The Impacts of Tax Policy on Alcoholic Beverage Sectors and Alcohol Demands in Japan

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Abstract

This paper examines the evolution of alcohol sectors and the impact of tax policies on these sectors, as well as the alcohol beverage demand systems in Japan, utilising the data from 1948 to 2011. With tax policy analyses, liquor tax policies are found to have exerted different impacts on productions and consumptions of different types of alcohols. Whilst sectoral growth and general economic performance in terms of final consumption expenditure per capita are found significant with major positive impacts, tax rates were found to have mixed impacts depending on the type of alcohol. The analyses suggest the possibility of preferential tax rates being beneficial for boosting sectoral performances for certain alcohols. The results from double-log and demand system equation estimations of five alcohols suggest that all alcohols are normal goods with positive expenditure elasticities except for *shōchu*. Although *shōchu* is also suggested to possibly be the safest taxable subject in Ramsey sense, the own-price elasticity estimates provide less coherent results, depending on the applied model.

Key Words: **liquor/alcohol tax, panel analysis, time-series analysis, AIDS, QUAIDS, dynamic AIDs, Japan**

JEL Classification: **H29, K34, N55**

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Introduction

In many countries, government policies have been playing major roles in alcoholic industry. The importance of liquor tax has been examined by numerous authors worldwide, mainly to investigate two issues: (1) its role in mitigating the adverse effects and social cost of alcoholic consumption, such as health problem and vehicle accidents (Cook and Moore, 2002; Chaloupka, Saffer and Grossman, 1993; Cook and Tauchen, 1982); (2) its role in raising the tax revenue for the government. These studies seem to give liquor tax sufficient justification for its existence and appropriate rate increase, although some studies cast doubt on the claimed effectiveness of tax (Kenkel, 1996; Mast et al. 1999). The liquor tax in Japan has always had its major footing on the tax revenue side.[1] Whatever the government intentions of taxing may be, whether liquor tax has any impact on the production and consumption of alcohols is a matter of concern, as it can suggest the possibility of liquor tax being an effective tool for different policy purposes. There are also views that excise tax, and especially that on things such as alcohols and tobacco is less distortionary. According to Ramsey (1927)'s optimal consumption tax which minimises welfare losses due to price distortions, tax rate should be inverse to the price elasticity of demand for the goods – thus, inelastically demanded goods should be taxed more heavily.[2] There are studies which suggest that the alcohol consumption is price inelastic, particularly for heavy drinkers, (Manning et al. 1995). On the other hand, there are studies suggesting that alcohols consumption responds well to the price change, with negative own-price elasticities varying in degrees depending on the alcohol type, as mentioned in Cook and

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[1] To mitigate adverse alcoholic effects, Japan has taken a path to administer other regulations, such as increased severity of punishment for drunk driving both in terms of criminal charges and social sanctions, rather than using tax as a tool. For instance, public servant can even lose his job from drunk driving alone, without causing any fatal accident, and restaurants and pub owners or personnel will be charged if they sell alcohol knowingly that the customer is driving back. There are few studies which estimated the social cost of alcohol-related problems in Japan, which show considerable costs to the society, although they used the base estimated figures from studies in the US that can shift the estimation results drastically (Nakamura et al., 1993; also see Kaji, 2013, for more information on various studies).

[2] According to Corlett and Hargue (1953/54), the ideal tax should impose excise tax on all goods including leisure, and that tax revenue can be raised by imposing higher tax rates on goods that are complementary to leisure. If we consider alcohols (and drinking) to be complementary to leisure and substitutes for labour, then higher liquor tax is warranted.

Moore (2002). Price elasticities are estimated to be quite different depending on alcohol types, among which beer typically has the lowest elasticities. For instance, a study by Clements et al. (1997) estimating demand systems for beer, wine and spirits with 30 years data for seven countries in Europe, Oceania and Northern America, found the average income and own-price elasticities the lowest for beer, 0.6 and -0.35, respectively. According to studies by Elder et al. (2010) who compiled past studies on the impacts of alcohol tax, the price elasticity of demand for alcohol, although measured in different ways, found a median elasticity of -0.50 for beer, -0.79 for spirits, and -0.64 for wine.[3] However, there are also studies showing variations in elasticity estimates. Eakins and Gallagher (2003), applying static and dynamic Almost Ideal Demand System (AIDS) models, estimate the own-price elasticity of beer to be -0.42~-0.77 depending on the applied model, while that of spirits and wine are -0.68~0.84 and -0.36~-1.59, respectively. They also compiled 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) for the analysis of beer, wine and brandies in Cyprus, found in one of the estimation models beer to be price-elastic with statistically significance while others were not. Obviously, the estimates can vary with data, estimated demand functions and the formula for calculating elasticities. The estimation of elasticities has been and still is an important topic as it can suggest policy directions.

In Japan, the alcoholic industry used to be one of the major contributors to the tax revenue. Japanese government has executed several significant legal changes regarding alcohol production and consumption, including the tax rates. There are yet few studies on the impact of liquor tax. One study, which the author is aware of, estimate the price elasticity of *saké* as 0.58, *shōchu* as -0.15, beer as -0.63, whisky as -0.35, and low-malt beer, referred here as fizzy drinks, as 0.61 (Takahashi et al. 2009), although the method taken is rather ad hoc, in the sense that they calculated elasticities based on the differences in consumed quantities of goods at the currently prevailing prices and the

[3] No standard errors (SE) or statistical significance for the elasticity estimates are provided by these studies (Clements et al., 1997; Elder et al, 2010; Eakins and Gallagher, 2003).

hypothetical prices excluding the liquor tax.[4] Another paper which investigates income and price elasticity of wine with double-log and Bayesian Age-Period-Cohort models, along with the determinants of wine consumption, gives the elasticities of -4.02 and -0.57, and of -0.001 and -0.798, for income and price elasticities respectively, although none had statistical significance (Mori et al. 2012).

In this paper, we examine the evolution of alcohol sectors and the impact of tax policies on these sectors, as well as the alcohol beverage demand systems in Japan, utilising the data from 1948 to 2011. Firstly, we look at the production and consumption trends of alcohols, then we provide a brief overview of the liquor tax system in Japan. An empirical model for analysing the impacts of tax is presented, followed by the estimation results, where estimations are conducted for the panels of different alcohols and for each alcohol type. We then estimate income (expenditure) and price elasticities of demand applying the double-logarithm (log-log) model, the AIDS model and its several variants, which includes household characteristics, quadratic AIDS (QAIDS) and DAIDS.

Production and Consumption Trends of Alcoholic Beverages

Japan has seen different evolutionary paths for different types of alcoholic beverages since the end of the World War II (WWII). Government policies have had significant influences on the conduct of alcoholic industry, as it was one of the major sources of tax revenue for the government for a long time. In particular, *saké* industry has been greatly affected, because that was the major alcohol consumed by the general public before the WWII, and because rice, from which *saké* is made, has been and still is the main staple food of Japan. During the late 1950s to the 1970s, Japan experienced a rapid economic growth as well as increasing westernisation of food and beverages. Western alcoholic beverages such as beer, whisky and wine were on their increasing demand, particularly since the 1970's, and combined with the prevalence of low-quality *saké* originating from the

[4] Positive and negative signs are added by the author from their results table, since they did not specify them in their results. No SE is provided.

war-time shortage of rice, the upsurge of other alcoholic beverages were inevitable.

As we can see in Graph1, *saké* production and consumption are clearly decreasing after the oil shock in 1974, although it seems to be stabilising in recent years. In this graph, the production trend of *saké* is shown together with the taxed quantity of *saké*, since the produced quantity is measured in its higher alcohol content of approximately 18~21º and while it is taxed in diluted quantity at around 15º, the degree in which it is normally sold and consumed.[5] The excess of taxed quantity of *saké* to the produced quantity has largely been increasing since the oil shock up until the early 1990's. This may suggest that *saké* was increasingly diluted, perhaps due to a more efficient method of creating raw *saké* with higher alcoholic content and/or due to an increasing demand for lower alcoholic-content beverages, as highlighted by the sharp growth of beer, liquor and fizzy drinks. The subsequent continuous decrease in the discrepancies between produced and taxed *saké* may suggest the shift in the structure of *saké* types produced and demanded – the high quality *saké, ginjoshu*, generally need not be diluted as it has alcohol content of around 15.5º in its raw form.

Shōchu, a Japanese spirit has much higher alcoholic contents compared to *saké* or wine, but are generally taken in a diluted from. There are two types of *shōchu*: (1) *kō-rui shōchu* which contains alcohol of less than 36º and is generally mass-produced by continuous- distillation method using unrefined *saké* called *moromi*; (2) *otsu-rui shōchu* which contains alcohol of less than 45º and is produced by single-distillation method using natural grains and potato. There are several kinds of *otsu-rui shōchu*, made from either rice, wheat, buckwheat, foxtail millet, sweet potato, potato, chesnut, or brown sugar of *Amami* Islands, and they usually have distinct aroma. Many of these *otsu-rui shōchu* are allowed to use a label of authentic (*honkakuha*) *shōchu*, if they meet the standards set by the government in 2002. *Shōchu* has traditionally been regarded as a cheap ethanol popular amongst the labour class, and authentic *shōchu* with strong aroma were mostly consumed only within the region. Nonetheless, the improvement of distillation technology, together with the

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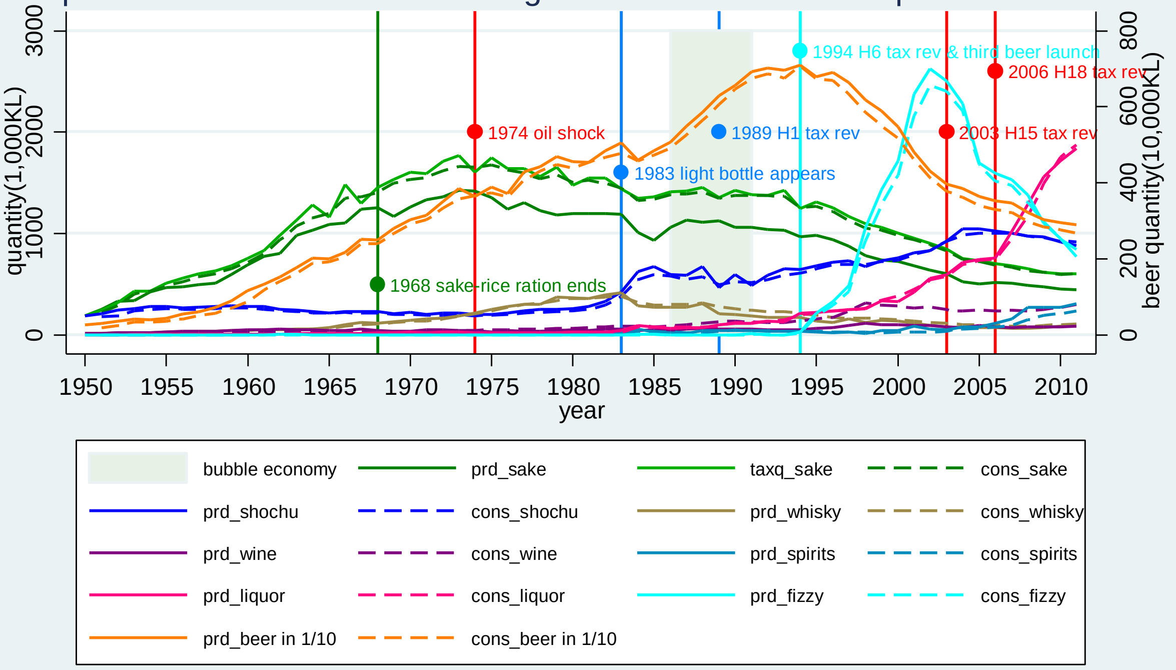
[5] The information based on a personal communication with the National Tax Agency staff, although there is also information that raw normal sake has alcohol content of around 22~23.º

legal labelling of authenticity raised the branding value of these quality *otsu-rui shōchu* nationwide, leading to the *shōchu* boom around 2003-2005 consumer seeking rare brands.[6]

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)

Fizzy and liquor drinks both include different types of the *second beer* (low-malt beer) and *third beer* (non-malt beer), which is made with ingredients other than malts such as maize and beans using different methods. Japanese categorisation of "liquor" includes various sweet/sour cocktails and *shōchu* cocktail.[7] The rapid growth of liquor and fizzy drinks started in 1994 when Suntory, one of the largest liquor companies in Japan, has launched the first successful *second beer*, which was also called as tax-saving beer. The trend of *second beer* was followed by a rapid development of various

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[6] Other factors for this *shōchu* boom were heath and women – that shōchu was regarded as healthy alcohol with low calorie, and was accepted by women who are a new consumer group (*Nippon Keizai Shimbun (Kyushu Regional Edition)*, 20 August 2004, p.14). The previous *shōchu* boom with a peak in 1985 was mainly led by the *kōrui-shōchu* (Development Bank of Japan, 2003).

[7] Note also that categorisation of wine also includes wine-like beverages made from other fruits, whisky includes both whisky and brandy, and spirits includes gin, vodka, rum, as well as distilled alcohol.

kinds of 'new genre beer.' The time was right after the complete burst of the Bubble Economy when bon-marché was gaining significance in daily life of people in Japan.[8] The prices of these beer-like drinks have been typically around two-thirds to half of the price of beer, reflecting the lower tax rate.[9] Looking at Graph1, it seems that *H6 Tax Revision* in 1994 which coincided the launch of the new genre beer (categorised in either fizzy or liquor) has shifted the trend in beer downwards. It looks as if beer was taken over by fizzy, then by liquor. The *H15 Tax Revision* of 2003 seems to have shifted the fizzy trend downwards, while increasing the trend for liquor, which appears to be even accelerated by the *H18 Tax Revision* of 2006 that reduced the corresponding tax rate by 40% (see footnote 6).

Saké, *shōchu* in diluted form, and wine, which are all typically taken with meals, can be distinguished from beer, liquor and fizzy drinks due to its mid-range alcoholic content. As we cannot see the trends for wine in Graph1 due to its relatively low quantity, we present *saké*, *shōchu* and wine production and consumption separately in Graph2. Unlike *saké*, there is an increasing trend of *shōchu*, as Japan experienced an authentic *shōchu* boom around 2003-2005 that boosted consumption and shed lights on various kinds of *shōchu*. Nonetheless, its increasing trend seems to have halted after the boom. Compared to *saké* and *shōchu*, we see much lower quantity of wine production and consumption in the left panel of Graph2. If we look at the log production/consumption in the right panel, however, wine shows even more rapid increase in its trends compared to *shōchu*, although its growth has also somewhat stabilised after the 1998 polyphenol boom when red wine was particularly sought after.

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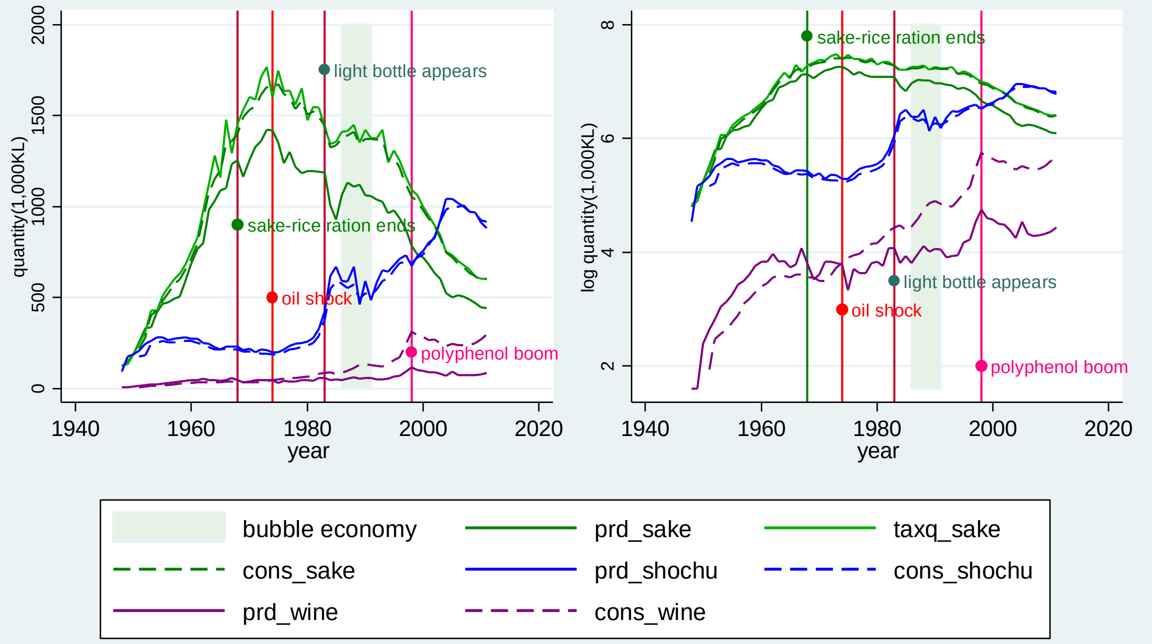
[8] Japan experienced a period of economic bubble, mainly from the end of 1986 to 1991, due to real estate and stock exchange speculations.

[9] For a typical size of beer (350ml), the tax were (1) ¥77.7 for beer and fizzy drink with malts content of 50% or more, (2) ¥53.4 for fizzy drink with 25-50% of malts, and (3) ¥36.8 for fizzy drink with 0-25% malts. The 2003 revision has extended (1) to include fizzy drink with 50% or more of malts and wheat, increased the tax of (2) and (3) by ¥8.9 and ¥10.2, and also newly imposed tax of ¥47 onto (4) other fizzy drinks. The 2006 tax has decreased the tax of (4) by ¥19 (National Tax Agency 2003, 2006).

Graph2. Selected Alcoholic Beverage Production & Consumption
(in 1,000KL & log): 1948-2011



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).
Data Source: Japan National Tax Agency (2013)

A Brief Overview of the Liquor Tax[10]

In this section, we briefly review the evolution of the liquor tax which saw several major changes in recent decades, a summary of which is provided in Table1. Currently, there are mainly ten types of alcohols 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, (10) other alcohols. The evolution of liquor specific (volume-based) tax is shown in Graph3. The provided liquor specific tax rate is the base rate for each category, and the actual tax rate is increased according to the ethanol content above the base degree.[11]

The liquor tax has a long history and numerous changes since 1872. The existing tax law was

[10] The information here is based on the liquor tax evolution table (1950-2006) available at the National Tax Agency.

[11] Currently, a one degree increase in alcohol content above the standard is levied an additional JPY10,000 or JPY11,000 for *shōchu*, whisky, spirits. Note that there are still sub-categories of tax rate for (9) fizzy and (10) other alcohols.

created in 1953 (*S28*), with significant revision in 1962 (*S37*) establishing the base for the current tax structure (Japan Cabinet Office, 2000).[12] In this revision of 1962, the new system of ad valorem tax was adopted for expensive alcohols, along with the volume-based specific tax for other types of alcohols. Also, the recategorisation of types took place and the self-assessment tax system commenced. The general tendency of liquor tax was such that higher tax rate was applied to expensive alcohols. For *saké*, the government set up a revised class system in 1964 (*S39*), consisting with special-class, first-class and second-class, and started to levy tax on the special-class *saké* two years later. The system of levying different tax rates to different classes of *saké* had actually started earlier in 1943 (*S18*) and existed until 1992 (*H4*), when the unified tax rate system for *saké* commenced.[13] Similarly, there were complicated ad valorem tax systems for expensive wines and simple specific tax for other wines. The ad valorem tax for wine was abandoned and tax rate was unified in 1989 (*H1*). The specific tax rate in nominal terms was largely reduced during the 1950s, until the trend is reversed to increasing rate in 1968 for most alcohol types. The specific tax was then increased in several stages, until the legal revision of April 1989 (*H1*) which saw a significant decrease in tax rate for wine, whisky, beer, and the first-class *saké*, with the abolishment of special-*saké* classification as well as the class-system for wine and whisky.[14] On the other hand, tax rates for *shōchu*, which was considerably lower than other spirits, such as whisky and brandy, never reversed its increasing tax trend up to present.[15] The tax rate for wine which has also been comparatively lower compared to *saké* or synthetic *saké*, also reverted to increasing rate in 2003. The definition of fizzy drinks was significantly modified in 1994, and the rates were increased twice

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

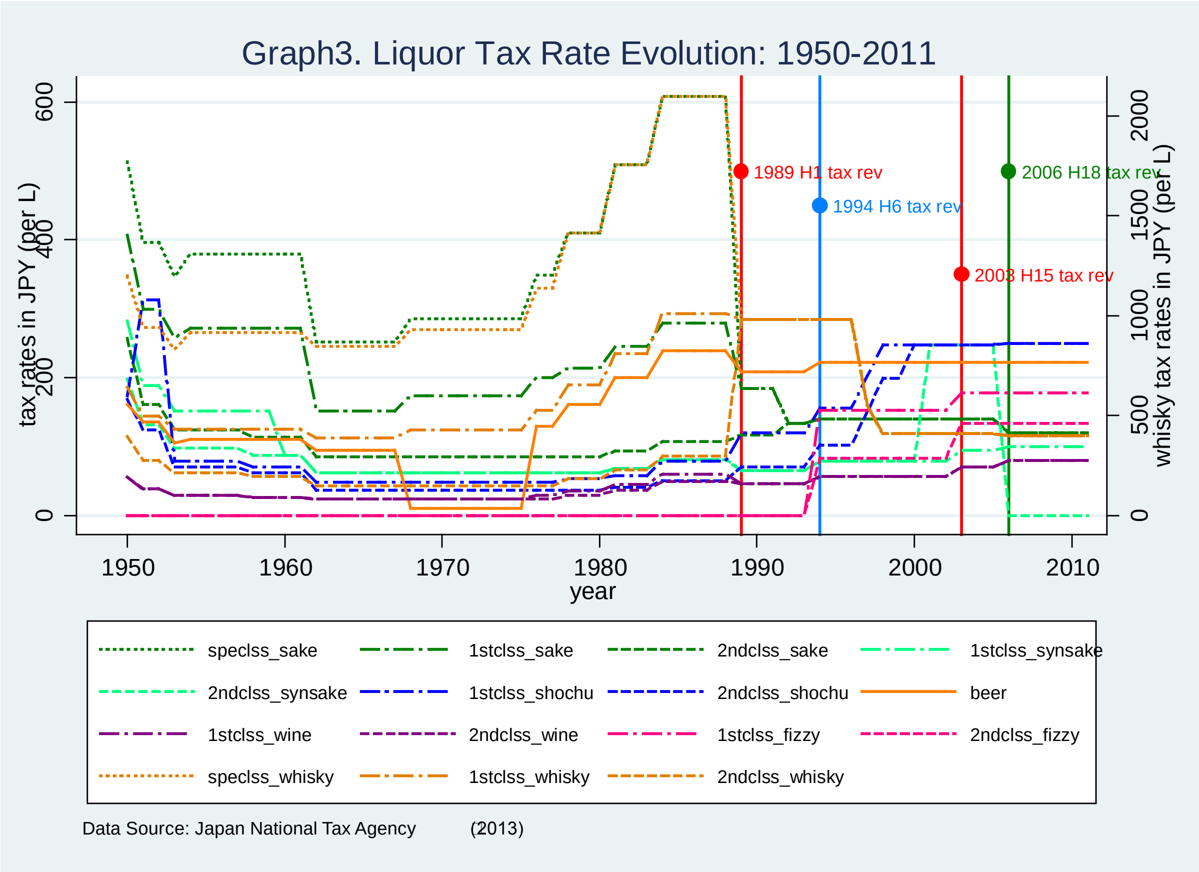
[13] At one point in time (1958-1962), there were four classes of *saké*, including quasi-first class. The special-class was abolished in 1989, three years earlier than the abolition of all *saké* classes.

[14] Along with the liquor tax, we should note that April 1989 marked a significant environmental change that the very first consumption tax was introduced in Japan at 3%. The consumption tax was increased to 5% in 1997.

[15] The increased tax rate for *shōchu* was induced by international pressure, as the alcohol exporting countries filed a complaint to GATT/ WTO as Japanese Liquor Tax system was essentially a tariff barrier against the iported spirits (*WANDS*, 1996; National Tax Agency, 2013).

since then.

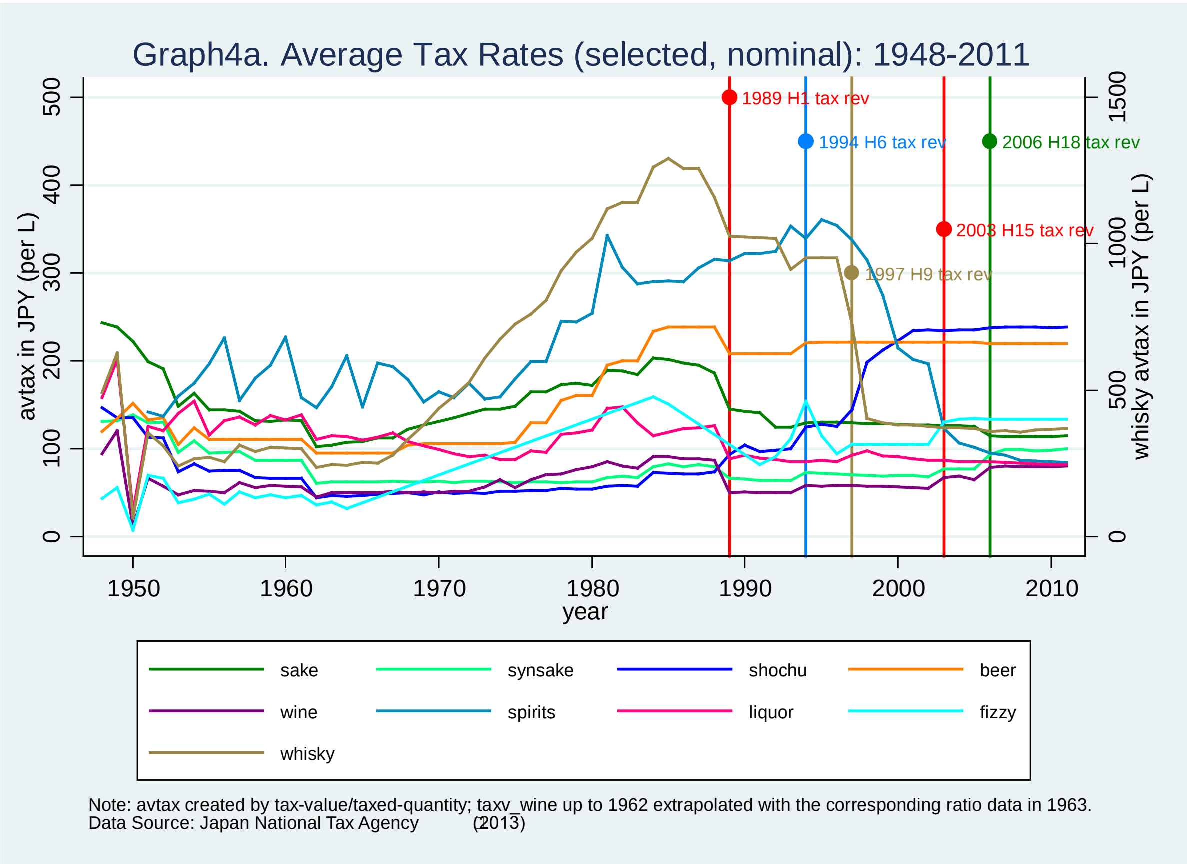
[Table1]

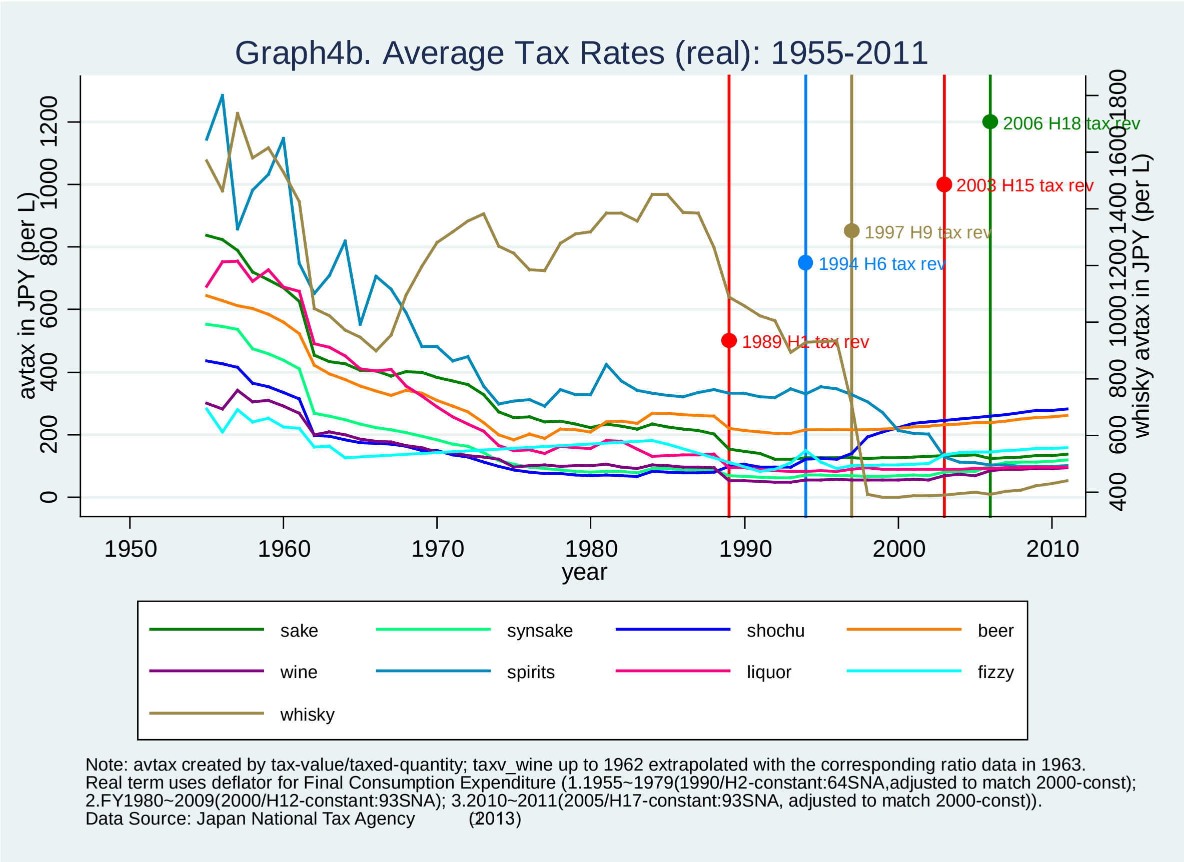


Thus, the differential tax rates for the same alcohol type continued for *saké*, synthetic *saké*, wine and whisky, until all class system was abrogated by the tax revision of May 2006, as shown in Graph3. The sole exception was *shōchu*, where the distinction was not ordered by class or rank but by its production method and ingredients; single-distilled *otsu-rui shōchu* had a lower tax rate, while continuous-distilled *kō-rui shōchu* had higher tax rate, until tax rates were unified in 2000 (*H12*).[16] The actual amount of tax levied for each alcohol type-class is fairly complicated, since it depends on the actual ethanol contents, and there have been different rules and exemptions on the applicable tax rates. Given also that we do not have data on class-wise production and consumption for each

[16] Note that in Graph3 & 5, we denoted higher tax rate of *shōchu*, *kō-rui*, as the first-class and *otsu-rui* as the second-class merely based on their tax rates. *Shōchu*'s tax rate is for the base rate of 25º alcohol level.

alcoholic beverage, we use average tax rate per alcohol type which is derived by dividing the aggregated taxed value per type by taxed quantity per type, in order to analyse the impact of tax policy. The aggregated tax value includes ad valorem tax and specific tax. In Graph4a and Graph4b, we see average tax rates of all major beverage types in nominal terms and real terms, respectively. The average tax rates in real terms have largely decreasing trends, except for whisky which had a large bump in the middle, around 1970~1990. Although the tax rate is highest for whisky per kilolitre, it is the highest for beer in terms of 1° of alcohol, and in terms of tax proportion to average commodity price (Table2). By far the lowest tax rate in all aspects is that for wine. Recent tax revisions have especially attempted to make the tax burden more equitable across different alcohol types.

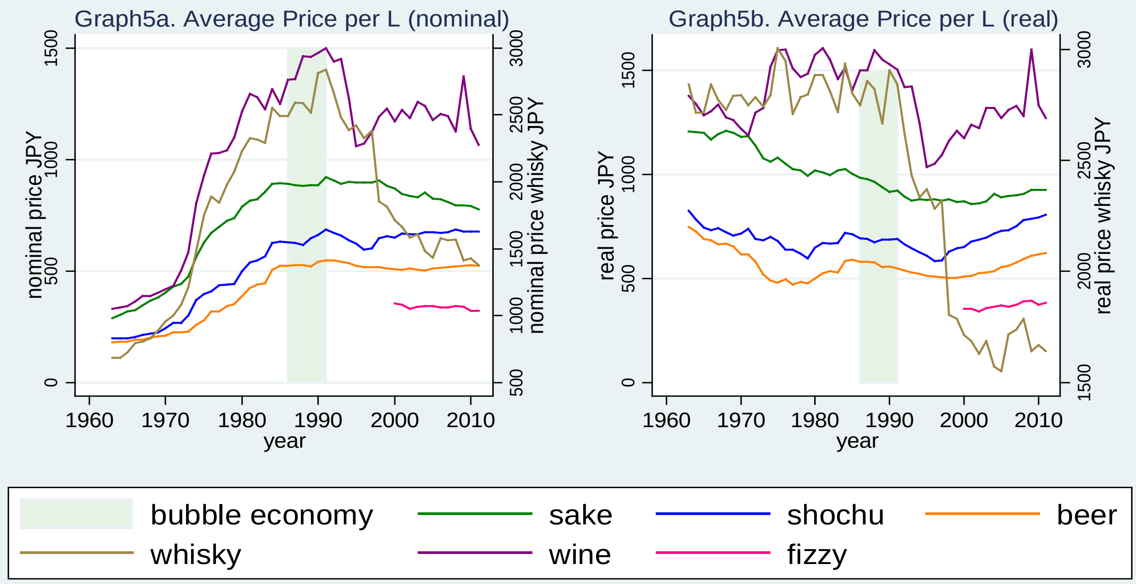




[Table2]

Reviewing the price and tax-price ratio for *saké*, *shōchu*, beer, whisky and wine, for which we have the data, generally speaking, nominal prices are increasing with the economic development, while real prices are decreasing for most alcohols. In the left panel of Graph5, Graph5a, we find moderately concave trends for *saké*, *shōchu* and beer, and more acute concave curves for whisky and wine, hitting the highest prices around the time of Bubble Economy (around 1986-1991). In the right panel, Graph5b showing prices in real terms, we have slight convex function for *saké*, *shōchu* and beer, yet more acute movement for wine and whisky. During the Bubble Economy, expensive commodities were sought after, and the observed trends for whisky and wine are considered to reflect the increased import of high priced items. While the price of whisky was fairly constantly decreasing after the Bubble's burst, until 2005, the price of wine did not decrease as much, but reverted to its increasing trends (in real terms) around the mid-1990s, hitting the polyphenol boom of

1997-98.

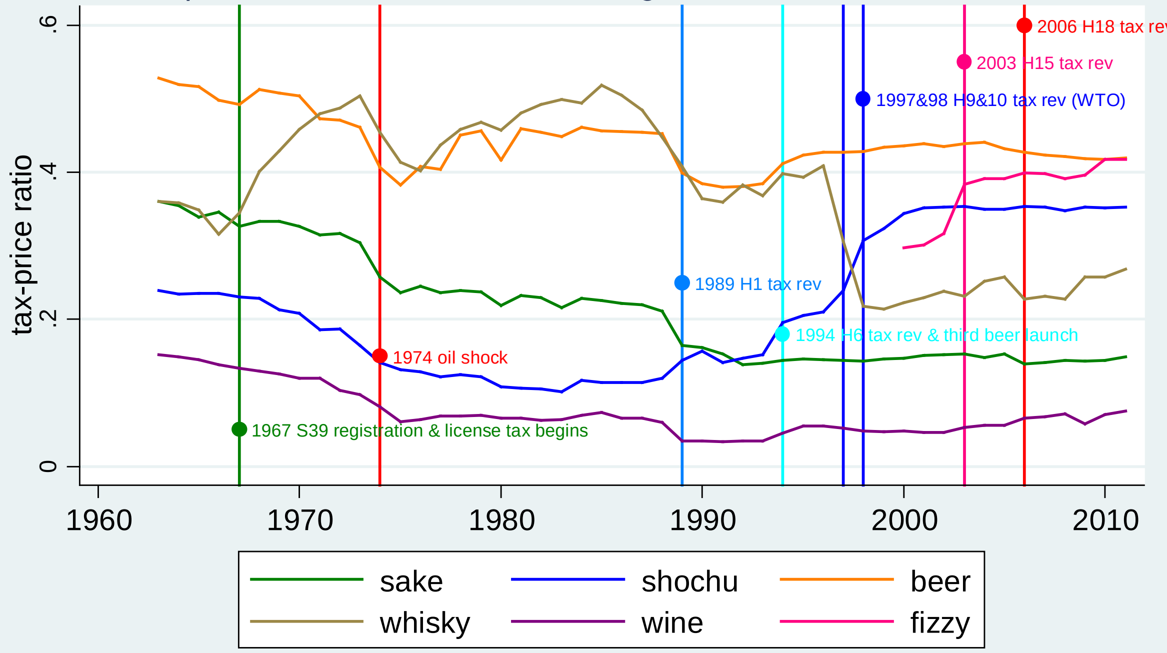


Graph5. Selected Alcoholic Beverage Average Price per L: 1963-2011 (nominal and real)

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)

As for the liquor tax-price ratio shown in Graph6, there are several features to be noticed. Most tax-price ratios are relatively stable or slightly decreasing except for *shōchu* and whisky. For *shōchu*, its tax rate was raised considerably in 1997 and 1998 (H9 and H10) due to criticisms by other countries that its tax rate remained too low in comparison to other spirits such as whisky or brandy (see footnote14). For whisky, we see a steep increase in the ratio during the mid-1960s, then a steep decrease in the mid-1990s, both due to tax revisions. We see two particularly high tax-price ratios, whisky and beer. Whilst higher tax ratio for whisky is not unusual since it is generally viewed as a luxurious item, beer is often considered to be a less expensive alcohol consumed by wider population, thus with relatively low rate of tax vis-à-vis its value. Japan's having a high tax ratio for beer originates from an outdated view from the pre-war period, recognising beer as a luxurious imported commodity. In addition, the fact that beer is produced by large companies makes the collection of liquor tax easier for the government, and as such, voluntary tax rate reduction may not be easily foreseeable. Indeed, beer has been having the highest tax-price ratio for most of periods.

Graph6. 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 Impacts of Tax Policy

As we have seen, government policy appears to have significant influence on the supply and demand of alcoholic beverages. We therefore attempt to estimate likely impacts of tax policy on production and consumption of different types of alcohols. We set three dependent variables, taxed quantity (*taxq*), consumption (*cons*), and domestic taxed quantity ($taxq_{dome}$).[17] Taxed quantity (*taxq*) of each type of alcohol is used instead of produced quantity. The *taxq* figures are highly similar to the produced quantity for most alcohols, yet due to complicated system of measuring production and evolving regulations, taxed quantity more accurately reflects the quantity traded in the market.[18] In

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

[18] While produced and taxed quantities are highly similar for most type of alcohols, with correlation coefficients of above 0.99, or above 0.98 (even for *saké*, synthetic *saké* and spirits), there is certain divergence for wine with correlation coefficient of 0.9523. In addition to the divergence between produced and taxed quantity for *saké*

order to understand the impacts of tax policy on domestic producers, we have $taxq_{dome}$ as one of the dependent variable, yet we currently have data available for shorter period, only since 1980.[19] Therefore, the estimated results will be reflecting more recent trends.

With ten types of alcohols, (1) *saké*, (2) synthetic *saké*, (3) *shōchu*, (4) beer, (5) whisky and brandy, (6) wine, (7) spirits, (8) liquor, (9) fizzy drinks, (10) other alcohols, we conduct panel estimation for all types as well as for several types together, as categorising them into similar types may elucidate certain policy impacts. Time-series estimations are also conducted for each type of alcohol separately. A summary table of variables is provided in Table 2.

Although ideally, we should include tax rates corresponding to classes or categorisation within the type as an independent variable, we do not have quantity data for each class to enable the class-wise analysis. Also, the fact that tax rates vary with its produced alcoholic contents within each class for some alcohol types means that products within the same class can be levied different amounts of tax. Moreover, the taxing method using the base degree plus the excess degree of alcoholic content also means that tax rate per 1º of ethanol may not necessarily be the same even for the same type of alcohol. Hence, we utilise an averaged tax rate (*avtax*) across classes within each type as a proxy variable for tax policy, derived by dividing the taxed-value by taxed quantity of each type. We see in Graph5 that average tax rates lie mostly between the first- and second-class specific tax rates for *saké* and *shōchu* for the period during which multiple classes were present, although it is above the standard specific tax rate for wine. This is due to the presence of ad valorem tax, which was present until 1989.[20] The ad valorem tax was applied mainly to high valued, imported wine, whisky and

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describe earlier, there are also such divergence for wine. According to a personal communication with the National Tax Agency officials in 2013, such divergence is considered to be mainly due to the utilisation of imported grape juice concentrate, which is not necessarily counted in production figure. It can also be due to the time lag between production and taxation time.

[19] For most alcohol types, the proportion of imported alcohols is not very large, except for wine and whisky. Wine has the highest share of imports, and it has been constantly increasing, accounting for more than 50% of wine consumption since 1994. For whisky, the proportion has been around 20%, yet on its continuously decreasing trend.

[20] The abolition of ad valorem tax in effect can be viewed to have been replaced by the sales tax introduced in the same year. The sales tax is applicable to all commodities in principle, started at 3% in 1989 (*H1*) and subsequently

brandy, although we have no available detailed information on this tax system. In this regard, even the average tax figure may not serve as a good proxy for tax policy for the period before 1989 for these items. We also utilise the tax-price ratio (*taxratio*) for each alcohol type, which is calculated as a ratio of average real tax value per litre to price per litre, with data from household consumption expenditure records available since 1963.[21]

The tax revisions especially since 1989 is said to have been aiming to achieve "neutrality, simplicity and fairness" of tax across different alcohol types (Japan Cabinet Office, 2000). As such, if liquor tax policy has historically been used as a revenue generating tool by the government, we might suspect that tax policy has been influenced by the market performance such as sectoral growth, rendering the latter endogenous to the tax system, although not contemporaneously. To avoid the possible endogeneity problem arising from an omitted variable problem, such as the prospect of sectoral growth viewed by the National Tax Agency, we include a variable, growth rate of tax value in a 3-year moving average form ($\Delta lnMA(3)\_taxv_i$). Additionally, we consider final consumption expenditure per capita (*fcepc*) to capture the general economic growth, and several dummies to capture the booms and other significant situational change.

With a panel data set, we would estimate the error-component models with fixed-effects or random-effects, decomposing the error term u_{it} into v_i, type-specific error, and e_{it} that affects observation *it*. Nonetheless, the error terms are found to be either or both serially correlated and/or heteroskedastistic for all the estimation models.[22] Therefore, we conduct estimations with feasible generalised least squares (FGLS) estimator allowing for panel-specific autocorrelation and heteroskedasticity across panels. We estimate the following basic model with/without some

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increased to 5% in 1997. In line with the argument of Chetty et al. (2009), the impact of sales tax may have been smaller than that of price increase because sales tax was not included in the price tag in the beginning. The inclusive sales tax, 'salient tax' rule was introduced in 2004 (*H16*), after 15 years.

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

[22] We applied serial correlation test suggested by Drukker (2003) and Wooldridge (2002), and a likelihood-ratio test for heteroskedasticity.

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

where IND_{it} is either of: $lntaxq_{it}$, $lncons_{it}$, and $lntaxq\_dome_{it}$

The three dependent variables for which we conduct estimations, $lntaxq_i$ is log of taxed quantity (*taxq*), $lncons_i$ is log of consumption (*cons*), and $lntaxq\_dome_i$ is log of taxed quantity of domestic produces ($taxq_{dome}$), for alcohol type *i*. For independent variables, $lnavtax_i$ (*avtax*) is the average real tax rate for *i*, $\Delta lnMA(3)\_taxv_i$ (*grw_taxv*), is a growth rate of three-year moving average of taxed value, $taxratio_i$ is the proportion of tax to the price of alcohol, $lnfcepc_t$ (*fcepc*) is log of real financial consumption expenditure per capita, $\mathbf{D_{taxchng}}$ is a vector of dummy variables denoting the period of important tax changes, *S37* (1962-1988), *H1* (1989-1993), *H6* (1994-211), *H5* (2003-2011) and *H18* (2006), and $\mathbf{D_{boom}}$ is a vector of dummy variables for important events, namely, the red-wine polyphenol boom (1997-1998) and the *shōchu* boom (2003-2005).

Given the fact that different types of alcohol may have different reaction to policy changes, we also conduct estimations using groups of similar alcohols. Thus, estimations are conducted for the following groups: (G0) *all alcoholic types*; (G1) *dinner alcohol* (*saké*, synthetic *saké*, *shōchu*, wine with about 12~15º of alcohol), where *shōchu* is normally taken in diluted form; (G2) *hard liquor* (*shōchu*, spirits, whisky, with about 25~50º of alcohol); (G3) *light alcohol* (beer, fizzy, liquor with about 5º of alcohol). Additionally, we conduct time-series estimation for each alcohol type, with an autoregressive moving-average (ARMA) model with maximum likelihood estimator, which allows for autocorrelated dependent variable (the AR component) as well as autocorrelated random disturbances (the MA component), both of which is set as order of one.[23] Thus the disturbance structure is: $u_t = \rho u_{t-1} + \varepsilon_t + \theta\varepsilon_{t-1}$.

[23] Since we do not have much theoretical suggestion in determining the appropriate number of lags for wine consumption, we made use of the correlogram, ran model with higher lags and check their significance, and made use of several information criteria, such as the Schwarz's Bayesian information criterion (SBIC), the Akaike's information criterion (AIC) and the Hannan and Quinn information criterion (HQIC).

Estimation Results: Impact of Tax Policy

The estimation results are presented in Table3~6 for each groups, G0 to G3. Note that the estimation results in the first column of each table, model (1), exhibited a sign of multicollinearity with relatively high variance inflation factors of above 10, but are presented here as they are generally comparable with other model results.

For G0, all alcohol types, we have significant positive impact of sectoral growth (*grw_taxv*), tax – price ratio (*taxratio*) and final consumption expenditure per capita (*fcepc*) on production (*taxq*) and consumption, while we find significant negative impact of average tax rate (*avtax*), all at the 1% significance level. The findings are robust across different estimation models. The positive significant impact of tax-price ratio seems to be coherent with the fact of beer, who has the highest tax-price ratio, being dominant in the market. For domestic production, for which data availability is limited to the past 20 years, the impact of sectoral growth is found to be negative at the 1% significance level. This finding seems to be matching with the fact that the period mostly coincides with the long recession period after the Bubble Economy. In a few estimations, we found evidences for tax change dummy variables being significant, although the findings are not robust. This possibly suggests that different law change had impacts in different directions for different types of alcohols, rather than having a unified impact across types.

For the sub-groups of alcohols (G1~G3), significant positive impacts of sectoral growth and final consumption per capita on production and consumption are generally detected, although the significance of sectoral growth is not seen for consumption in G3. The magnitude of impact of sectoral growth is consistently greater for production than for consumption in all estimations. The negative impact of tax rate is found to be robust in G2 production and consumption, although it is found only in some of the estimation models in G1 production, and none in G3. Therefore, tax rate seems to exert fairly different impacts on different types of alcohol. Tax-price ratio is found to be robustly significant only in G1 production, with positive impacts. The positive significant impact of tax ratio may imply that cheaper ranges of alcohols within the same type are more present in the market. Note that *taxratio* is not included in the estimation for G3, since the data was available only for beer in this group. Several tax change dummies are found to be significant and robust. Particularly for G1, *S37tax*, *H1tax* are found to have significant positive impacts on production and consumption, although *H15tax* is found to have negative impact on domestic production. The first two tax revisions characterise major reduction in liquor taxes for most alcohol types, while the last one increased the tax for synthetic *saké* and wine. There is limited evidence that booms had any significant impact across different alcohol types.

[Table3~6]

The results of ARMA estimation for each alcohol type are provided in Table7. Possible heteroskedasticity is also taken into account by using the Huber/White/sandwich estimator for standard error (SE) calculations. Two estimation results are presented here for production and consumption of each type, one with tax rate (*avtax*) and one with final expenditure per capita (*fcepc*). We estimated with either of these independent variables because they exhibited extremely high multicollinearity in these estimations. The results of estimations with *taxratio* are not presented here as it was not found significant in any of the estimations, except for AR(1) estimation for wine production, where *taxratio* had a negative coefficient of -0.237 with 5% significance. We present the results of ARMA whenever MA component is found significant and AR results otherwise. Both specifications produced similar results. From Table7, we can see that sectoral performance has significant positive impacts on both production and consumption, except for one of *shōchu* consumption and whisky production estimations. Similar to the panel estimations, the magnitude of sectoral growth impact is higher for production, and is particularly high for *saké,* beer and wine. The impact of tax rate is found significant and negative in *saké* production and consumption, beer production and consumption, and wine production, while the effect is found significant and positive in one of *shōchu* consumption estimation. This finding for *shōchu* seems strange yet we see from the graphs that its tax rate was increased considerably during the 1990s (Graph3), yet both production and consumption increased during this period (Graph2). Given the historically low tax rate of *shōchu*, rate increase itself may not have affected the consumption of *shōchu*, and it is still the cheapest way to obtain ethanol (see Table2). Tax rate is estimated to have no significant impact on *shōchu* production, whisky production and consumption, and wine consumption. Final consumption per capita is found to be positive significant for all production and consumption, except for *shōchu*, and the magnitudes are particularly high for beer. Beer production and consumption, both of which are the top in terms of quantities, indeed seem to correspond well with the general economic performance (Graph1). The non-significance of *fcepc* for *shōchu* suggest a possibility of *shōchu* being an inferior good, whose major boom and price increase happened after the Bubble's burst. We find positive significant impact of *S37tax* (major tax reduction) for *saké* and whisky productions. We see significant negative effect of *H1tax* of 1989 for *shōchu*, reducing production by approximately 36%. As a matter of fact, *shōchu* was the only alcohol whose tax rate was increased then, and significantly so, by 30% and 44% in nominal terms (as aforementioned, there are two kinds of *shōchu*), while all other alcohols enjoyed either reduction or no change in tax rate. As for *H6tax* of 1994, which increased tax rate for *saké*, synthetic *saké*, *shōchu*, beer, wine, significant negative coefficient is estimated for *saké* consumption, *shōchu* production and consumption, as well as whisky consumption. Finally, we see significant positive effect of polyphenol boom for wine, both in production and consumption, with magnitudes of 16~21% increase.

The estimation results from panel and time-series analyses suggest that tax policies had impacts in different directions for different types of alcohols, rather than having a unified impact across types, indicating a possibility of preferential tax rates being beneficial for boosting sectoral performances for certain alcohols. Differential impacts of economic growth, tax rates and tax-price ratio suggest that the income and price elasticities of demand are likely to differ amongst different types of alcohols, which we shall consider in detail in the next section.

[Table 7]

Expenditure Elasticity and Price Elasticity of Demand

Estimation results from the previous section suggest that tax policy has significant impacts on production and consumption of alcoholic beverages in general. At the same time, differing impacts of economic growth, tax rates and tax-price ratio suggest that income and price elasticities of demand likely vary with alcohol types. As liquor tax as well as sales tax is currently invisible to consumers, being already inclusive in the price of alcohols, we investigate the impact of price change on alcohol expenditures.[24] As Ramsey (1927)'s theory of optimal consumption tax suggests that welfare loss is minimised if tax rate is set higher for inelastically demanded goods, we estimate expenditure and price elasticities of demand for alcoholic beverages applying double-log model and the AIDS model, after Deaton and Muellbauer (1980)'s, and its variants, namely, AIDS with demographic characteristics, QUAIDS and DAIDS. We utilise annual household expenditure data available for 1963-2011.

The Double-Log Estimation

For elasticity estimation, we first calculate expenditure and constant price elasticity of demand in a log-log multiplicative form, $q_{it} = \alpha \cdot X_t^{\beta_1} p_t^{\beta_2} \cdot e^{\gamma_1 t}$, translated into a 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 estimable equation is:

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

where *lnq* stands for log of quantity purchased in ml, *lnX* is log of total household consumption expenditure, as a proxy of income, *lnp* is log of average real price of the goods derived by the actual expended amount divided by the quantity, *t* takes into account time effects. The estimated coefficient

[24] Note however, that historical tax rates have not necessarily been translated well into the price of alcohols for some items. For available data between 1963 and 2011, partial correlations between tax rate and real average price for *saké*, *shōchu*, beer, whisky and wine are: 0.358, 0.697, 0.980, 0.871, and 0.498, respectively.

β_1 and β_2 is partial expenditure and price elasticity of demand, respectively. The model is estimated with and without time effects, as well as other household characteristics variables which are available in average terms across households in any given year, namely the number of family member (*hhmem*), age of household head (*agehh*), and number of working members (*wkmem*), as shown in Table8. As specified earlier, panel estimation is done with FGLS permitting panel-specific autocorrelation and/or heteroskedasticity across panels, and type-wise time-series estimation is done with AR(1) using variance Huber/White/sandwich variance estimator. A summary of variables and the estimated results are given in Table8 and Table9, respectively.

[Table8 & Table9]

Based on the consumer demand theory, the income/expenditure elasticities are expected to be positive for normal goods, while own price elasticities are expected to be negative. The results in Table9 from the double-log estimations show significant positive expenditure elasticities for panel estimation as well as all for most of time-series estimations. A notable exception is *shōchu*, which has significant *negative* coefficients in all three estimations, suggesting *shōchu* being an inferior good. In terms of magnitudes, we see that *shōchu*, beer and whisky are elastic in terms of household's total consumption expenditure. The significance of expenditure elasticities for *saké* and wine is not robust and seems to be affected by the presence of *t* variable. Time variable *t* is found significant in all estimations, negative for panel, *saké*, beer and whisky, and positive for *shōchu* and wine. As for own-price elasticities, we find significant negative, inelastic coefficients for all but *shōchu* which has significant positive highly elastic estimates. This suggests that while other alcohols are normal goods, *shōchu* is possibly a Giffen good, or it could be that *shōchu* quality has improved, accompanied not only by its increase in price but also in demand. Since we do not have information on quality, it is not possible to make a conclusive interpretation. Another possible reason for finding such result is that *shōchu* is still a relatively inexpensive alcohol vis-à-vis the others, even for its price increase, as we have seen. As for household characteristics, only *agehh* is found to be significant with negative coefficients in estimations without *t* variable.

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

Although the results from the double-log model seem quite probable, the model is criticised as a crude one which is inconsistent with utility theory except for special cases (Deaton, 1997:). Thus, we estimate a conditional demand function and elasticities of demand which is consistent with utility theory, applying Deaton and Muellbauer (1980)'s (1) Almost Ideal Demand System (AIDS) and its three variants: (2) quadratic-AIDS (QUAIDS); (3) AIDS/QUAIDS incorporating socio-demographic factors; (4) dynamic-AIDS (DAIDS). We give short descriptions on each model then proceed to estimation results interpretation.

In AIDS models, demand systems are considered in terms of expenditure shares of different commodities, here, alcoholic beverage expenditures share of different alcohol types.[25] 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 paid for alcohol *i*, q_i is the quantity of alcohol *i* purchased or consumed, and *X* is the 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. With the indirect utility function where utility is expressed in terms of price *p* and total expenditure *X*, expenditure share equations can be expressed as:

(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:

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

[25] Our estimation results is limited in the sense that synthetic *saké*, spirits, liquor, fizzy and other alcohols had to be excluded from the analysis, given unavailability of household expenditure data on these items. Given the fact that liquor and fizzy consumption are increasing especially in recent years, perhaps in place of beer, our estimation results are limited in this respect.

For theoretical restriction of expenditure function being linearly homogeneous of degree zero in prices and total expenditure, we must have the following condition: (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 to satisfy (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 thus is assigned a value a priori as the minimum level of expenditure for subsistence when all prices were unity. Accordingly, α_0 is set as 4.9 throughout the analyses.[26] Based on the estimates, expenditure, as a proxy for income, and price elasticities are calculated. The expenditure elasticity is given by : $e_i=1+ \beta_i w_i^{-1}$, and own/cross price elasticity is given by: $\eta_{ij} = -\delta_{ij} + \{ \gamma_{ij} - \beta_i(\alpha_j + \sum_{i=1}^K \gamma_{ij} lnp_i)\} w_i^{-1}$, where δ_{ij} is Kronecker delta, δ_{ij} =1if $i=j$ and δ_{ij}=0 otherwise.[27] These elasticities can be derived straightforwardly by differentiating log of purchased quantity of item *i* by log of expenditure ($dlnq_i/dlnX$), and by differentiating log of quantity of item *i* by log of price of item *i* ($dlnq_i/dlnp_i$), respectively, applying the chain rules in both cases. Elasticity forms have been presented by numerous authors, including Ray (1980) and Green and Alston (1990).

QUAIDS model is devised by Banks et al. (1997) in order to allow the Deaton and Muellbauer (1980)'s AIDS model to be consistent with more realistic Engel curve. An additional component permitting for a quadratic log of expenditure enables the demand function to differentiate responses to goods according to different income levels, so that goods can be luxuries or necessities depending on the income level. The functional form is:

(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 additional last term to the original AIDS equation (3) above represents a quadratic of log of expenditure divided by the price index, with $b(\mathbf{p})$, the Cobb-Douglas price aggregator, $b(\mathbf{p}) =$

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[26] Noting that alcoholic may not be necessary goods and that there can be households which do not consume alcohol at all, we have data only in aggregate form, so do not have any data of zero alcoholic consumption. Also AIDS does not allow for corner solution that all commodities are to be consumed in some positive amount (Deaton 1997: 304).

[27] The presented price elasticities are Marshallian or uncompensated elasticities, where Hicksian or compensated elasticities that solely represent price/substitution effects can be provided directly from Slutsky equation, $\eta_{ij}^C = \eta_{ij} + X_{i\_mean} w_i$

$\prod_{i-1}^{N} p_i^{\beta i}$ and the extra term λ_i which requires that $\Sigma^k{}_{i=1}\lambda_i = 0$ (see Banks, et al. 1997 for details). Checking for the likely model fit, nonparametric kernel regressions with Gaussian specification, as in the case of Banks et al. (1997), are conducted (see Appendix). The results indicate that shares of item expenditures vis-à-vis log of consumption expenditures have 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 AIDS model, which is encompassed in the QUAIDS, as a special case when $\lambda_i = 0$ for all i.

An AIDS model with socio-demographic factors incorporates demographic characteristics using the scaling technique introduced by Ray (1983). Application of a scale allows us to incorporate household characteristics (**z**) into expenditure analysis across varying households. The scaling function m_0 is composed of two multiplicative factors, a basic component and a price and utility-varying component: $m_0(\mathbf{p}, \mathbf{z}, u) = \overline{m}_0(\mathrm{z}) \cdot \varphi(\mathbf{p}, \mathbf{z}, u)$, where the first component captures the increase 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 price and utility, capturing changes in consumption patterns depending on **z**. The estimable equation of the expenditure share takes the 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 allows for price and utility variation in scale, whose adding up condition requires that $\Sigma^k{}_{i=1}\vartheta_{ri} = 0$ for $r = 1\ldots s$. The basic scale for household characteristics vector **z** is set as $\overline{m}_0(\mathrm{z}) = 1 + \sigma'\mathbf{z}$, where σ is a vector of estimable parameters representing a 'basic' equivalent scale (Ray, 1983). For QUAIDS with demographic characteristics, the expenditure share equation becomes as below, with additional terms (Poi, forthcoming):

(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 for QUAIDS version is:

(8) e_i=1+[β_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) $\eta_{ij} = -\delta_{ij}$,+ [γ_{ij} – [β_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 the number of family member (*hhmem*), age of household head (*agehh*), and number of working members (*wkmem*), as shown in Table 8.

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

(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 exerts on the current expenditure. While θ_{ij} is defined in subsistence utility terms, η_i is defined additional utility terms, what is called 'bliss' by Deaton and Muellebauer (1980). On the other hand, δ_i captures the effect of previous purchase on the individual items, what is called 'memory coefficient' by Pollack (1970).[28] Allowing for autocorrelated disturbances with autocorrelation coefficients ρ_i, where the estimation equation's disturbances are assumed to take a form, $u_{it} = \rho_{it-1} + \varepsilon_t$, with ε_t ~ IID (0, σ^2), the expenditure share equation becomes:

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

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

While Ray (1984) puts restriction on ρ_i to be identical across all items in his estimations, he

[28] Pollack assumes that δ_i is same for all *i*, in order to achieve stability, and that δ_i =[0,1). However, if such restrictions are applied, some parameters turn inestimable within the equation systems in our case.

recognises also that this is not a realistic assumption. We estimate two versions of the demand systems, with a single ρ and ρ_i. The corresponding expenditure and own/cross price elasticities of demand are:

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

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

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

Estimation of AIDS function fits a system of nonlinear equations by iterative feasible generalized nonlinear least-squares (IFGNLS). Table10 presents estimation results and corresponding expenditure and own price elasticities from six models: (1) AIDS; (2) AIDS-hh; (3) QUAISD-hh; (4) DAIDS-a with single autocorrelation coefficient (ρ); (5) DAIDS-b with item-wise autocorrelation coefficients (ρ_i).[29] We see estimated coefficients are fairly different among the models. For instance, we have negative β_i implying necessities, with at least 5% significance level, for *saké* in AIDS and AIDS-hh, while we have it for *shōchu* in AIDS-hh, QUAIDS-hh, DAIDS-a and DAIDS-b. Significant positive β_i implying luxuries, are observed for beer, whisky and wine in AIDS, beer and wine in AIDS-hh, and beer in QUAIDS. The finding of beer being luxury seems fit more to a historical view of beer being imported expensive goods, which has given the reason for the high tax rate, but may also be applicable in current period – beer is regarded as luxurious alcohol vis-à-vis its cheaper alternatives of recently invented non-malt or law-malt beer (*fizzy* and *liquor*), and price of beer in terms of 1 degree of ethanol is the most expensive as we have seen (Table 2). We present only γ_{ii} here due to limited space, yet γ_{ij} indicate the impact of change in the price of good j on the expenditure share of i, with ($X/P(\mathbf{p})$) held constant. With γ_{ii} here, the estimated coefficients suggest that own compensated price elasticities are likely to be positive for most alcohols in AIDS and QUAIDS, and for *saké* and beer in DAIDS.

[29] We present the results with *hhmem*, but also estimated with other demographic variables. With *agehh*, the estimated coefficients for σ was negative significant in AIDS yet did not have estimated SE for QUIADS. With *wkmem*, both AIDS and QUAIDS had insignificant positive σ. Inclusion of two or three demographic variables seem to make estimation improper that those SE are not reported for most cases.

Regarding the extra parameter for QUAIDS-hh estimations, we have significant positive λ_i for beer, significant negative λ_i for whisky and significant positive λ_i for wine. These results are somewhat matching with the expectation from the nonparametric kernel regressions discussed above. The parameters of AIDS-hh and QUIADS-hh, ϑ_i and σ are both found significant at the 1% level, however, the signs are opposite for *saké*, beer and wine, depending on the estimation model. Yet, given the fact that ϑ_i indicates the impact of relative price of i on the scale effect of σ, opposite signs of estimated ϑ_i and σ actually produce impacts of the demographic variable in the same direction. For instance, positive ϑ for *saké* indicates that the impact of relative price of *saké* exert positive impact on the household member scale effect σ, which is negative in AIDS-hh. On the other hand, we have negative ϑ for *saké* and positive scale effect σ in QUAIDS-hh, which imply that the combined impact is also negative. If we look only at the household member scale effect σ though, the results are inconclusive. It seems that negative σ of AISD-hh is more reasonable that, an additional household member who is likely a child, would induce less alcohol consumption by 20%.[30]

Turning to DAIDS, the estimated coefficients all show 0.00 for δ_i and θ_{ii}, as those coefficients have small actual numbers with five to six zeros after the decimal point. Some of these δ_i and θ_{ii} are found to be significant, indicating that there are minute previous individual-item purchase effects (δ_i) on *saké*, *shōchu* and beer in DAIDS-a, and on beer in DAIDS-b, and minute previous total expenditure effects (θ_{ii}) in subsistence utility terms on *shōchu* in DAIDS-b. These findings can be reasonable, given consumption patterns of these alcohols which have been more widely taken for a longer period of time compared to whisky or wine. Looking at η_i, the estimation results are rather strange. For DAIDS-a, we have *saké* and wine coefficients both being significant, with same coefficients of large magnitudes (0.94) yet with opposite signs. For DAIDS-b, we have all items being significant at the 0.1% level with all coefficients having large magnitudes. As a matter of fact, using these estimated η_i,

[30] To remind, the data are for households of at least two persons that are likely to consist of two adults. In our estimations, an AIDS model seems to be more appropriate for estimation with demographic characteristics than its QUAIDS counterpart.

both expenditure and price elasticity calculations by (13) and (14) produce extremely large figures, indicating inappropriate estimation results for η_i in our case. Given these, we present DAIDS elasticities, calculated with the AIDS elasticity functional form, setting η_i = θ_{ii} =0. As for the autocorrelation coefficient ρ_i, it is not found significant in DAIDS-a, and found significant and positive for *shōchu* and wine in DAIDS-b, although the impacts are minute having five zeros after the decimal point.

The expenditure elasticities calculated at the means, also shown in Table10, exhibit differences among the models, particularly between static AIDS, and the rest. *Saké* is found to have significant negative expenditure elasticity only in AIDS, while *shōchu* is found to have negative expenditure elasticities in other four estimations, although the estimates are insignificant in DAIDS models. The estimated negative expenditure elasticity for *shōchu* suggesting it being an inferior good matches the results from the double-log estimations and the tax policy estimations in terms of the final consumption expenditure per capita. The only item which is found to be robustly elastic is beer – the most drunken alcohol in Japan. This coincides with the tax policy regression results where beer consumption was found to be particularly 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, while the impact on *saké* and *shōchu* is unclear.

As for own price elasticities, calculated at the means, we have 'positive' estimates for *saké*, *shōchu* and wine in AIDS and AIDS-hh estimations, although all the estimates are statistically insignificant in AIDS-hh. Positive and elastic own-price elasticity for *shōchu* matches the results for earlier double-log estimations. Positive elasticity for *saké* was also found in Takahashi et al. (2009), cited above, although inelastic. Beer and whisky have negative price elasticities, although none is significant at the 5% level. For QUAIDS-hh, we have significant positive elasticity for *saké*, which is elastic, and significant negative elasticity for beer, which is inelastic. The other items are insignificant, implying that elasticities are not statistically different from zero. Looking at the cross-price elasticities, almost all η_{ij} are significant in the AIDS model suggesting that most alcohol items are either substitute or complement to each other, results which may be unlikely. Concentrating on the statistically significant results that are robust across AIDS/QUAIDs models, we see that increase in price of *shōchu* and beer decrease the consumption of *saké*, while increase in the price of beer is found to increase the demand for *shōchu* by 1.5~ 2% and to decrease the demand for *saké* by 1~1.5%. Whisky and wine are estimated to be complements to each other with the statistical significance at 1%.

Turning to price-elasticity estimates in DAIDS, all coefficients have negative signs except for *shōchu* in DAIDS-b The results are more coherent with other literature findings that alcohols are normal goods, although estimates for *saké* and *shōchu* exhibit no statistical significance in both estimations. We have significant negative elastic estimate for whisky and wine in both DAIDS models, and significant negative inelastic estimate for beer in DAIDS-b. Although we must be cautious in using the results from DAIDS as the elasticity formula had to be changed to that of AIDS, the results suggest that it would be particularly inefficient to impose excise tax on whisky or wine, yet efficient to impose tax on *saké* and *shōchu.* The estimated cross-price elasticities suggest that *saké* and beer are complements to each other in both DAIDS, results that are also seen in AIDs estimations. *Shōchu* is estimated to be a substitute for *saké* and wine a substitute for whisky in DAIDS-a, both at the 5% significance level.

Having few robust estimation results across models, we should note possible instability of AIDS model application in the case of alcoholic beverages in Japan. Particularly, the complexity of extended AIDs models considered here, although they are supposed to be more realistic models, seems to impose certain strain on estimations, and that results may significantly differ depending on the models employed.[31] Our results seem to signify the importance of distinguishing the

[31] For instance, Andrikopoulos and Loizides (2010) cited earlier also had different estimations results for three DAIDS models they employed. Also, the estimation result table present in the paper shows missing SE (t-values) for some parameters in their DAIDS estimations, which may indicate that the model applied was not appropriate.

‘subsistence’ and the ‘bliss’ within the same category of goods in an AIDS analysis.[32]

[Table 10]

Conclusions

Utilising the data from 1948 to 2011, we saw that liquor tax rates used to be discriminative to expensive alcohols through ad valorem tax and class systems, although such system was abolished by early 1990. The liquor tax policy revisions have had different implications on each alcohol, which were indeed observed in the tax policy regressions investigating the impacts 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 impacts on production in general, except for domestic production. The impacts of final consumption per capita are found to be positive with statistical significance for most production and consumption, with a notable exception of *shōchu* in time-series estimations, suggesting that *shōchu* is an inferior good. The results from demand system analyses provide supporting evidences for this finding that increase in expenditure level raise the level of consumption for most alcohols except for *shōchu*. Tax rate is found to have mixed impacts depending on the type of alcohol. It is found to have significant negative impacts particularly for *saké* and beer, while it is estimated to be significant and positive for *shōchu*. These findings suggest that *shōchu* is possibly a Giffen good, whose income effects are greater than its substitution effects. Nonetheless, there can be other factors at function that are not evident from the available data, such as quality improvement and price increase taking place during the period of recession. The analyses suggest the possibility of preferential tax rates being beneficial for boosting sectoral performances for certain alcohols.

In order to estimate the demand elasticities of alcohols, the double-log, AIDS and its variant models

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Thompson (2004) raises the issue of unrealistic assumption of AIDS models in particular that the expenditure level is independent of item price change, when we are looking at group expenditure. However, applying his suggested remedies did not principally change the estimated results.

[32] We initially attempted to estimate the AIDS models with such differential quality categories for *saké* and whisky for which data are available, but the data were not for long enough period to allow the estimations.

are applied for five alcohols. In terms of total alcohol expenditure, *shōchu*, beer and whisky are found to be elastic in double-log and static AIDS estimations, where *shōchu* has negative elasticities across models except for the original AIDS. The result reinforces the earlier findings of *shōchu* being an inferior good. Regarding price elasticities in the double-log estimations, all items but shōchu are found to have significant negative own-price elasticities, with least elastic being wine. *Shōchu* is found to have significant positive and elastic own-price elasticity in the double-log model, indicating that the item is the most ideal subject for taxation. The AIDS/QUAIDS estimations on own-price elasticities essentially suggest that any alcohol item can be subject to taxation, without distorting the welfare level, since they are either positive with statistical significance or negative without statistical significant. On the other hand, DAIDS estimations suggest that imposing tax on whisky and wine is particularly inefficient. At least from the estimated result we have at hands, the safest taxable item seems to be *shōchu*. Taking together with alcohol trend and tax policy analyses conducted, there might be differential quality and other issues at work in the background for such elasticity findings, as well as possible inappropriateness of AIDS model application to the alcoholic beverages data we used. The results signify the importance of distinguishing the qualities within the same category of goods in the demand system analyses.

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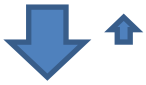
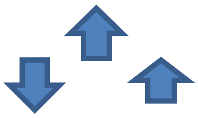
Table 1 Summary of the Liquor Tax Evolution (1962~2013)

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. Panel Estimation Results: G1 – Dinner Alcohols (*Saké*, Synthetic *Saké*, *Shōchu*, Wine)

	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	0.946***	0.966***	0.881***	0.876***	0.744***	0.873***	0.463***	0.487***	0.410***	0.389***	0.410***	0.357	0.630*	-0.819*	-1.552***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]	[0.00]	[0.21]	[0.09]	[0.10]	[0.00]
ln average tax rate (real)	0.102	0.082	-0.464**	-0.790***				0.068	-0.257	-0.198			1.292***		
	[0.33]	[0.42]	[0.05]	[0.00]				[0.42]	[0.21]	[0.31]			[0.00]		
ln Tax ratio a)			0.469**	0.859***	0.457***	0.09			0.348*	0.262	0.027			1.194***	1.185***
			[0.03]	[0.00]	[0.00]	[0.42]			[0.08]	[0.19]	[0.77]			[0.00]	[0.00]
ln final consumption pc	0.446***		0.347*		0.771***	0.425**	0.438***				0.445***	0.917			-2.375***
	[0.00]		[0.09]		[0.00]	[0.04]	[0.00]				[0.01]	[0.23]			[0.00]
S37tax	0.162***	0.183***			0.260**		0.080**	0.130**	-0.04			.	.	.	
	[0.01]	[0.01]			[0.02]		[0.04]	[0.03]	[0.58]			.	.	.	
H1tax	0.191**	0.228**			0.195**		0.077	0.186**	0.016			0.053	0.176**	0.269***	
	[0.04]	[0.03]			[0.02]		[0.16]	[0.03]	[0.77]			[0.41]	[0.01]	[0.01]	
H6tax	0.116	0.184*			.		0.058	0.210**	.			.	.	.	
	[0.25]	[0.09]			.		[0.38]	[0.02]	.			.	.	.	
H15tax	-0.160*	-0.11			-0.136		-0.092	-0.031	0.018			-0.145	-0.412***	-0.237**	
	[0.07]	[0.25]			[0.29]		[0.15]	[0.70]	[0.84]			[0.17]	[0.00]	[0.05]	
H18tax	0.048	0.029			0.049		0.036	0.015	-0.007			0.054	0.102	0.05	
	[0.35]	[0.60]			[0.53]		[0.33]	[0.75]	[0.90]			[0.37]	[0.12]	[0.58]	
Polyphe. Boom	0.022	0.015	0.048	0.016	0.035	0.049	0.005	-0.002	0.003	0.001	0.02	0.034	0.03	0.062	0.032
	[0.53]	[0.72]	[0.33]	[0.71]	[0.53]	[0.33]	[0.86]	[0.95]	[0.94]	[0.99]	[0.59]	[0.39]	[0.53]	[0.39]	[0.68]
Shōchu boom	0.101	0.071	-0.001	-0.008	0.091	-0.006	0.069	0.035	-0.018	-0.006	0.006	0.131	0.230**	0.167	0.02
	[0.16]	[0.37]	[0.99]	[0.85]	[0.40]	[0.91]	[0.19]	[0.60]	[0.80]	[0.86]	[0.86]	[0.13]	[0.01]	[0.14]	[0.79]
Constant	4.071***	4.695***	8.061***	10.917***	6.227***	4.963***	4.541***	5.290***	7.733***	7.410***	5.478***	4.191***	-0.582	8.296***	10.285***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.41]	[0.00]	[0.00]
N	228	228	147	147	147	147	228	228	147	147	147	80	80	57	57

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* and wine only, so syntheticr *saké* is 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 5. Panel Estimation Results: G2 - Hard Liquor (*Shōchu*, Whisky, Spirits)

	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)
MA(3) growth rate tax value	1.276***	1.295***	0.791***	0.931***	0.717***	0.908***	0.579***	0.640***	0.408**	0.440***	0.419***	0.388	0.556*	-0.221
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.02]	[0.00]	[0.00]	[0.20]	[0.07]	[0.57]
ln average tax rate (real)	-0.505***	-0.563***	-0.285	-0.572***				-0.167*	-0.686***	-0.428**			-0.275**	
	[0.00]	[0.00]	[0.20]	[0.00]				[0.07]	[0.00]	[0.01]			[0.04]	
ln Tax ratio[a]			0.306	0.445	-0.06	-0.235*			0.859***	0.436*	-0.061			0.057
			[0.28]	[0.11]	[0.63]	[0.09]			[0.00]	[0.06]	[0.54]			[0.78]
ln final consumption pc	0.911***		0.890***		1.124***	0.973***	1.060***				1.033***	0.244		
	[0.00]		[0.00]		[0.00]	[0.00]	[0.00]				[0.00]	[0.80]		
S37tax	-0.055	-0.013			0.538***		0.008	0.031	0.11			.	.	.
	[0.52]	[0.88]			[0.00]		[0.90]	[0.70]	[0.33]			.	.	.
H1tax	-0.286**	-0.197			0.136**		-0.043	0.029	0.069			0.142*	0.102	0.098
	[0.02]	[0.11]			[0.05]		[0.65]	[0.78]	[0.41]			[0.07]	[0.17]	[0.27]
H6tax	-0.389***	-0.265*			.		-0.152	-0.02	.			.	.	.
	[0.01]	[0.07]			.		[0.19]	[0.87]	.			.	.	.
H15tax	0.121	0.238*			-0.043		-0.034	0.108	0.131			0.098	0.176	-0.034
	[0.38]	[0.09]			[0.71]		[0.76]	[0.38]	[0.31]			[0.47]	[0.13]	[0.80]
H18tax	0.002	-0.049			0.063		0.037	-0.024	-0.016			0.026	-0.012	0.051
	[0.98]	[0.56]			[0.35]		[0.57]	[0.74]	[0.84]			[0.74]	[0.86]	[0.54]
Polyphe. Boom	-0.011	-0.02	0.023	0.003	0.02	0.008	0.003	-0.019	-0.005	-0.013	-0.002	-0.001	-0.009	0.015
	[0.84]	[0.73]	[0.73]	[0.96]	[0.68]	[0.88]	[0.95]	[0.72]	[0.93]	[0.81]	[0.95]	[0.99]	[0.86]	[0.80]
Shōchu boom	-0.035	-0.123	0.021	0.011	0.075	0.022	0.043	-0.059	-0.065	0.011	0.015	0.018	-0.046	0.067
	[0.76]	[0.29]	[0.74]	[0.87]	[0.43]	[0.70]	[0.64]	[0.56]	[0.55]	[0.83]	[0.71]	[0.87]	[0.63]	[0.56]
Constant	7.716***	8.232***	7.494***	9.346***	5.340***	5.387***	4.890***	5.992***	10.532***	8.477***	5.544***	4.360***	6.116***	5.673***
	[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	171	171	98	98	98	98	171	171	98	98	98	60	60	38

Note: p-value in brackets (* p<0.05, ** p<0.01, *** p<0.001); Estimation (1) and (15) exhibit an evidence of multicollinearity; a) Tax ratio data available for 1963-2011 for *shōchu* and whisky only, so spirits is 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 6. Panel Estimation Results: G3 - Beer & Third Beer (Beer, Liquor, Fizzy Drinks)

	Production/Supply					Consumption				Production (Domestic Only)		
	1955-2011					1955-2011				1991-2011 [a)]		
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(1)	(2)	(3)
MA(3) growth rate tax value	0.079	0.319**	0.286**	0.352**		0.121	0.205**	0.071	-0.123	-0.544**	-0.546**	-0.587**
	[0.56]	[0.04]	[0.02]	[0.02]		[0.18]	[0.05]	[0.67]	[0.47]	[0.05]	[0.04]	[0.03]
ln average tax rate (real)	0.006	-0.241	-0.499		-0.307			-0.168	-0.36		0.207**	0.294***
	[0.99]	[0.24]	[0.18]		[0.11]			[0.49]	[0.41]		[0.04]	[0.00]
ln final consumption pc	2.101***	1.856***		1.906***	1.745***	1.612***	1.566***	1.658***		3.533*		
	[0.00]	[0.00]		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]		[0.06]		
S37tax	0.017		0.277			0.091			0.106	.	.	
	[0.94]		[0.26]			[0.54]			[0.72]	.	.	
H1tax	0.242		0.651*			0.227			0.435	-0.339**	-0.277*	
	[0.48]		[0.09]			[0.28]			[0.33]	[0.03]	[0.06]	
H6tax	0.748*		1.460***			0.459*			1.231**	.	.	
	[0.05]		[0.00]			[0.07]			[0.01]	.	.	
H15tax	0.4		0.897**			0.105			0.822**	0.068	0.324	
	[0.21]		[0.01]			[0.67]			[0.04]	[0.80]	[0.14]	
H18tax	-0.161		-0.333			-0.077			-0.284	-0.085	-0.19	
	[0.41]		[0.13]			[0.59]			[0.25]	[0.59]	[0.18]	
Polyphe. Boom	-0.021	-0.012	-0.018	-0.014	-0.021	-0.023	-0.008	-0.025	-0.027	-0.097	-0.115	-0.09
	[0.88]	[0.89]	[0.91]	[0.86]	[0.80]	[0.82]	[0.91]	[0.81]	[0.88]	[0.37]	[0.27]	[0.39]
Shōchu boom	-0.244	0.005	-0.568*	0.002	-0.003	-0.081	-0.002	0.016	-0.476	-0.03	-0.252	-0.007
	[0.36]	[0.96]	[0.06]	[0.98]	[0.97]	[0.69]	[0.98]	[0.88]	[0.15]	[0.89]	[0.18]	[0.94]
Constant	3.249*	5.727***	5.968***	4.423***	6.860***	3.677***	5.256***	5.553***	5.915**	3.903**	5.796***	5.607***
	[0.10]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.02]	[0.01]	[0.00]	[0.00]
N	147	147	147	147	147	142	142	138	138	60	60	60

Note: p-value in brackets (* p<0.05, ** p<0.01, *** p<0.001); Estimation (1) exhibits an evidence of multicollinearity; tax ratio not included as it is available for beer only. ; a) 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 7. 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 consum ption 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 8. 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 9. 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 10. 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														
e_i	-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]
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_{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]
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									
e_i	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]**

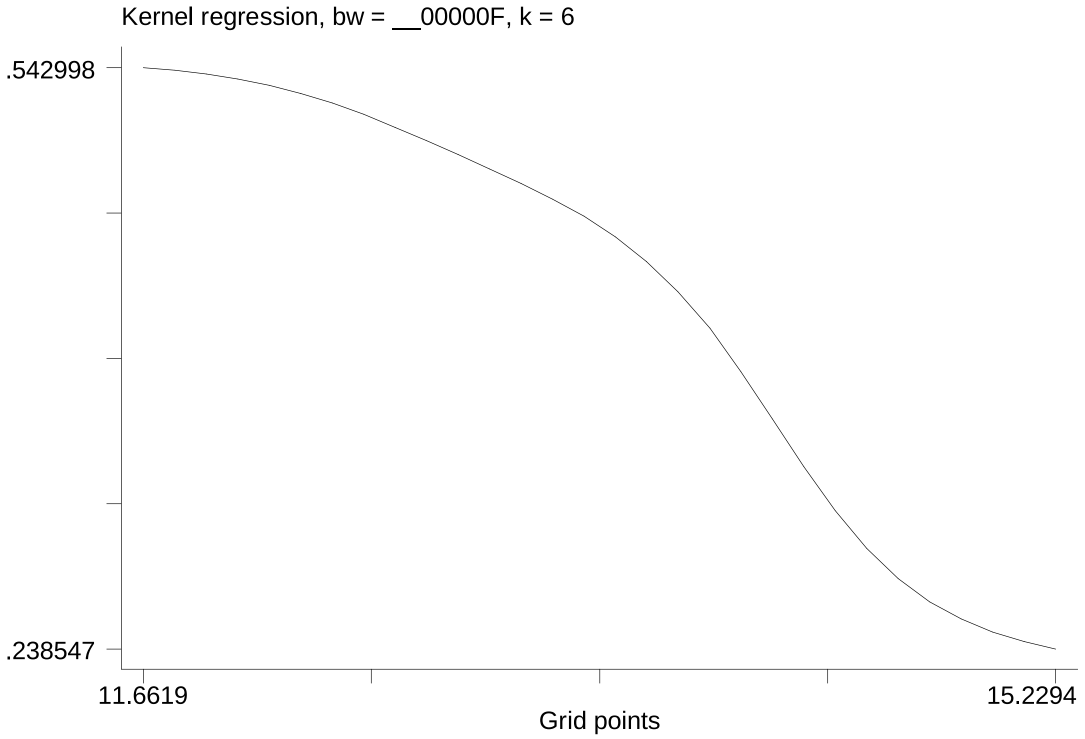
Note: p-value in parentheses; elasticities are calculated at mean of variables; Own-price elasticities are in diagonal, shown in bold; Cross-price elasticity matrix are shown for elasticity of good in row *i* with respect to changes in price of good in column *j*; Own/cross-price elasticities for DAIDS 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).

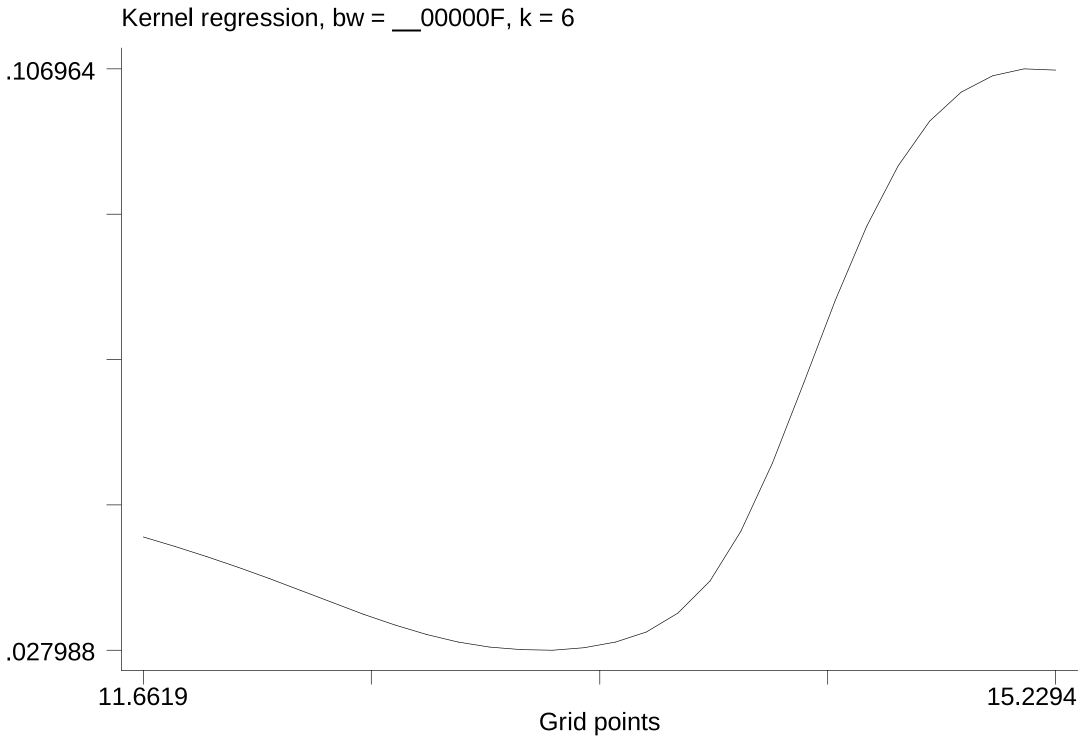
APPENDIX

Nonparametric Kernel Regressions with Gaussian Specification

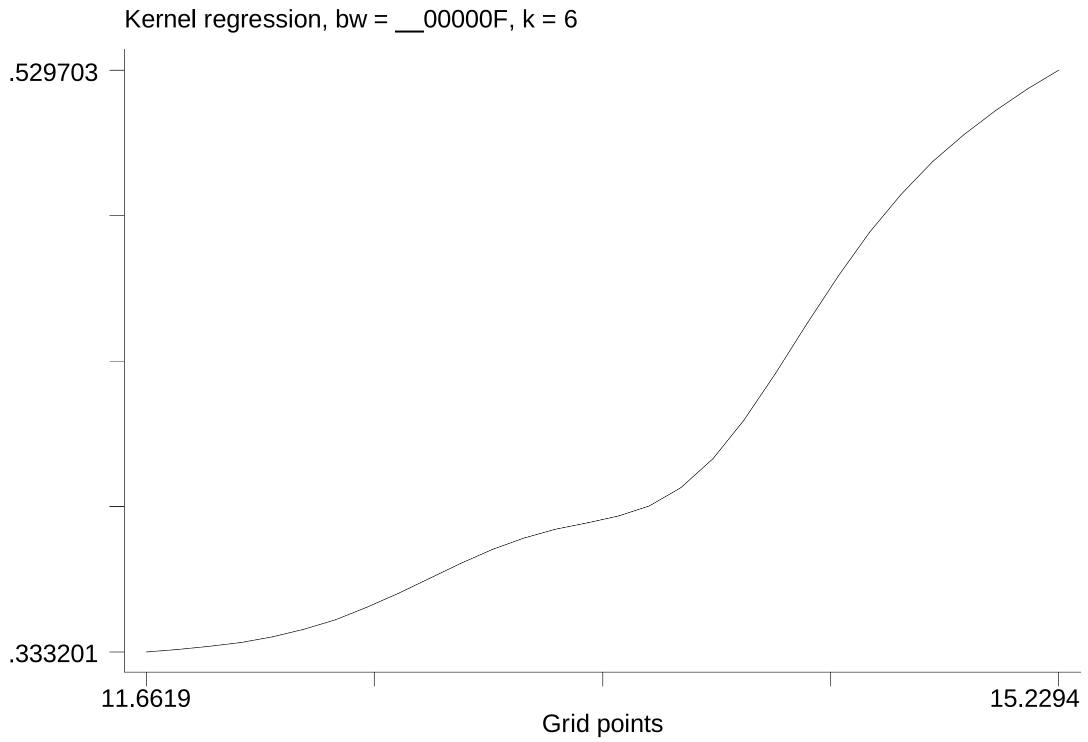
1. y = expenditure share for *saké*, x = log of total alcohol consumption expenditure



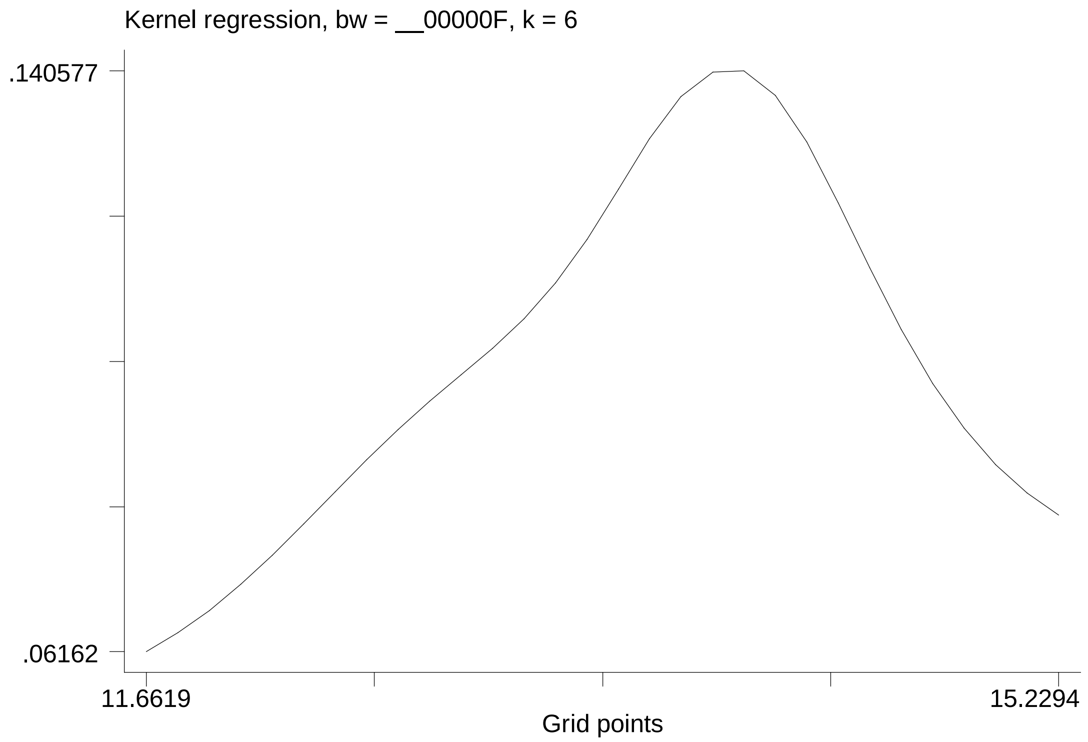
2. y = expenditure share for *shōchu*, x = log of total alcohol consumption expenditure



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