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Does Japanese Liquor Taste Different?: Empirical analysis on the national treatment under the WTO

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Abstract

The national treatment obligation, along with most favored nation obligation, is an important principle of non-discrimination adopted by the WTO. It requires that foreign products be treated no less favorably than national products. This paper empirically examines the 1996 WTO recommendation that a Japanese distilled alcohol beverage, *shochu*, is a 'directly competitive or substitute product' to other distilled drinks, and thus not taxing similarly is in violation of its national treatment obligation. Demand estimates obtained from a three-stage nested logit model reveal that *shochu* and other distilled beverages are matched substitutes for each other. Upon the recommendation by the WTO Appellate Body, Japan changed its liquor tax rates closer to the optimal level.

Keywords: National treatment obligation; WTO; Nested logit discrete choice model; Optimal taxation

JEL classification: F13; R11

1 Introduction

The national treatment (hereafter NT) obligation, along with most favored nation obligation, is an important pillar supporting non-discrimination principle at the World Trade Organization (hereafter WTO). Whereas most favored nation obligation requires equal treatment among different nations, the NT obligation requires the treatment of imported goods, once they have cleared customs, to be no worse than that of domestically produced goods (See for example Jackson, 1997). It is an undertaking by the WTO to prevent domestic tax and regulatory policies from being used as protectionist means that would offset its efforts to reduce border measures. The interpretation of the NT obligation is of critical importance to the WTO members, because it has a profound impact on countries' freedom to choose domestic policies.

A major interpretative issue over the NT obligation is to determine whether the imported and domestic products are 'directly competitive or substitutable.' (hereafter DCS for short) While the absence of 'directly competitive and substitutable' relationship between imported and domestically produced products precludes any possibility of protective effects concerned under the NT provision, it is interesting to note that case-law has not clarified the interpretation of the terms in Article III of the General Agreement on Tariffs and Trade 1994 (hereafter GATT). As Horn and Mavroidis (2004: 43) states, the WTO have no clear methodology to offer for interpreting the NT obligation enshrined in Article III.2, which deals with DCS products. The purpose of the paper is to provide an economic framework to assess under the NT obligation the relationship between imported and domestic products in an application to Japanese alcoholic beverages.

In July 1995, Canada, the EC and the US requested consultations with Japan at the WTO, under the complaint that a Japanese law taxed the locally produced alcoholic beverage *shochu* more favorably than a series of other distilled drinks (*Japan–Tax on Alcoholic Beverages* (hereafter *Japan-Tax*) [1]). The appellate body agreed with the Panel's conclusion that the plaintiffs' complaint was appropriate. In October 1996, Japan accepted the WTO's recommendation, and completed the revision in 2000 to the Japanese Liquor Tax Law. An integral issue of the dispute was whether *shochu* and the other distilled beverages were 'directly competitive and substitutable,' and if so, whether the former was not taxed similarly to the latter.[2] In the process of dispute settlement, the appellate body viewed that the decisive criterion in the determination of 'directly competitive or substitutable' is whether they have common end-uses, inter alia, as shown by elasticity of substitution [3]. This empirical issue addressed above by the Panel is relevant for the concept of

[1] WTO Doc. WT/DS 8, 10, 11/AB/R of 4 October 1996

[2] Another issue raised in *Japan-Tax* was whether shochu and vodka are 'like' product, and whether Japan taxed the latter in excess of the former. This issue turned out not being dealt with by the discipline of economics, as the Appellate Body confirmed that customs classification is an appropriate criterion to define likeness. This paper thus will not look into the issue on likeness in the NT obligation any further.

[3] WT/DS8/AB/R, WT/DS10/AB/R, WT/DS11/AB/R (1996: 24).

market definition often employed in the fields of industrial organization and antitrust economics. Nevertheless, to our knowledge, the economic literature has devoted hardly any attention to this issue. Using the existing method available in the fields of industrial organization and antitrust economics, this paper revisits the WTO dispute of *Japan-Tax*, and evaluates ex-post whether the conclusion reached by the WTO makes sense in that *shochu* and the other distilled beverages were in a directly competitive or substitutable relationship to one another.

The paper begins to perform a test of small but significant and non-transitory increase in price, namely SSNIP, to determine whether *shochu* and other distilled beverages constitute a relevant market. The SSNIP test is a convenient method for antitrust practitioners to identify the smallest market relevant to product competition. Our test reveals that *shochu* alone forms a relevant market, independent of other beverages. Since the SSNIP test is known to be vulnerable to possible statistical biases acrrued by endogeneity and omitted variables, the paper proceeds to estimate consumer demand of alcoholic beverages. We use a multi-stage nested logit structure to describe Japanese consumers' choices among different beverage types. Controlling for possible endogeneity in the price variable, the paper finds, in contrast to the finding in the SSNIP test, that *shochu* and the other beverages are close substitutes. This result is robust to alternative nest structures or sets of instruments used in the estimation. The paper's econometric evidence based on the demand estimation corroborates with the conclusion reached by the WTO Panel.

The NT obligation is often seen as imposing considerable constraints on national government's sovereignty. In the context of alcoholic beverages under study, Japanese government restricted their ability to freely determine internal alcoholic taxes; Upon the WTO recommendation, the government revised its Liquor Tax Law to set the tax rates of distilled liquors at similar levels. It is thus imperative to ask whether these constraints imposed by the NT obligation contribute to national welfare. Based on the obtained demand estimates, this paper finds that consumer welfare improved substantially after the tax revision. Indeed, the revised tax rates became closer to the optimal level calculated by the estimates.

The rest of this paper is organized as follows. The next section provides an overview of the dispute. The issue of dispute was whether *shochu* was DCS to other distilled liquors. Then the section applies the SSNIP test often conveniently employed in antitrust economics so as to determine the market definition. Section 3 estimates the demand model to analyze DCS relationship in a more rigorous manner. The model characterizes the consumer purchasing behavior of alcoholic beverages in Japan, relying on a random-utility discrete choice framework. Using these results, Section 4 discusses a consequence of the tax reform following the WTO recommendation. Section 5 concludes.

2 Historical Background and Preliminary Analysis

This section begins with an overview of the WTO dispute over Japanese alcoholic drink, *shochu*. A major issue of the dispute was whether *shochu* and other distilled beverages were 'directly competitive and substitutable' (namely DCS) to each other. If they were, the plaintiff parties claimed that wide differences in Japanese liquor tax rates observed in Section 2.1 should not been allowed. While the WTO appellate body concluded that *shochu* and other beverages were DCS, and thus not taxing similarly across the beverages violated the WTO rule, the Body did not employ any precise criteria regarding the determination of DCS. In Section 2.2, we suggest a simple approach corresponding closely to the procedure taken by an antitrust authority, when it assesses the impact of, say, a proposed merger. Our analysis concludes that *shochu* independently constituted a relevant market, implying that shochu and other beverages are not DCS. To check the robustness of the result obtained in this section, we perform a full-fledged demand analysis in the subsequent section.

2.1 Overviews of the WTO Dispute

On 21 July 1995, the EC requested consultations with Japan concerning the internal taxes levied by Japan on certain alcoholic beverages pursuant to the Japan's Liquor Tax Law (WT/DS8/1). On the following month, the U.S (WT/DS8/2) and Canada (WT/DS8/3) joined the consultations. The three parties made essentially the same complaint in that Japan had acted inconsistently with Article III of GATT 1994 by applying higher tax rates on alcoholic beverages including whiskies, brandies, other distilled alcoholic beverages than the rates imposed on Japanese *shochu*.

When the parties requested the consultations to the WTO, the Japanese Liquor Tax Law classified alcoholic beverages into nine categories, four of which are distilled beverages under the focus of this study, including *shochu*; liqueurs; spirits; and whiskies (brandies included).[4] Indeed, in 1994, the tax rates on distilled liquors per kilo-liter, adjusted by alcohol concentration, ranged from the highest of 24,558 JY on whisky to the lowest of 3,941 JY on *shochu*, as shown in Figure 1.[5] While the Law makes no distinction between domestic and imported beverages, the parties of EU, US and Canada complained that Japan unduly favored *shochu* over the other beverages, the latter which accounted for higher shares of imports.[6]

In July 1996, the Panel agreed with the plaintiffs, and the WTO appellate body subsequently concluded that "*shochu* and other distilled spirits and liqueurs [...] except for vodka are 'directly competitive or substitute' products, and Japan, by not taxing them similarly, is in violation of its

[4]The other five categories are *sake*, *sake* compounds, *mirin*, beer, and wine.

[5]There has been two kinds of *shochu*; *shochu* A of high quality and *shochu* B otherwise. For the sake of exposition, Figure 1 shows the sales-weighted average of the two *shochu*'s.

[6]In 1994, imports took 3.4% of domestic consumption quantity for *shochu*, while 27.5% for whiskies, 22.5% for spirits and 2.7% for liqueurs.

obligation under Article III:2, second sentence, of the GATT 1994." [7] In response to the Panel Reports and the judgement of appellate body, Japanese government gradually reformed the Liquor Tax Law, and in October 2000, *shochu* was taxed at the same rate to the rate of the other distilled beverages, as shown in Figure 1.

During the settlement procedure, neither the WTO Panel nor appellate body offered precise criteria as to how DCS should be determined. While the appellate body list in the report factors relevant to the criteria, such as cross-price elasticity, elasticity of substitution, end-uses, consumers' tastes and habits, and products' properties and so on, it also added to mention that the list was not exhaustive, and did not clarify what weights to be given to each of the factors mentioned in the list.

As we understand that the concept, DCS, is intended to capture the degree to which an increase in the tax on a set of products benefits another set of products in terms of an increased sales volume, the appropriate indicator for DCS must have been elasticity of substitution. In the subsequent sections of this paper, we present a formal statistical method to measure the magnitude of DCS between *shochu* and other beverages in *Japan-Tax*. We utilize publicly available data and attempt to address econometric issues involved in the empirical exercise. We believe that a statistical method proposed in the following sections would help understand how to determine DCS stipulated in the NT obligation.

In Section 3, we apply a discrete-choice model to directly estimate elasticity of substitution and assess the validity of the claim in that *shochu* and other distilled beverages are DCS. Before introducing such a model, Section 2.2 presents the technique much simpler than that used in Section 3 to assess DCS between *shochu* and other beverages.

2.2 Preliminary Analysis of Market Definition

In evaluating DCS relationship between a multiple of products, the adjudicating bodies are essentially asking whether the products are in the same relevant market. If the products are determined to be in the same market, they must highly substitute each other in the eyes of consumers. Otherwise, they are not in direct competition. While the adjudicating bodies in the WTO have no clear approaches to define the relevant market, it noted in the report that "Under national antitrust [...] regimes, the extent to which products directly compete is measured by the elasticity of substitution. (Paragraph 6.31 in WT/DS8/R, WT/DS10/R and WT/DS11/R).

Before estimating the elasticity of substitution in Section 3, this subsection proposes a much simpler statistical method often employed by national antitrust to identify the smallest market relevant to product competition. To anticipate the result, the method finds that *shochu* alone

[7] WT/DS8/R, WT/DS10/R, WT/DS11/R, p30. See also footnote 2.

constitutes an independent market, and thus is not DCS relationship with other beverages. We also discuss weaknesses in the test as well in this subsection, leading us to demand estimation.

This subsection utilizes the Small but Significant Non-transitory Increase in Prices (SSNIP) test, which was introduced with the 1982 US Merger Guidelines and has been widely used by competition authorities to define the relevant market. Starting with the narrowest possible market definition, if it is profitable for a hypothetical monopolist to increase the price(s) of the product(s) in this market by 5%, the candidate market is therefore the relevant market. This is because the presence of unprofitable hypothetical monopolist implies that the elasticity of substitution is considered to be small. If, on the other hand, the increase in price(s) is not profitable because consumers would substitute to products outside the candidate market, the market definition must be extended to include the closest of these substitutes, in order to ensure that any product exercising a competitive pressure on the product(s) in question is included in the market definition. Products are added to the candidate market until the price increase is profitable for a hypothetical monopolist owning all the products in the candidate market. The relevant market has then been found.

As Katz and Shapiro (2003) concisely describe, the effect of a SSNIP on the hypothetical monopolist's profits depends on the prevailing profit margin earned on each unit sold and on the percentage of unit sales that would be lost as a result of the price increase. The price increase would be profitable, if the former would be greater than the latter:

$$\frac{\Delta q_j/q_j}{\Delta p_j/p_j} > -\frac{1}{(\Delta p_j/p_j) + M_j}, \tag{1}$$

where q_j, p_j and M_j are respectively quantity demanded, price and markup for product j. We are interested in investigating whether or not *shochu* was DCS to other alcoholic beverages, or whether the above equation (1) satisfies Japanese *shochu* data.

Figure 2 shows the quantity and price data for the distilled liquors used in this study. The data on the public domain are traced back to the year of 1994, and we extend the data to 2002, two years after the final revision to the Liquor Tax Law. The annual data has regional dimension with 47 prefectures in the country. The aggregated national level data prior to 1996 when the WTO Panel report was published, indicate that the equation (1) always hold for any values of M: the left-hand side of (1) takes the value of 11.24, whereas the right-hand side takes a negative value. This result would suggest that *shochu* constituted a relevant market, independent of other distilled beverages. This inference crucially depends on the observation made in Figure 2 in that price and quantity of *shochu* appeared to move in the same direction: Indeed, the unconditional correlation coefficient is 0.26. As noted by Trajtenberg (1990), this positive correlation may be due to the lack of control for endogeneity in the price variable. In the next section, we address the endogeneity issue by using demand estimation.

3 Demand Model

This section introduces the estimation model we use to describe the Japanese alcoholic market. In Section 3.1, we introduce a demand system, derived from a random-utility discrete choice model of consumer behavior. Since we do not observe the individual purchasing behavior, we aggregate across individual buyers to obtain the demand for an alcoholic product, while still allowing for heterogeneity across consumers. The nested logit structure used in the paper provides us with a simple testing hypothesis as to whether or not *shochu* and the other distilled alcohol beverages were DCS one another. Following the discussion of identification issues made in Section 3.2, estimation results are presented in Section 3.3. Robustness to different nest structures is also examined in this subsection.

3.1 Nested Logit Model

This study follows the approach taken by the discrete-choice literature and assumes individual consumer as the purchasing entity. Each consumer i is assumed to maximize the following indirect utility function in year t by choosing product $j \in [1, ..., N]$ at market m:

$$u_{ijmt} = \alpha p_{jmt} + x_{jmt}\beta + \xi_{jmt} + \varepsilon_{ijmt}. \tag{2}$$

where u_{ij} is consumer i's utility from consuming product j (the time and prefecture subscripts are omitted if there is no confusion). The total number of products, N, is the same across m in our data. The vector x_j is product j's observed attributes including year and prefecture dummies. Since it is difficult to identify product attributes commonly perceived across alcoholic beverages, we employ product dummy variables in the estimation. Let p_j be a real price (adjusted by the overall CPI), and ξ_j stands for an unobserved (by an econometrician) product quality of alcoholic product j with $E\left(\xi_j\right) = 0$. It is convenient to decompose u_{ij} into ε_{ij} and δ_j:

$$\delta_j = \alpha p_j + x_j\beta + \xi_j.$$

The mean valuation in the population of consumers for product j is denoted by δ_j, and the deviation in consumer i's taste from the mean is captured only by the mean-zero error, ε_{ij}. Here we impose assumptions on ε_{ij} that generate a nested logit structure.

We consider the following three-stage nested logit model: On the first node, an individual consumer, whose age is over twenty, legal drinking age, decides whether or not to purchase alcohol in market m, and if they decides to buy, they choose distilled or un-distilled beverages. On the second node, given the choice of distilled beverages, a consumer decides which of *shochu* or other distilled drinks to choose. On the final node, a consumer chooses products, including two types of *shochu* (denote this set as J_{d1}), and whisky, liqueurs and spirits (denote as J_{d2}) as the categories of distilled beverages; and beer, wine, sake, and sake compound (denote this set as J_o) are in un-distilled beverages.

The nested logit gives a closed-form choice probability. The market share for product j is given by (see McFadden, 1978, for example):

$$s_j = \frac{e^{\delta_j} G_j(e^{\delta_0}, \dots e^{\delta_J})}{G(e^{\delta_0}, \dots e^{\delta_J})},$$

where

$$G(\cdot) \equiv 1 + \left[\left\{ \sum_{j \in J_{d1}} \exp\left(\frac{\delta_j}{1-\sigma_b} \right) \right\}^{\frac{1-\sigma_b}{1-\sigma_a}} + \left\{ \sum_{j \in J_{d2}} \exp\left(\frac{\delta_j}{1-\sigma_b} \right) \right\}^{\frac{1-\sigma_b}{1-\sigma_a}} \right]^{1-\sigma_a} + \left\{ \sum_{j \in J_o} \exp\left(\frac{\delta_j}{1-\sigma_b} \right) \right\}^{1-\sigma_b},$$

and $G_j(\cdot)$ is the derivative of $G(\cdot)$ with respect to e^{δ_j}. We set the mean utility from the outside alternative normalized to be zero. The market share s_j is defined as the fraction of potential market size, which is calculated under the assumption that an individual of over the legal drinking age annually drinks 5000 bottles of liquors, each bottle containing 200 ml of 100-percent alcoholic concentration. [8] As McFadden (1978) has shown, the nested structure is consistent with random utility maximization if and only if the parameters, σ_a and σ_b, lies within the unit interval, and satisfy $\sigma_a \leq \sigma_b$. When the coefficients approach 0, the distribution of the error terms tends towards an i.i.d. extreme value distribution and the choice probabilities are given by the simple multinomial logit model. As the coefficients approach 1, the error terms become perfectly correlated and consumers choose the alternative with the highest strict utility.

The relative size of σ_a and σ_b provides us with the information as to whether *shochu* and the other distilled beverages are in the DCS relationship. In particular, if the value of σ_a equals that of σ_b, it implies that the choice between *shochu* and the other distilled beverages is not important in explaining consumers' purchasing behavior, and the model collapses to a simple two-stage nested logit model with the choice of outside alternative on the first stage, and the subsequent product choice. If, however, the value of σ_a significantly differs from that of σ_b, the market of *shochu* and that of the other distilled beverages can be considered being segmented. We normalize the standard error ε_{ij} to be one. This normalization is innocuous in that this standard error cannot be identified from the other utility parameters, as is common with other discrete choice models.

The market share of the outside option (i.e., the share of the people who choose not to buy) is

[8] A bottle under this definition contains, for example, four litter of beer, or is equivalent to a bottle of wine. Alternatively, we doubled the potential market size defined in this paper to find that the paper's results reported below quantitatively hold.

denoted by s_0. Thus $s_0 + \sum s_j$ must be equal to one. Following Berry (1994), a linear regression model for this three-stage nested logit is derived as follows:

$$\ln(s_j) - \ln(s_0) = \alpha p_j + x_j\beta + \sigma_a \ln(s_{g(j)}) + \sigma_b \ln(s_{j|g(j)}) + \xi_j, \tag{3}$$

where $s_{g(j)}$ is the share of second-level subgroup $g(j)$ in first-level subgroup, $s_{j|g(j)}$ is the observed within second-level subgroup share of alcoholic beverage j. We estimate this model in Section 3.3. Since p_j, $s_{g(j)}$ and $s_{j|g(j)}$ are all endogenous, we use instrumental variables in estimating (3).

3.2 Instruments

It may be that three explanatory variables in (3) are correlated with the error, ξ_j. Obvious variables are $s_{g(j)}$ and $s_{j|g(j)}$, since these contain part of the dependent variable, s_j. The other variable that is plausibly correlated with ξ_j is p_j. As we saw in Section 2, the observed characteristics, represented by product dummy variables, do not fully capture product images and consumers' perception of observed quality that could change over time. We thus interpret ξ_j as the unobserved quality error. If ξ_j is correctly perceived by consumers and sellers in the market, then this unobserved quality error is likely correlated with price: Better-quality product may induce higher willingness to pay, and sellers may be able to charge higher prices due to higher marginal costs or oligopolistic market power.

Traditionally cost variables that are excluded from x_j, such as input prices, are used as instruments in homogenous-goods model, and continue to be appropriate here. We take advantage of geographical dimension of the data, and construct the variable that measures the geographic accessibility to the alcoholic beverages from the suppliers' point of view. We use the variable of supplier access, SA, defined as follows:

$$SA_{jmt} = \sum_n \frac{q_{jnt}}{d_{nm}}, \tag{4}$$

where q_{jnt} is the total production volume for product j manufactured in market n in period t, and d_{nm} is the distance between the markets n and m. This variable measures the distance-weighted sum of liquor supply at market m. It implies that the existence of transport costs would prevent a distant supplier from shipping a larger volume of liquors, and thus lowers the value of SA_{jmt}. Relatively long vinification and distillation process makes it difficult to quickly adjust production volume to demand shocks. Indeed, for each of the nine alcoholic beverages, the correlation coefficients between residuals of AR(1) regressions of volumes of consumption and production are small (the average value of the coefficients is 0.053). Based on small estimated correlation coefficients of AR(1) regressions of consumption volumes and the supply access measure, it is likely that production volumes of other regions are also slow to adjust to demand shocks in region m. Therefore, the supplier-access variable would serve as a cost side instrument for the price variable. We also expect that a product with greater accessibility from suppliers achieve a higher within market shares, $s_{g(j)}$ and $s_{j|g(j)}$.

In product differentiation models, the cost measure of other products can also be an appropriate instruments. With market power in supply, the markup of each product depends on the costs of the other products. The supplier-access measure, which reflects a transport-related cost, of other products are thus related to p_j. However, since they are considered to be exogenous, they are valid instruments. In the present study, we include in the set of instruments the sum of the supplier-access measure of other products within the same subgroup, as well as those outside of the same subgroup. In total, we have three instruments in the estimation, the results of which are discussed in the following subsection.

3.3 Demand Estimates

This subsection presents estimation results of the demand model (3) discussed above. We estimate the equation using an instrumental variable (IV) method. It is known that the IV method can produce severely biased estimates, if the instruments are weak. We thus check the explanatory power of instruments, conditional on the included exogenous variables in the first stage of the IV method. We obtain an F-statistic for each of the endogenous variables discussed in Section 3.2. To conserve space, Table 2 reports the average value of the F-statistics. We find that all the instruments used in this paper are not weak at the 99-percent confidence level of F-statistics. The estimated coefficients in the table are obtained by regressing the dependent variable onto the exogenous and fitted values of endogenous variables. Table 1 shows three estimation results. All specifications control for product and year effects.

[Table 1]

Specification (1) reports the estimation results of three-level nested logit model by 2SLS. The estimated price coefficient is negative of statistical significance. Comparison with the OLS result in column (2) shows that the instruments successfully control for the bias in the price coefficient, from 0.009 (OLS) to -1.037 (2SLS). The coefficient of $s_{j|g(j)}$, σ_b, moves from 0.926 (OLS) to 0.686 (2SLS). These findings indicate the successful elimination of the endogeneity in the positive correlation of these variables with with the demand error ξ_j.

One of the paper's primary interest in the demand estimates is whether the estimated values of σ_a and σ_b are statistically the same. The Wald test reported in Table 1 cannot reject the null hypothesis that $\sigma_a = \sigma_b$, and provide evidence consistent with the finding made in the previous section that *shochu* and other distilled beverages constituted the same relevant market, and thus were in the DCS relationship. This result implies that the three-stage nested logit can be collapsed into the two stages. Indeed, the estimates obtained from the two stage nested logit model are similar to those under Specification (1).

To check the robustness of the nest structure reported in Table 1, we try three other choice models. For the demand estimates summarized in Table 2, none of the obtained parameters satisfy $0 \leq \sigma_a \leq \sigma_b < 1$, the inequality that should hold under consumer's utility maximization.

[Table 2]

By use of the demand estimates reported in Specification (1) in Table 1, we can calculate the following own- and cross-price elasticities.

$$\frac{\partial s_k p_j}{\partial p_j s_k} = \begin{cases} \frac{\alpha p_j}{1-\sigma_b}\left[1 - \frac{\sigma_b-\sigma_a}{1-\sigma_a} s_{j|g(j)} - \sigma_a \frac{1-\sigma_b}{1-\sigma_a} s_{j|f(j)} - (1-\sigma_b) s_j\right] & \text{if } j = k \\ \frac{\alpha p_j}{1-\sigma_b}\left[- \frac{\sigma_b-\sigma_a}{1-\sigma_a} s_{j|g(j)} - \sigma_a \frac{1-\sigma_b}{1-\sigma_a} s_{j|f(j)} - (1-\sigma_b) s_j\right] & \text{if } j \neq k \text{ and } g(j) = g(k) \\ \frac{\alpha p_j}{1-\sigma_b}\left[- \sigma_a \frac{1-\sigma_b}{1-\sigma_a} s_{j|f(j)} - (1-\sigma_b) s_j\right] & \text{if } g(j) \neq g(k) \text{ and } f(j) = f(k) \\ \frac{\alpha p_j}{1-\sigma_b}\left[-(1-\sigma_b) s_j\right] & \text{if } f(j) \neq f(k). \end{cases} \tag{5}$$

The respective $f(j)$ and $g(j)$ represent the first-level and the second-level subgroups to which an alcoholic beverage j belongs. While $s_{j|g(j)}$ is the observed within second-level subgroup share of alcoholic beverage j, $s_{j|f(j)}$ is the observed within first-level subgroup share of beverage j.

Table 3 shows own- and cross- price elasticities averaged across markets. A cell entry (i, j), where i indexes row and j column, inform us of a percent change in market share of product i with one percent change in price of j. The table indicates an elastic demand for each of the distilled liquors, with own-price elasticities ranging between -5.7 (*shochu* A) and -21.3 (Liqueurs). The estimated own-price elasticity for the distilled liquors is on average -4.5, implying that Japanese alcoholic demand is estimated more elastic than those found in other countries. For example, Chaloupka, Grossman, and Saffer (2002) report that own-price elasticity for distilled beverages on average is found to be -1.5.

[Table 3]

Cross-price elasticities are also reported in Table 3, suggesting that demand substitution between *shochu* and other distilled beverages is presumably large. In the next section, we use the estimated elasticities to calculate the optimal taxes on Japanese liquors and conduct welfare exercises in comparison with the actual liquor taxes.

4 Evaluating Japan's liquor taxes

The NT obligation is often seen as imposing considerable constraints on national government's sovereignty. As for the Japanese Liquor Tax Law under study, Japanese government was presumably under constraint regarding their ability to freely determine domestic alcoholic taxes, and reformed the Law to make distilled liquors to be taxed at the same rates upon the WTO recommendation.

In this section, we evaluate this reform from the viewpoint of Japanese consumer welfare. In what follows, using the demand model estimated in the previous section, we first derive the optimal tax rates that maximize social welfare. Then, comparing the optimal and the actual tax rates, we investigate whether the reform made the tax rates closer to the optimal. Furthermore, we quantitatively evaluate the tax reform in terms of the economic surplus.

4.1 Optimal Liquor Taxes

The optimal tax rates are those that maximize social surplus, provided that national tax revenue for all the alcoholic beverages remains the same as the actual revenue R. Under the assumption of perfect competition in the Japanese alcoholic market,[9] the Ramsey pricing is derived from the following optimization problem:

$$\max_{T} \; v(P;I) \qquad \text{s.t.} \; \sum_{k=1}^{N} t_k x_k(P;I) \geq R\,, \tag{6}$$

where $v(\cdot)$ is a representative consumer's indirect utility function, P is a vector of product j's prices p_j, I is income, and $x_j(P;I)$ is the demand for product j, where j includes two kinds of *shochu*'s, whisky, spirits and liqueurs A specific tax rate for j is given by t_j, and thus under the assumption of perfect competition, $p_j = c_j + t_j$, where c_j is the marginal cost for product j. The first order condition with respect to t_j is given by

$$\frac{\partial v(P;I)}{\partial p_j} + \lambda \left\{ x_j(P;I) + \sum_k (p_k - c_k) \frac{\partial x_k(P;I)}{\partial p_j} \right\} = 0\,. \tag{7}$$

[9] According to the Census of Manufactures in 2003, 224 firms produced shochu in Japan, 25 firms produced Whisky, and 128 firms produced the other distilled alcoholic beverages.

where λ is the Lagrangian multiplier that represents the implicit marginal value of liquor tax. Using Roy's identity, we obtain the optimal tax rates as follows:

$$\begin{cases} \frac{\lambda - \frac{\partial v(P;I)}{\partial I}}{\lambda} x_j(P;I) + \sum_{k \in J}(p_k - c_k)\frac{\partial x_k(P;I)}{\partial p_j} = 0, \\ \qquad j \in J\,,\ J \equiv \{\textit{shochu A},\ \textit{shochu B}, \text{ whisky, spirits and liqueurs}\} \\ \\ (P - C)'X(P;I) = R\,. \end{cases} \tag{8}$$

From the above equations, we derive the optimal tax rates. The three-stage nested logit model gives a closed form derivative, $\frac{\partial x_k(P;I)}{\partial p_j}$. [10] Substituting this into (8) gives us the implication that the optimal tax rates t are the same across all products j's. Hence the same specific tax rates results in the small ratio of tax to price for a relatively elastic product. This is in line with the well-known Ramsey pricing.

Figure 3 shows the ratio of an actual to the optimal tax rate for each product. Before the tax reform, all distilled spirits were taxed more than the optimal rates. While the ratio of the actual tax rates for *shochu* was 3.25, the ratios of other distilled spirits took much higher values, such as 5.04 for liqueurs, 6.09 for spirits and 15.06 for whiskies. After the tax reform, the ratios of the actual to the optimal tax rates approach to one for all products: 1.06 for *shochu* and 1.09 for whisky in 2002. These results suggest that the reform that complied with the WTO's recommendation make the tax rates closer to the optimal.

[Figure 3]

Note that the level of the optimal tax critically depends on the value of the price coefficient. Table 5 shows the optimal tax rate in 1994 based on various values of demand parameters. Column (1) shows the rate with the base model. Column (4)-(6) shows results with various values of nest structure parameters, namely σ_a and σ_b. Column (7) shows the result with the two-stage nested logit model estimation; these are similar to the base result. While the optimal tax rate is robust to the values of nest structure parameters, it is sensitive to the value of the price coefficient. Column (2) and (3) shows the results with 10% increase/decrease of the value respectively. Since the calculated optimal rate spreads (from 814 in (3) to 4,188 in (2)), it is difficult to point out exactly the optimal tax rates in 1994.

[Table 5]

[10] See (5).

4.2 Consumer surplus

We quantitatively evaluate the tax reform in terms of distortion in consumer surplus. We compute the compensating variation (hereafter CV) between under an actual tax system and the optimal one. For the three-stage nested model estimated above, CV can be calculated by:[11]

$$CV = \frac{\ln\left\{G\left(e^{\delta_0^*}, \ldots, e^{\delta_J^*}\right)\right\} - \ln\left\{G\left(e^{\delta_0^{actual}}, \ldots, e^{\delta_J^{actual}}\right)\right\}}{(-\alpha)}, \quad (9)$$

where δ^* is the mean utility under the optimal tax rates, and δ^{actual} is the mean utility under the actual tax rates. The difference between δ^* and δ^{actual} arises from the difference in prices. Under the assumption of perfect competition, the difference in prices equals to the difference in tax rates. In the following calculations, the mean utilities from outside goods are set zero ($\delta_0^* = \delta_0^{actual} = 0$), and the tax rates for the other alcoholic products which were not objective in the dispute, such as beer and wine, are fixed at actual rates (e.g. $\delta_{beer}^* = \delta_{beer}^{actual}$).

We find that the loss of consumer surplus was 1,623 billion yen in 1994; the loss had decreased with the tax reform, leading to 17 billion yen in 2002. Figure 4 shows the sum of CV's relative to the total values in consumption on the alcoholic beverages. Before the tax reform, the loss of consumer welfare is equivalent to 25% of total consumption value. The last row in Table 5 shows that this value is robust to the estimated values of demand parameters, while the optimal tax rates critically depend on the value of the price coefficient as discussed above. After the tax reform, this distortion dropped to 0.4% in 2002. The remaining distortion presumably comes from the difference in tax rates between *shochu* and whisky. In summary, the tax reform upon the WTO recommendation substantially improved Japanese consumer welfare close to the optimal level.

[Figure 4]

5 Conclusion

The main purpose of this paper was to evaluate the WTO dispute on Japan's Liquor Tax Law—*Japan–Tax on Alcoholic Beverages*. The defining problems of this dispute was whether *shochu* and other distilled spirits were in DCS. This paper approached to this problem in terms of consumers' preference. We estimated the demand system for Japan's alcoholic beverages market by using a three-stage nested logit model, and found that consumers perceive little distinction between *shochu*

[11] Eq.(9) is based on the findings of Small and Rosen (1981) and Trajtenberg (1990). When $\sigma_a = \sigma_b$ or $\sigma_a = 0$, a three-stage nested logit model is collapsed to a two-stage nested logit model. See, for example, Kitano and Ohashi (2010). Also, when $\sigma_a = \sigma_b = 0$, a three-stage nested logit model is reduced to a simple logit model. See, for example, Nevo (2000).

and other distilled beverages.

We also examined the optimal tax rates for each alcoholic beverage, and compare them to the actual taxes. Upon the recommendation by the WTO appellate body, Japan made the liqueur tax reform, leading to almost identical specific tax rates for distilled beverages at issue. By the reform, Japan's liquor tax rates became closer to the optimal, and consumer welfare substantially improved.

A Data Sources

Estimating the model requires the following variables: market shares, prices in each market, and local supply of each alcoholic beverage for calculating supplier access.

Market shares and prices are obtained from annual alcoholic beverages and food statistics (*Sake-rui Shokuhin Toukei Nenpou*). This data are aggregated by the category of alcoholic beverages by Japan's Liquor Tax Law, and covers up 47 prefectures in Japan from the period of 1994 to 2002. Supply of alcoholic beverages in each plants are obtained from the Census of Manufactures. This data provides the output of alcoholic beverages of each plant.

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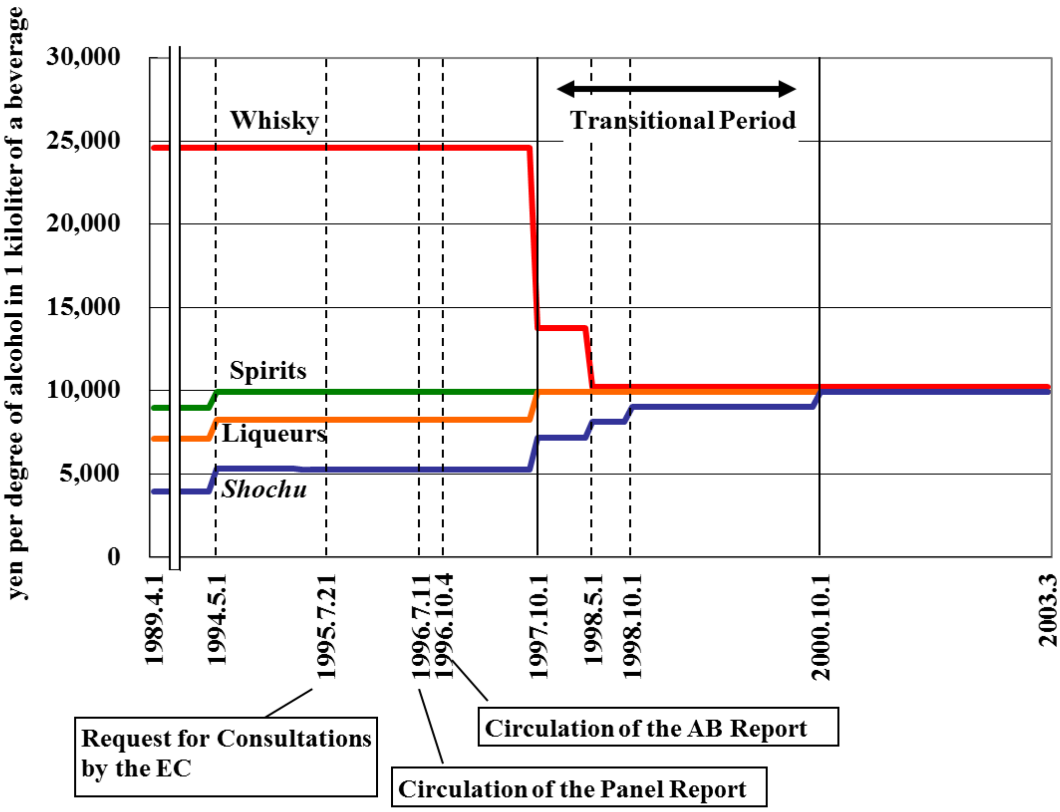
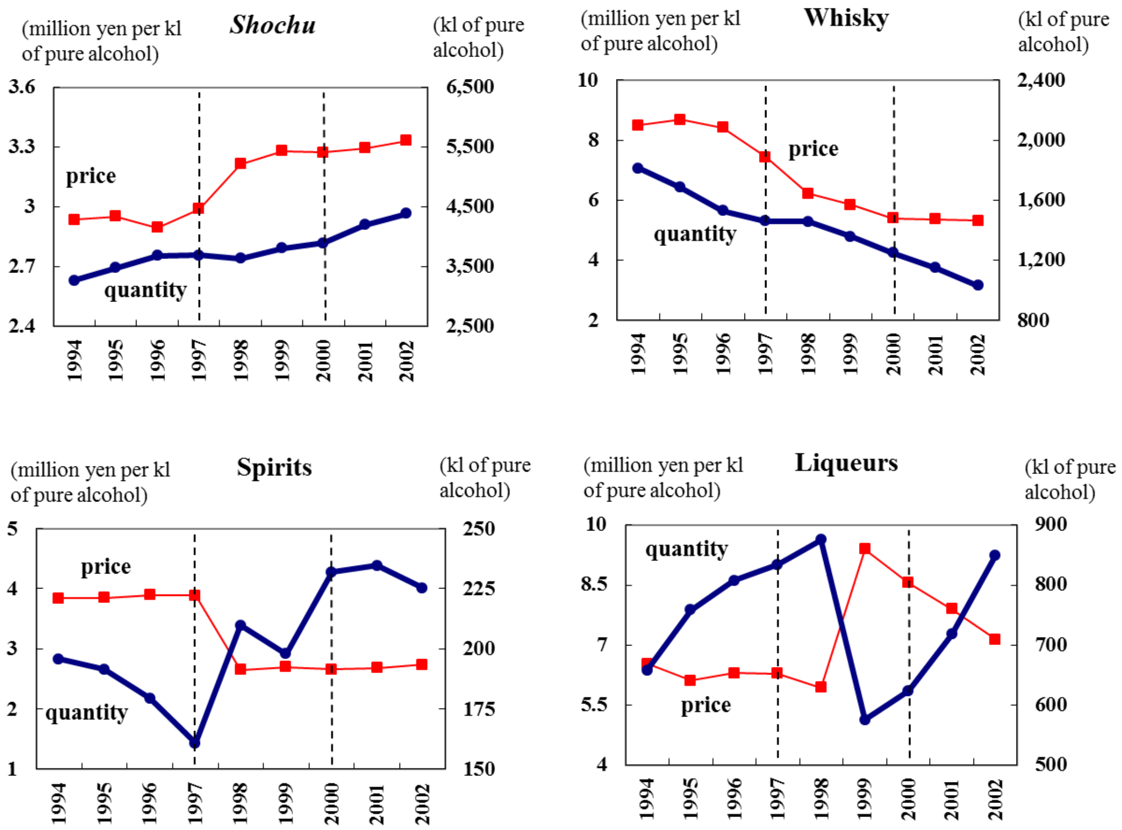
Figure 1: Legal Changes of the Liquour Tax Law



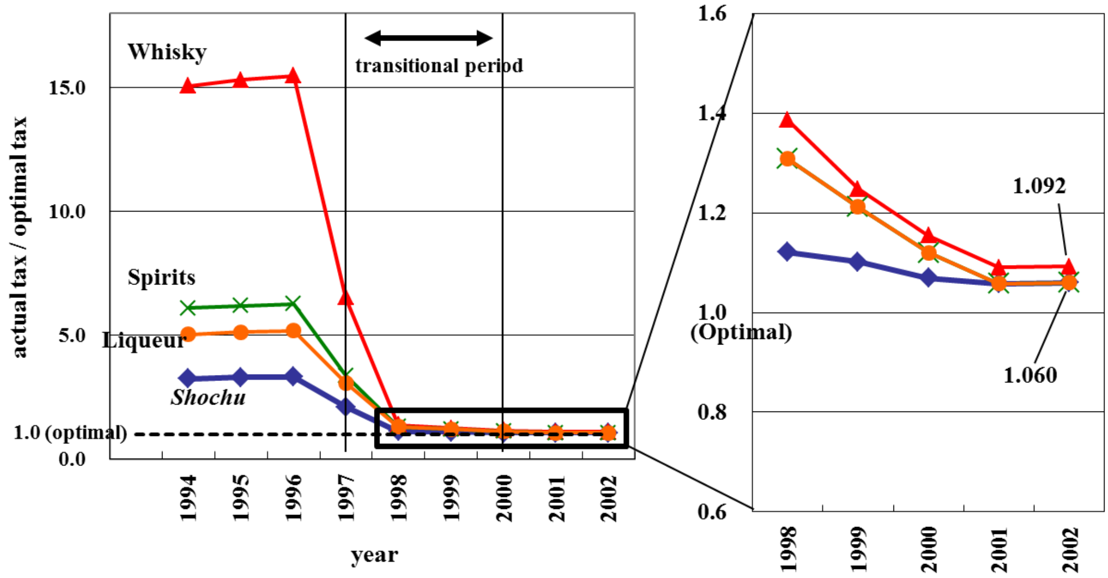
Note: Created from National Tax Agency Annual Statistics Report (*Kokuzeicho Tokei Nenposho*) 1989-2003. The rates are expressed as a specific amount in Japanese Yen per degree of alcohol in one kilolitre of a beverage; they are the reference rates, which apply to beverages with the reference alcoholic content (e.g. 40 percent for whisky). A tax rate of *Shochu* is the weighted average of tax rates of *Shochu* A and *Shochu* B which is weighted by quantities. The tax rates before September 1997 are as follows; 6,228 for *Shochu* A, 4,084 for *Shochu* B, 24,558 for Whisky, 9927 for Spirits, and 8,217 for Liqueurs. The tax rates after October 2000 are as follows; 9,924 for *Shochu* A, *Shochu* B, Spirits, and Liqueurs, and 10,225 for Whisky.

Figure 2: Prices and Quantities



Note: Quantity of *shochu* is the sum of quantities of *shochu* A and *shochu* B; prices of *shochu* is the weighted average of price of *shochu* A and *shochu* B which is weighted by quantities. The period between dotted vertical lines is the transitional period of liquor tax change following the dispute.

Figure 3: Ratios of Actual Tax Rates to the Optimal



Note: A value of *Shochu* is the weighted average of values of *Shochu* A and *Shochu* B which is weighted by quantities.

Figure 4: Degree of Distortion

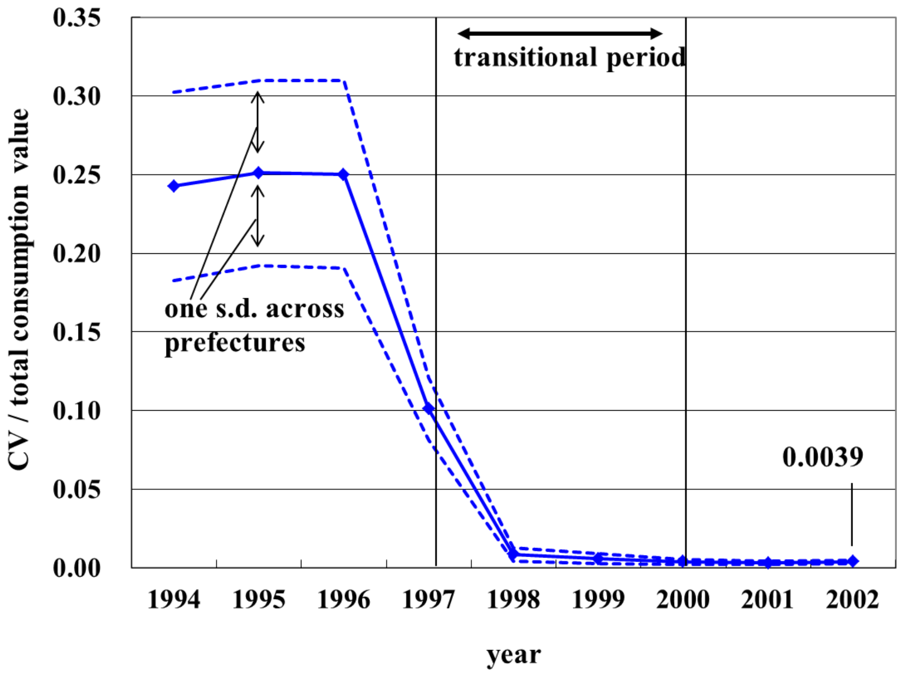


Table 1: Estimation Results

	(1) IV 3-stage nested logit estimates	s.e.	(2) OLS 3-stage nested logit estimates	s.e.	(3) IV 2-stage nested logit estimates	s.e.
Price	-1.037	[0.492]**	0.009	[0.007]	-1.034	[0.485]**
σ_a	0.671	[0.671]	0.642	[0.019]***		
σ_b	0.686	[0.365]*	0.926	[0.014]***		
σ					0.690	[0.351]**
No. Observations	3807		3807		3807	
R^2	0.66		0.95		0.66	
First-stage F-statistics	8.723***		-		3.835**	
p-value of Wald test $H_0: \sigma_a = \sigma_b$	0.98		0.00***			

Note: Heteroskedasticity-robust standard errors are used. * significant at 10%; ** significant at 5%; *** significant at 1%. First-stage F-statistics provide the average explanatory power of the instruments.

Table 2: Robustness to Other Nest Structures

second-level subgroups	Base Model: {Shohu}, {Whisky, Spirits, Liqueurs}		
$0 \le \sigma_a \le \sigma_b < 1$	satisfied		
p-value ($H_0: \sigma_a = \sigma_b$)	0.98		
second-level subgroups	{*Shochu*, Whisky}, {Spirits, Liqueurs}	{*Shochu*, Spirits}, {Whisky, Liqueurs}	{*Shochu*, Liqueurs}, {Whisky, Spirits}
$0 \le \sigma_a \le \sigma_b < 1$	not satisfied	not satisfied	not satisfied
p-value ($H_0: \sigma_a = \sigma_b$)	0.32	0.02** (significantly $\sigma_a > \sigma_b$)	0.84
second-level subgroups	{*Shochu*, Whisky, Spirits}, {Liqueurs}	{*Shochu*, Whisky, Liqueurs}, {Spirits}	{*Shochu*, Spirits, Liqueurs}, {Whisky}
$0 \le \sigma_a \le \sigma_b < 1$	not satisfied	not satisfied	not satisfied
p-value ($H_0: \sigma_a = \sigma_b$)	0.24	0.02** (significantly $\sigma_a > \sigma_b$)	0.97

Note: In all cases, the first-level subgroups are {*Shochu*, Whisky, Spirits, Liqueurs}, {*Sake*, *Sake* compounds, Beer, Wine}, and {outside goods}. *Shochu* includes two types; *shochu* A and *shochu* B. The null hypothesis, $H_0: \sigma_a = \sigma_b$, is tested by a Wald test; p-values are reported. ** significant at 5%

Table 3: Own and Cross Price Elasticities

	Shochu	Other Distilled Drinks
Shochu	-5.70	5.37
Other Distilled Drinks	4.08	-14.48

Note: Cell entries *(i, j)*, where *i* indexes row and *j* column, give the percent change in total market share of products within category *i* with one percent change in prices of all products within category *j*. Averages across markets are reported. *Shochu* includes *Shochu* A and *Shochu* B; Other Distilled Drinks includes Whisky, Spirits, and Liqueurs.

Table 4: Robustness to the Values of Parameters

	3-stage nested logit						2-stage nested logit
	(1) Base Model	(2)	(3)	(4)	(5)	(6)	(7)
the price coefficient	-1.037	-1.141	-0.934	-1.037	-1.037	-1.037	-1.034
σ_a	0.671	0.671	0.671	0.000	0.336	0.671	0.690
σ_b	0.686	0.686	0.686	0.686	0.343	0.900	0.690
optimal tax rate in 1994	1631	4188	814	1372	1455	1631	1591
CV/ total consumption value in 1994	0.243	0.206	0.224	0.275	0.253	0.246	0.243

Note: The unit of tax rate is yen per degree of alcohol in one kiloliter of a beverage.