
H18tax	-0.004	-0.041			0.058		0.018	-0.048	0.014			0.012	-0.035	0.036	
	[0.95]	[0.46]			[0.16]		[0.68]	[0.40]	[0.70]			[0.81]	[0.46]	[0.44]	
Polyphe. Boom	0.026	0.018	0.03	0.013	0.026	0.027	0.027	0.006	-0.004	-0.005	0.013	0.02	0.004	0.036	0.022
	[0.49]	[0.65]	[0.39]	[0.68]	[0.38]	[0.39]	[0.39]	[0.88]	[0.89]	[0.83]	[0.60]	[0.56]	[0.91]	[0.29]	[0.55]
Shōchu boom	0.004	-0.068	-0.013	-0.013	0.087	-0.014	0.033	-0.091	0.025	-0.01	-0.008	0.033	-0.046	0.051	-0.036
	[0.95]	[0.39]	[0.69]	[0.65]	[0.13]	[0.65]	[0.60]	[0.25]	[0.62]	[0.67]	[0.74]	[0.65]	[0.50]	[0.44]	[0.31]
Constant	6.477***	6.882***	10.509***	11.351***	6.035***	5.759***	4.272***	5.490***	10.058***	9.705***	5.964***	4.694***	7.111***	7.442***	8.882***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
N	525	525	257	257	257	257	540	516	257	257	257	200	200	95	95

Note: p-value in brackets (* p<0.05, ** p<0.01, *** p<0.001); Estimation (1) exhibits an evidence of multicollinearity; a) Tax ratio data available for 1963-2011 for *saké, shōchu*, beer, whisky and wine only, so other types are dropped from the analysis using this variable; b) domestic tax data available for 1989-2011 only (1991-2011 taking MA(3) growth rate tax value).
Data Source: A) Alcohol Related Data: Long-Term Time Series Data (1948-2011) and Liquor Tax information from the National Tax Agency (2013); B) Real Tax Values calculated using Deflator for Final Consumption Expenditure (1)FY1955~1979(1990/H2-constant: 64SNA, adjusted to match (2))；(2)FY1980～2009(2000/H12-constant：93SNA)；(3) 2010～2011(2005/H17-constant：93SNA, adjusted to match (2)); C) Final Consumption Expenditure Per Capita and Price data for tax ratio used Final Consumption Expenditure data, for (1) 1963-2007: 20-3-a Annual Household Expenditures and Quantity Purchased by Commodity (Non-agricultural, forestry and fishery Households with 2 or more; 1963-2007 All Japan); (2) 2008-2010: 20-3-b Annual Household Expenditures and Quantity Purchased by Commodity (Households with 2 or more, including agricultural, forestry and fisheries households; 2000-2010 All Japan); (3) 2011: H2~H22 Yearly Amount of Expenditures, Quantities and Average Prices per Household (1990-2012 all Japan) , and Total Population of Japan (2013) from the Statistical Bureau of Japan.

Table 4. Time-Series (ARMA) Estimation Results: *Saké*, *Shōchu*, Beer, Whisky, Wine (1955-2011)

	Saké				*Shōchu*				Beer				Whisky				Wine			
	production		consumption		production		consumption		production		consumption		production		consumption		production		consumption	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
MA(3) grw rate tax val.	1.079***	0.903***	0.322***	0.260***	0.627***	0.656***	0.045	0.237***	1.656***	0.841**	1.176***	0.623*	0.477	0.404	0.246***	0.244***	1.071***	0.742***	0.156***	0.156***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.50]	[0.00]	[0.00]	[0.02]	[0.00]	[0.08]	[0.10]	[0.24]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
ln av. tax rate	-0.321**		-0.187***		0.07		0.263**		-1.034***		-0.627***		-0.266		-0.018		-0.594***		0.003	
	[0.02]		[0.01]		[0.71]		[0.01]		[0.00]		[0.00]		[0.19]		[0.84]		[0.00]		[0.96]	
ln final consumption pc		0.657***		0.655***		0.333		0.271		1.401***		1.357***		0.971***		0.960***		0.877***		1.053***
		[0.00]		[0.00]		[0.20]		[0.41]		[0.00]		[0.00]		[0.00]		[0.00]		[0.00]		[0.00]
S37tax	0.090**	0.112*	0.046	0.081**	0.116	0.093	0.171***	0.077	0.075	0.066	0.058	0.074	0.205***	0.253***	-0.055	-0.04	0.056***	0.026	0.055	0.062***
	[0.02]	[0.05]	[0.25]	[0.01]	[0.17]	[0.14]	[0.00]	[0.21]	[0.17]	[0.15]	[0.30]	[0.14]	[0.00]	[0.00]	[0.24]	[0.13]	[0.00]	[0.84]	[0.11]	[0.01]
H1tax	0.004	0.048	-0.008	0.030*	-0.358***	-0.358***	-0.060**	-0.037	0.022	0.077*	0.007	0.066*	-0.090**	-0.05	-0.039	-0.02	-0.041	0.106	-0.004	0.009
	[0.94]	[0.41]	[0.72]	[0.10]	[0.00]	[0.00]	[0.04]	[0.35]	[0.52]	[0.05]	[0.84]	[0.08]	[0.02]	[0.40]	[0.14]	[0.26]	[0.20]	[0.23]	[0.91]	[0.56]
H6tax	-0.047	-0.059	-0.037***	-0.041**	-0.165***	-0.164***	-0.076***	-0.065**	-0.006	0.02	0.02	0.029**	-0.045	-0.025	-0.064***	-0.071***	-0.015	-0.051***	0.026**	0.018
	[0.23]	[0.25]	[0.01]	[0.03]	[0.00]	[0.00]	[0.00]	[0.02]	[0.71]	[0.15]	[0.14]	[0.02]	[0.39]	[0.72]	[0.00]	[0.00]	[0.69]	[0.00]	[0.04]	[0.12]
H15tax	0.025	0.033	0.035	0.033	-0.022	-0.025	-0.009	-0.018	0.017	-0.002	0.016	-0.003	0.029	0.03	0.033	0.017	0.013	-0.028	0.013	-0.004
	[0.65]	[0.61]	[0.25]	[0.41]	[0.52]	[0.43]	[0.81]	[0.52]	[0.46]	[0.97]	[0.55]	[0.96]	[0.53]	[0.68]	[0.40]	[0.77]	[0.79]	[0.80]	[0.78]	[0.94]
H18tax	-0.007	0.005	-0.034	-0.009	0.039	0.049	0.017	0.026	-0.027***	-0.001	-0.023*	0.014	0.034	0.054	-0.024	0.026	-0.033	-0.066	-0.085*	-0.03
	[0.91]	[0.94]	[0.32]	[0.80]	[0.22]	[0.14]	[0.64]	[0.38]	[0.00]	[0.98]	[0.06]	[0.71]	[0.43]	[0.39]	[0.49]	[0.61]	[0.50]	[0.58]	[0.06]	[0.59]
Polyphe Boom	-0.028	-0.017	-0.036	-0.024	-0.036	-0.029	-0.071*	-0.045**	0.002	0.027*	0.007	0.026	0.016	0.052	0.014	0.031	0.159*	0.210**	0.188*	0.204**
	[0.46]	[0.65]	[0.13]	[0.31]	[0.23]	[0.21]	[0.05]	[0.03]	[0.93]	[0.06]	[0.76]	[0.22]	[0.79]	[0.12]	[0.65]	[0.29]	[0.09]	[0.04]	[0.05]	[0.04]
Shōchu boom	-0.022	-0.032	-0.039	-0.033	0.072	0.079	0.072	0.069	-0.015	-0.01	-0.028	-0.008	-0.009	0.006	-0.059	-0.024	-0.059	-0.043	-0.086	-0.045
	[0.73]	[0.67]	[0.51]	[0.64]	[0.32]	[0.26]	[0.33]	[0.27]	[0.56]	[0.88]	[0.39]	[0.91]	[0.93]	[0.96]	[0.39]	[0.82]	[0.28]	[0.74]	[0.33]	[0.67]
Const.	8.321***	6.382***	7.532***	6.352***	5.755***	6.069***	4.643***	6.098***	13.309***	7.136***	10.767***	7.084***	5.726***	3.957***	4.136***	4.078***	6.680***	3.700***	4.241***	4.147***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
AR(1)	0.987***	0.994***	0.988***	0.995***	0.985***	0.973***	0.989***	0.982***	0.986***	0.988***	0.993***	0.987***	0.985***	0.974***	0.992***	0.983***	0.983***	0.873***	0.996***	0.966***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
MA(1)			0.569***	0.537***	0.485***	0.502***	1.000***	0.698**	1.000***	0.304***	1.000***	0.462***	0.532**	0.294**	1.000***	1.000***			1.000***	1.000***
			[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]	[0.05]	[0.00]	[0.00]			[0.00]	[0.00]
sigma _cons	0.062***	0.058***	0.039***	0.034***	0.070***	0.070***	0.049***	0.053***	0.055***	0.055***	0.049***	0.052***	0.097***	0.093***	0.060***	0.054***	0.089***	0.094***	0.061***	0.056***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
N	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
bic	-102.77	-110.45	-150.67	-165.61	-83.79	-85.17	-120.29	-115.47	-107.41	-111.83	-119.86	-118.92	-46.66	-52.53	-96.56	-109.96	-61.57	-58.2	-94.59	-105.94

aic	-127.28	-134.97	-177.23	-192.17	-110.35	-111.73	-146.85	-142.03	-133.97	-138.39	-146.42	-145.48	-73.22	-79.09	-123.12	-136.52	-86.09	-82.71	-121.15	-132.5

Note: p-value in brackets (* p<0.05, ** p<0.01, *** p<0.001)
Data Source: A) Alcohol Related Data: Long-Term Time Series Data (1948-2011) and Liquor Tax information from the National Tax Agency (2013); B) Real Tax Values calculated using Deflator for Final Consumption Expenditure (1)FY1955~1979(1990/H2-constant: 64SNA, adjusted to match (2))；(2)FY1980～2009(2000/H12-constant：93SNA)；(3) 2010～2011(2005/H17-constant：93SNA, adjusted to match (2)); C) Final Consumption Expenditure Per Capita and Price data for tax ratio used Final Consumption Expenditure data, for (1) 1963-2007: 20-3-a Annual Household Expenditures and Quantity Purchased by Commodity (Non-agricultural, forestry and fishery Households with 2 or more; 1963-2007 All Japan); (2) 2008-2010: 20-3-b Annual Household Expenditures and Quantity Purchased by Commodity (Households with 2 or more, including agricultural, forestry and fisheries households; 2000-2010 All Japan); (3) 2011: H2~H22 Yearly Amount of Expenditures, Quantities and Average Prices per Household (1990-2012 all Japan) , and Total Population of Japan (2013) from the Statistical Bureau of Japan.

Table 5. Summary Statistics of Variables (for Elasticity Estimation)

Variable	Obs	Mean	Std. Dev.	Min	Max	Variable	Obs	Mean	Std. Dev.	Min	Max
Real Annual Expenditure (JPY)						Real Price per Litre (JPY)					
saké	48	8306.35	3763.60	1255.66	12666.18	*saké*	48	603.86	303.35	69.69	930.34
shōchu	48	2721.75	2204.81	112.58	6504.60	*shōchu*	48	437.37	234.81	47.58	685.63
beer	48	15818.50	10381.05	733.93	33793.78	beer	48	349.41	187.82	43.26	555.21
whisky	48	2913.55	2124.23	120.16	6600.24	whisky	48	1546.06	870.83	164.14	3095.80
wine	48	1150.36	1004.46	54.07	3553.80	wine	48	878.21	465.23	79.55	1495.00
Consumed Quantity (L)						Household (hh) Characteristics					
saké	48	15.61	4.77	7.91	22.84	no of member	48	3.63	0.36	3.09	4.3
shōchu	48	5.08	2.87	1.78	11.00	age of hh head	48	48.54	4.23	43.7	56.3
beer	48	40.90	11.80	17	62	work member	48	1.55	0.94	1.35	1.67
whisky	48	1.79	0.81	0.73	3.46						
wine	48	1.12	0.74	0.36	2.90						

Data: (1) *1963 to 2007* from 20-3-a Annual Household Expenditures and Quantity Purchased by Commodity (Non-agricultural, forestry and fishery Households with 2 or more; 1963-2007 All Japan); (2) *2008 to 2010* from 20-3-b Annual Household Expenditures and Quantity Purchased by Commodity, (Households with 2 or more, including agricultural, forestry and fisheries households; 2000-2010 All Japan)
Data source: Japan National Statistical Bureau (2013)

Table 6. Expenditure and Own Price Elasticities of Demand: Double Log Estimation (1963-2011)

	Panel		AR(1)/ARMA(1)														
	lnq 5 types		lnq *saké*			lnq shōchu			lnq beer			lnq whisky			lnq wine		
	(1)	(2)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
ln total exp.[a]	0.726***	0.586***	0.846**	0.743***	0.498**	-1.115***	-1.261***	-1.059***	1.076***	1.092***	0.994***	1.522***	1.264***	1.003***	0.295	0.414*	0.553**
	[0.00]	[0.00]	[0.01]	[0.00]	[0.03]	[0.01]	[0.00]	[0.01]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.20]	[0.06]	[0.01]
ln price[b]	-0.599***	-0.530***	-0.891*	-0.844***	-0.669**	1.336**	1.437***	1.401***	-0.899***	-0.907***	-0.893***	-0.945***	-0.828***	-0.706***	-0.583***	-0.598***	-0.616***
	[0.00]	[0.00]	[0.06]	[0.00]	[0.02]	[0.02]	[0.01]	[0.01]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
t	-0.023***		-0.035***	-0.043***		0.039***	0.058***		-0.018***	-0.025		-0.066***	-0.042**		0.045***	0.043	
	[0.00]		[0.00]	[0.00]		[0.00]	[0.01]		[0.01]	[0.21]		[0.00]	[0.02]		[0.00]	[0.11]	
no hh		0.096		-0.718***	-0.127		0.051	-0.589		-0.165	0.18		-0.61	-0.096		0.908	0.217
member		[0.62]		[0.00]	[0.42]		[0.95]	[0.58]		[0.65]	[0.60]		[0.17]	[0.80]		[0.23]	[0.70]
age of		-0.030**		-0.023	-0.090***		-0.047	0.058		0.008	-0.025		-0.101**	-0.148**		0.064	0.122***
hh head		[0.03]		[0.26]	[0.00]		[0.52]	[0.45]		[0.84]	[0.31]		[0.01]	[0.02]		[0.20]	[0.00]
constant	3.377***	5.410***	3.842**	8.936***	11.448***	15.609***	18.766**	14.713	0.626	0.838	1.886	-6.117***	3.332	5.543	5.282**	-2.674	-3.782
	[0.00]	[0.00]	[0.05]	[0.00]	[0.00]	[0.00]	[0.03]	[0.13]	[0.55]	[0.80]	[0.55]	[0.00]	[0.43]	[0.22]	[0.02]	[0.61]	[0.44]
AR component																	
AR(1)			0.813***	0.31	0.354**	0.715***	0.766***	0.665**	0.868***	0.864***	0.893***	0.918***	0.893***	0.917***	0.806***	0.784***	0.764***
			[0.00]	[0.25]	[0.02]	[0.00]	[0.00]	[0.02]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
MA(1)															0.257***	0.263***	0.273***
															[0.00]	[0.00]	[0.01]
sigma			0.035***	0.033***	0.042***	0.089***	0.088***	0.094***	0.058***	0.057***	0.059***	0.077***	0.070***	0.074***	0.124***	0.121***	0.124***
constant			[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
N	240	240	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
AIC	.	.	-172.08	-176.49	-153.75	-83.19	-80.01	-76.06	-124.3	-120.59	-119.91	-95.52	-101.13	-98.32	-48.42	-47.03	-47.04
BIC	.	.	-160.85	-161.52	-140.65	-71.96	-65.04	-62.96	-113.08	-105.62	-106.81	-84.29	-86.16	-85.22	-35.32	-30.19	-32.07

Note: p-value in brackets (* $p<0.05$, ** $p<0.01$, *** $p<0.001$); a) expenditure elasticity; b) price elasticity.
Data: (1) 1963-2007: 20-3-a Annual Household Expenditures and Quantity Purchased by Commodity (Non-agricultural, forestry and fishery Households with 2 or more; 1963-2007 All Japan); (2) 2008-2010: 20-3-b Annual Household Expenditures and Quantity Purchased by Commodity (Households with 2 or more, including agricultural, forestry and fisheries households; 2000-2010 All Japan); (3) 2011: H2~H22 Yearly Amount of Expenditures, from Japan National Statistical Bureau (2013).

Table 7. Expenditure and Own Price Elasticities of Demand: AIDS Estimations (1963-2011)

	AIDS					AIDS w hhmem					QUAIDS w hhmem				
	saké	*shōchu*	beer	*whisky*	wine	*saké*	*shōchu*	beer	*whisky*	wine	*saké*	*shōchu*	beer	*whisky*	wine
α_i	-0.91	0.38	1.25	0.09	0.18	0.08	0.23	0.65	-0.08	0.12	-0.82	-0.01	2.28	-0.84	0.39
	[0.00]	[0.00]	[0.00]	[0.22]	[0.00]	[0.08]	[0.00]	[0.00]	[0.10]	[0.00]	[0.00]	[0.91]	[0.00]	[0.00]	[0.00]
β_i	-0.72	0.01	0.53	0.14	0.04	-1.89	-0.40	2.04	0.14	0.11	0.12	-0.61	0.51	0.05	-0.07
	[0.00]	[0.68]	[0.00]	[0.01]	[0.00]	[0.00]	[0.00]	[0.00]	[0.52]	[0.04]	[0.38]	[0.00]	[0.00]	[0.77]	[0.17]
γ_{ii}	1.25	0.25	0.80	0.05	0.06	0.47	0.06	0.35	0.16	0.04	0.92	0.07	1.18	0.41	0.06
	[0.00]	[0.00]	[0.00]	[0.14]	[0.00]	[0.00]	[0.28]	[0.00]	[0.01]	[0.00]	[0.00]	[0.11]	[0.00]	[0.00]	[0.00]
λ_i											-0.04	0.01	0.11	-0.12	0.04
											[0.12]	[0.22]	[0.00]	[0.00]	[0.00]
ϑ_{i_hh}						0.52	0.05	-0.51	-0.03	-0.04	-0.21	0.15	0.21	-0.25	0.10
						[0.00]	[0.02]	[0.00]	[0.57]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
$\sigma_{\_hh}$						-0.20					0.73				
						[0.00]					[0.01]				
	Expenditure and Own/Cross-Price Elasticities														
ei	-1.18	1.14	2.14	2.51	2.08	0.95	-1.62	1.44	1.43	0.39	-0.11	-0.93	2.09	0.84	1.80
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]	[0.27]	[0.28]	[0.00]	[0.00]	[0.06]	[0.00]
η_{ij} *saké*	**2.68**	-0.77	-1.52	0.95	-0.15	**0.43**	-0.28	-1.09	-0.12	0.10	**1.43**	-0.34	-0.97	-0.11	0.09
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	**[0.12]**	[0.01]	[0.00]	[0.33]	[0.05]	**[0.00]**	[0.00]	[0.00]	[0.29]	[0.04]
shōchu	-3.96	**2.09**	1.94	-1.76	0.55	-0.43	**0.23**	1.49	0.42	-0.09	-1.10	**-0.17**	1.97	0.11	0.11
	[0.00]	**[0.00]**	[0.00]	[0.00]	[0.04]	[0.27]	**[0.37]**	[0.00]	[0.17]	[0.37]	[0.00]	**[0.38]**	[0.00]	[0.37]	[0.33]
beer	-2.17	0.25	**-0.13**	-0.22	0.12	-0.91	-0.01	**-0.41**	-0.15	0.04	-1.40	0.11	**-0.79**	0.02	-0.03
	[0.00]	[0.01]	**[0.12]**	[0.01]	[0.00]	[0.00]	[0.40]	**[0.00]**	[0.13]	[0.21]	[0.00]	[0.08]	**[0.00]**	[0.38]	[0.25]
whisky	2.12	-1.60	-1.24	**-0.68**	-1.11	-0.55	0.11	-0.78	**0.72**	-0.93	-0.78	-0.09	0.81	**-0.25**	-0.54
	[0.00]	[0.00]	[0.00]	**[0.15]**	[0.00]	[0.26]	[0.37]	[0.03]	**[0.24]**	[0.00]	[0.05]	[0.37]	[0.03]	**[0.37]**	[0.00]
wine	-2.58	1.24	1.70	-3.09	**0.65**	1.19	-0.39	1.12	-2.53	**0.23**	0.33	0.09	-0.36	-1.65	**-0.22**
	[0.00]	[0.05]	[0.00]	[0.00]	**[0.04]**	[0.05]	[0.29]	[0.01]	[0.00]	**[0.31]**	[0.29]	[0.39]	[0.27]	[0.00]	**[0.29]**

		DAIDS-a (single ρ)					DAIDS-b (5ρi)				
		saké	*shōchu*	beer	*whisky*	wine	*saké*	*shōchu*	beer	*whisky*	wine
α_i		0.23	0.06	0.56	0.14	0.00	0.00	1.33	0.62	-0.43	-0.53
		[0.00]	[0.14]	[0.00]	[0.00]	[0.85]	[0.97]	[0.02]	[0.00]	[0.39]	[0.01]
β_i		0.07	-0.09	0.01	0.02	-0.02	0.05	-0.10	0.02	0.04	-0.01
		[0.11]	[0.04]	[0.73]	[0.35]	[0.16]	[0.33]	[0.00]	[0.80]	[0.39]	[0.78]
γ_{ii}		0.30	-0.02	0.28	-0.04	-0.03	0.29	-0.03	0.24	-0.02	-0.03
		[0.02]	[0.78]	[0.02]	[0.38]	[0.27]	[0.02]	[0.73]	[0.04]	[0.63]	[0.39]
λ_i	δ_i	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		[0.02]	[0.01]	[0.00]	[0.63]	[0.07]	[0.06]	[0.18]	[0.02]	[0.26]	[0.24]
ϑ_{i_hh}	θ_{ii}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		[0.36]	[0.63]	[0.11]	[0.91]	[0.20]	[0.96]	[0.04]	[0.56]	[0.57]	[0.34]
$\sigma_{\_hh}$	η_i	0.94	0.00	0.00	0.00	-0.94	0.97	1.00	0.95	-3.92	1.00
		[0.00]	[0.13]	[0.10]	[0.09]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
	ρ_i	0.00					0.00	0.00	0.00	0.00	0.00
		[0.24]					[0.93]	[0.01]	[0.13]	[0.08]	[0.04]
		Expenditure and Own/Cross-Price Elasticities									
ei		1.22	-0.08	1.03	1.21	0.43	1.17	-0.30	1.04	1.39	0.76
		[0.00]	[0.88]	[0.00]	[0.00]	[0.29]	[0.00]	[0.49]	[0.00]	[0.00]	[0.37]
η_{ij} *saké*		**-0.16**	0.35	-1.12	-0.15	-0.14	**-0.13**	-0.12	-0.80	-0.11	-0.01
		[0.68]	[0.13]	[0.00]	[0.35]	[0.29]	**[0.75]**	[0.69]	[0.00]	[0.48]	[0.92]
shōchu		1.87	**-1.23**	-0.14	-0.42	0.00	0.55	**0.43**	-0.28	-0.54	0.15
		[0.04]	**[0.24]**	[0.86]	[0.40]	[1.00]	[0.54]	**[0.67]**	[0.68]	[0.25]	[0.72]
beer		-0.73	-0.12	**-0.42**	0.16	0.07	-0.50	-0.24	**-0.50**	0.19	0.01
		[0.00]	[0.38]	**[0.10]**	[0.17]	[0.38]	[0.01]	[0.39]	**[0.03]**	[0.09]	[0.94]
whisky		-0.52	-0.46	0.71	**-1.43**	0.49	-0.69	-0.46	0.60	**-1.03**	0.20
		[0.36]	[0.29]	[0.20]	**[0.00]**	[0.07]	[0.28]	[0.56]	[0.24]	**[0.02]**	[0.51]
wine		-1.15	-0.02	1.24	1.45	**-1.95**	-1.04	2.43	-0.09	-0.16	**-1.90**
		[0.38]	[0.99]	[0.25]	[0.05]	**[0.03]**	[0.45]	[0.09]	[0.94]	[0.82]	**[0.02]**

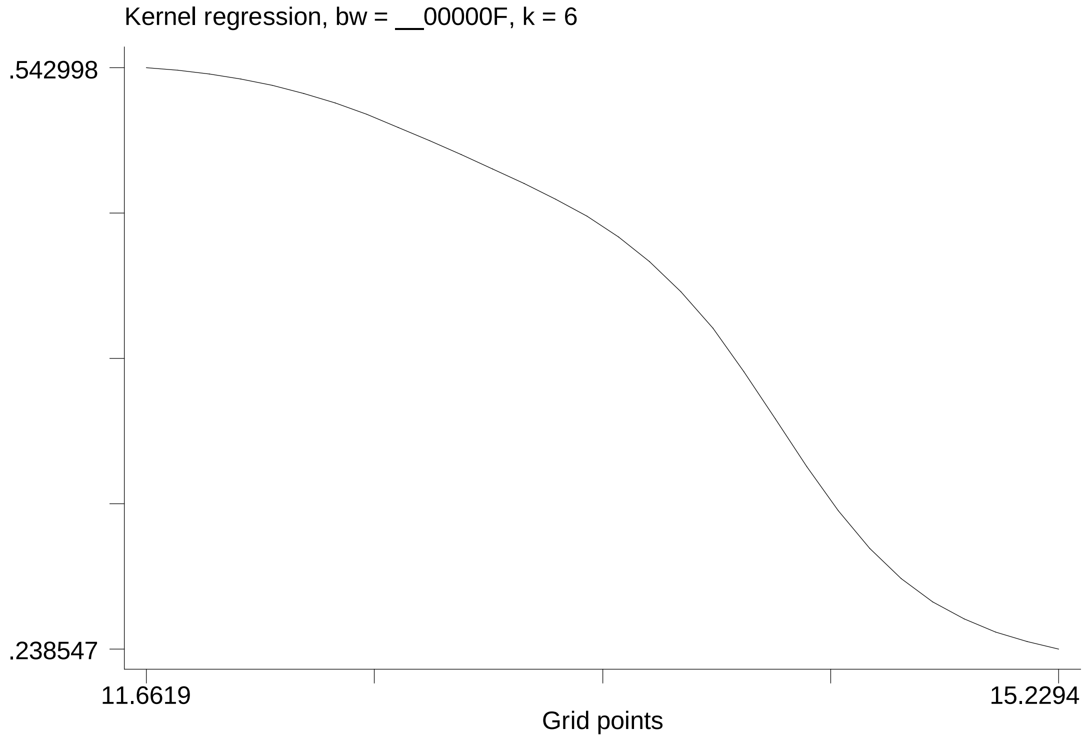
Note: p-value in parentheses; elasticities are calculated at mean of variables; Own-price elasticities are in diagonal, shown in bold; Cross-price elasticity matrix are shown for elasticity of good in row *i* with respect to changes in price of good in column *j*; Own/cross-price elasticities for DAIDS model use the ordinal AIDS elasticity formula (explanation given in the article). AIDS, QUAIDS and DAIDS models are estimated with IFGNLS using nonlinear systems of equations estimations.

Data: (1) 1963-2007: 20-3-a Annual Household Expenditures and Quantity Purchased by Commodity (Non-agricultural, forestry and fishery Households with 2 or more; 1963-2007 All Japan); (2) 2008-2010: 20-3-b Annual Household Expenditures and Quantity Purchased by Commodity (Households with 2 or more, including agricultural, forestry and fisheries households; 2000-2010 All Japan); (3) 2011: H2~H22 Yearly Amount of Expenditures, from Japan National Statistical Bureau (2013).

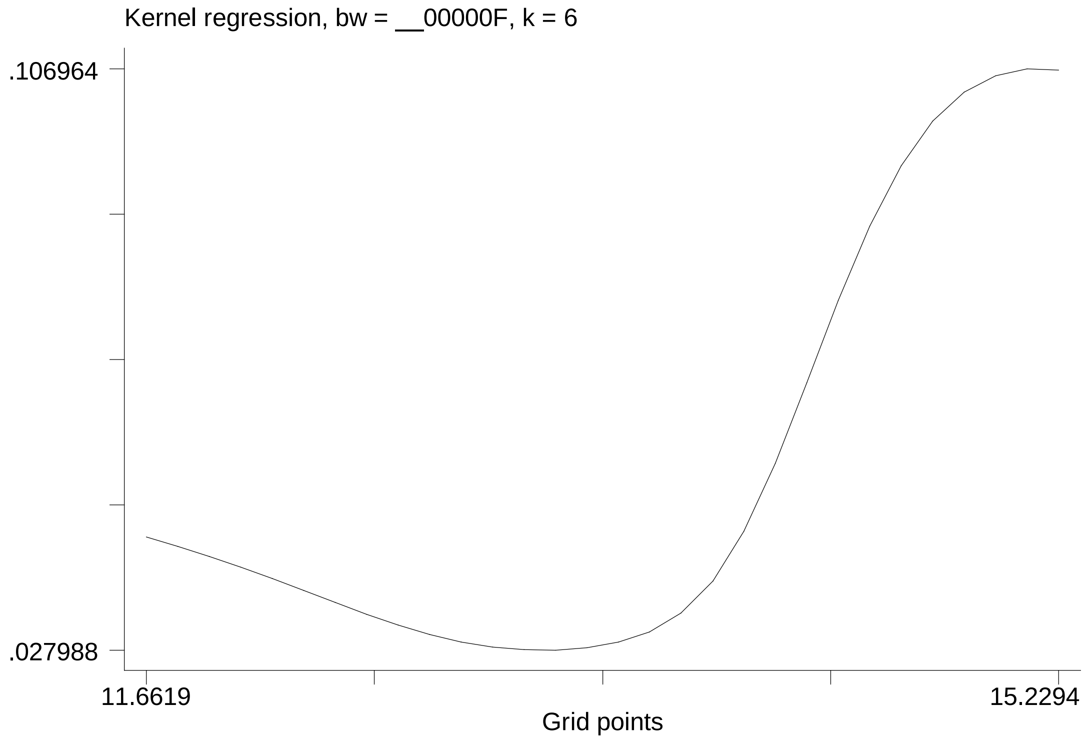
APPENDIX

Nonparametric Kernel Regressions with Gaussian Specification

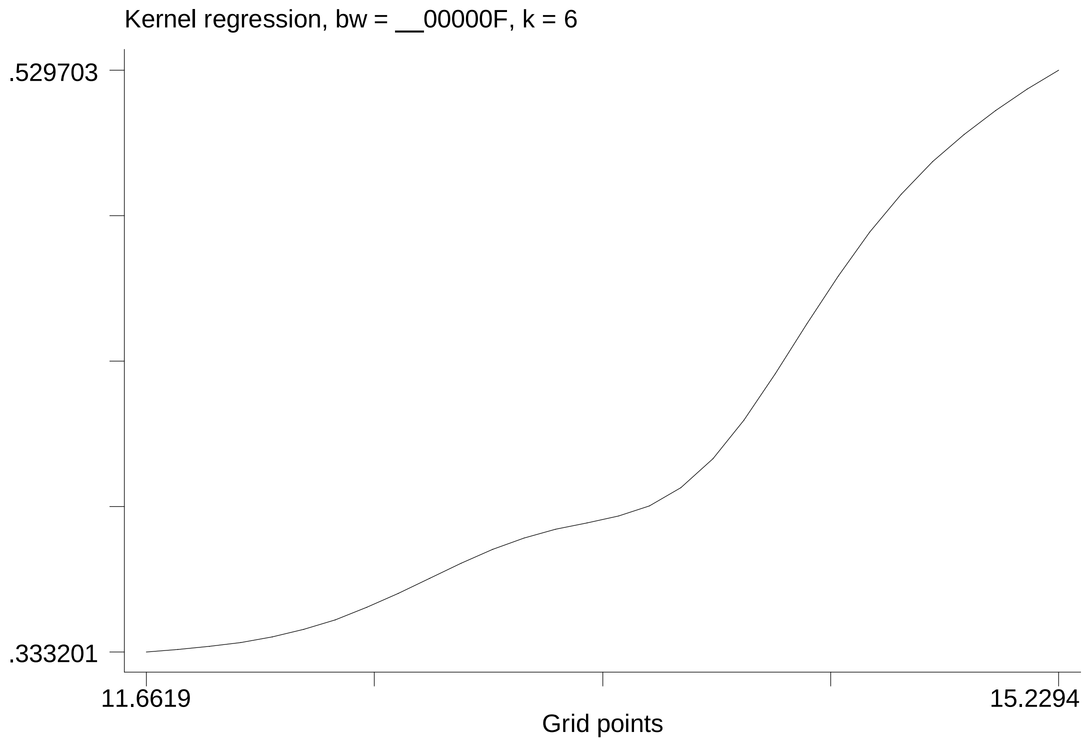
1. y = expenditure share for *saké*, x = log of total alcohol consumption expenditure



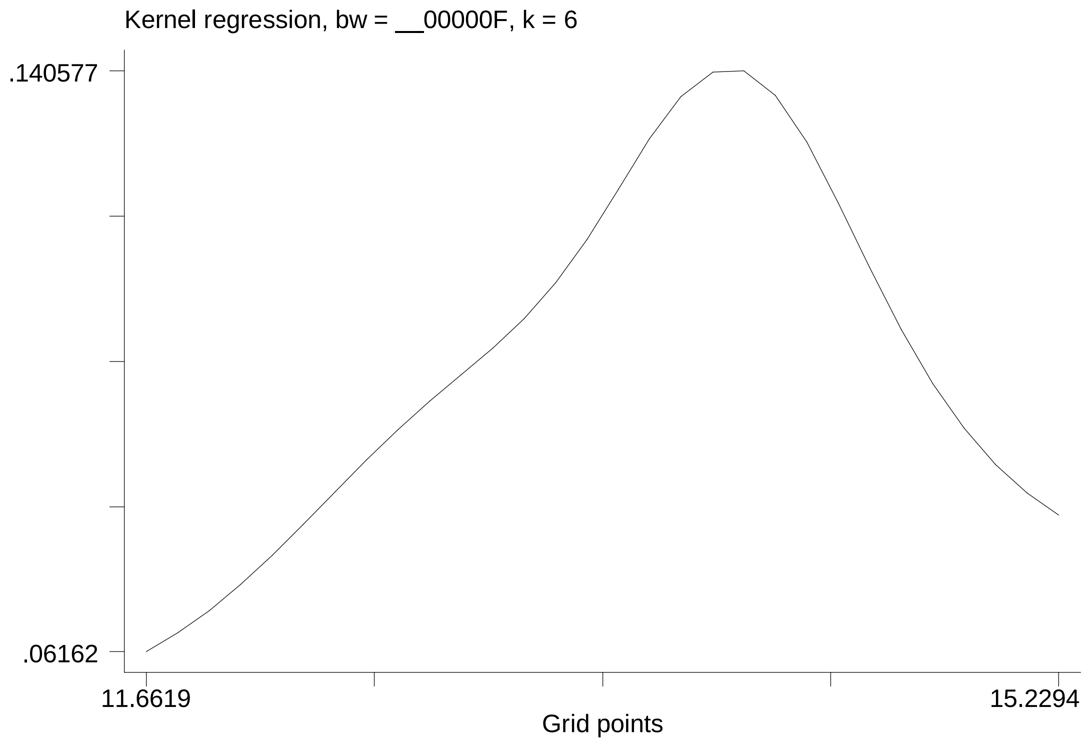
2. y = expenditure share for *shōchu*, x = log of total alcohol consumption expenditure



3. y = expenditure share for beer, x = log of total alcohol consumption expenditure



4. y = expenditure share for whisky, x = log of total alcohol consumption expenditure



5. y = expenditure share for wine, x = log of total alcohol consumption expenditure