Price elasticity of on- and off-premises demand for alcoholic drinks: A Tobit analysis

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Price elasticity of on- and off-premises demand for alcoholic drinks: a Tobit analysis

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ABSTRACT

Background: Understanding how price policies will affect alcohol consumption requires estimates of the impact of price on consumption among different types of drinkers and across different consumption settings. This study aims to estimate how changes in price could affect alcohol demand across different beverages, different settings (on-premise, e.g. bars, restaurants and off-premise, e.g. liquor stores, supermarkets), and different levels of drinking and income.

Methods: Tobit analysis is employed to estimate own- and cross-price elasticities of alcohol demand among 11 subcategories of beverage based on beverage type and on- or off-premise supply, using cross-sectional data from the Australian arm of the International Alcohol Control survey 2013. Further elasticity estimates were derived for sub-groups of drinkers based on their drinking and income levels.

Results: The results suggest that demand for nearly every subcategory of alcohol significantly responds to its own price change, except for on-premise spirits and ready-to-drink spirits. The estimated demand for off-premise beverages is more strongly affected by own price changes than the same beverages in on-premise settings. Demand for off-premise regular beer and off-premise cask wine is more price responsive than demand for other beverages. Harmful drinkers and lower income groups appear more price responsive than moderate drinkers and higher income groups.

Conclusion: Our findings suggest that alcohol price policies, such as increasing alcohol taxes or introducing a minimum unit price, can reduce alcohol demand. Price appears to be particularly effective for reducing consumption and as well as alcohol-related harm among harmful drinkers and lower income drinkers.

Key words: Alcohol demand, elasticities, price policy, Tobit model
Introduction

Excessive alcohol consumption is an important cause of social and health harms (Babor et al., 2010). There is strong evidence that price-based interventions, such as increasing alcohol taxation, banning alcohol promotions, or introducing a minimum unit price, would be effective approaches to reduce the level of alcohol consumption and related health and social problems in a society (Anderson et al., 2009). However, to determine the most effective approach to alcohol pricing interventions, good estimates of price elasticity are needed.

The price elasticity of demand, a ratio of percentage changes in demand of a product given a price change, has been widely discussed in many previous studies for a range of goods and services. Based on the results of more than 100 studies in over 25 countries, three meta-analyses found that the mean overall price elasticity of alcohol demand is about -0.5 (Gallet, 2007; Wagenaar et al., 2009; Fogarty, 2010). Importantly, this overall elasticity provides little information on how pricing policies will affect particular drinkers or beverage categories. Recent studies have focused on the estimation of elasticities for different beverage types and different trade sectors for alcohol price policy appraisal (Doran et al., 2013; Holmes et al., 2014; Meng et al., 2014; Srivastava et al., 2014), highlighting the important differences in price effects across the alcohol market. Elasticities vary across different categories depending on consumers’ preferences, and are also affected by the different existing taxes and prices for different beverage types.

A consumer’s response to price may also be expected to vary by whether the beverage is purchased for on-premise or off-premise consumption, since an on-premise drink is considerably more costly than an off-premise drink. This has important implications for the likely impact of price changes on both consumption and on different types of business. However, previous studies have rarely differentiated between on-premise and off-premise price-elasticities, as the present study does. The extent to which a change in one beverage’s price or tax affects consumption of competing goods is measured as a cross-elasticity. Estimating cross-price elasticities between different types of beverages and between on- and off-premise purchases allows us to understand the substitutory or complementary relationships between different beverage categories (Meng et al., 2014).

Understanding how changes in price could affect alcohol demand among different subpopulation groups has become increasingly important as policy makers look for evidence that price policies will affect heavy or problem drinkers and raise concerns that price policies may unduly affect moderate drinkers (e.g. Australian Government, 2010). Research suggests that drinkers who are socioeconomically disadvantaged and risky drinkers are more likely to purchase cheap alcohol and to experience more alcohol-related harms than others in the population (Ally et al., 2014; Callinan et al., 2015; Morrison et al., 2015). Using cross-sectional survey data, Holmes et al. (2014) and Meier et al. (2010) have estimated alcohol price elasticities among different subpopulation groups in the U.K. and have found that lower income and more hazardous drinkers are more price responsive than higher income and moderate drinkers. However, the effect of price on heavy drinkers in particular remains controversial, with different reviews coming to different conclusions (Wagenaar et al., 2009; Nelson, 2013), suggesting a need for further empirical studies.

In measuring price elasticities of alcohol demand among different subpopulation groups, many previous studies used population survey data (Purshouse et al., 2010; Meier et al., 2010; Meng et al., 2014; Holmes et al., 2014; Sharma et al., 2014), as it provides price variations based on an individual’s consumption and purchasing behaviour, unlike aggregate-data, time series and experimental data.
However, most of these previous studies have excluded zero observations in the analysis. This means that, when estimating price elasticity of demand for a type of beverage, participants with zero consumption of this particular beverage dropped out (for instance, consumers reporting that they only consumed beer and cider in the survey were then excluded in the estimation of price elasticity of wine demand). Similarly, abstainers were excluded from all estimation. This can lead to inconsistent results, because the error term on such conditional equations is no longer symmetrically distributed (Greene, 2011). Collis et al. (2010) suggested that a Tobit model can overcome this issue by coping with zero observations. Therefore, consumers who chose not to consume alcohol or a particular type of beverages can be involved in the estimation.

The present study employs a Tobit model approach to estimate own- and cross-price elasticities of 11 categories of beverage [comprising on- and off-premise separately for regular beer (full strength), low-mid strength beer, bottle wine, spirits and Ready to Drink spirits (RTDs), and off-premise cask wine], using cross-sectional data from the 2013 Australian arm of the International Alcohol Control (IAC) survey. Previous studies, including the influential modelling work that underpins the Sheffield Alcohol Model, have used cross-sectional survey data to estimate price elasticities, based on the cross-sectional variations in prices that respondents are exposed to [e.g. (Angulo et al., 2001; Purshouse et al., 2010)]. Price elasticities of alcohol demand were also estimated for different subgroups, particularly for different types of drinkers and income levels, and compared with previous estimates from the literature.

**Methods**

**Data**

Data were collected from the IAC survey—a national telephone survey collecting data on the experience of alcohol consumption and purchasing from 2020 English-speakers (age 16+) across Australia. A computer-assisted telephone interview with a general population sample was reached by random digit dialling to landlines (60%) or mobile phones. The sample was generally representative of the Australian adult population (Jiang et al., 2014). The cooperation rate was 51.5% (the proportion of responders among the eligible people actually contacted) and if including all cases of non-contact as part of the denominator, the response rate was 37.2%, computed by the standards set by the American Association for Public Opinion Research (AAPOR; 2008).

Risky drinkers were oversampled, using a preliminary screener question where potential respondents were asked, “how often would you consume five or more standard drinks in a session?” Respondents who stated that they did this once a month or more often were considered risky drinkers for the purposes of study sampling, and invited to participate. Of the respondents who did not drink five or more Australian Standard Drinks (ASD, one ASD = 10 grams ethanol) in a session at least monthly (including non-drinkers), a randomised one-third were asked to participate. Using this method, the 30.1% of Australians who reported drinking five or more ASDs in a session once a month or more [as per the 2010 National Drug Strategy Household Survey (Australian Institute of Health and Welfare, 2011)] made up 67% of the sample. Respondents were assigned weights reflecting the number of eligible persons in the household (for landlines), and their access to landlines and/or mobile phones, as well as whether they were in the heavier-drinking subsample. In a second stage of weighting, data were weighted inversely by sample selection probability and to reproduce the age, sex and geographic composition and drinking status of the Australian adult population in the 2011 census (ABS, 2011), with the weighted total number set equal to the unweighted sample size (Livingston and Callinan, 2015). The over-sampling of risky drinkers has thus been adjusted for in all results presented in this paper.
The Australian survey was adapted from the New Zealand version of the IAC survey (Casswell et al., 2012). Questions about purchasing of alcohol were asked using detailed loops: respondents were asked how often they consume and purchase alcohol from a range of types of on- and off-premise venues, what they usually purchase at each venue type, and how much they consume. Information on the amount and cost of alcohol purchased allowed calculation of a unit price per standard drink across different beverage and outlet types (See Appendix for more details of computing alcohol prices, consumption and purchasing using survey questions). Thus, the IAC survey data provide the opportunity to estimate price elasticity by utilizing cross-sectional variation in alcohol consumption, purchasing and price to determine price sensitivity across the population at a point in time. The survey questionnaire, methodology and sample design are reported in detail in the Australian IAC technical report (Jiang et al., 2014).

**Tobit regression model**

Tobit regression models were employed to estimate price elasticities of demand for alcohol in Australia. The model supposes that there is a latent variable $Q_i^*$ (quantity of alcohol demand or consumption). This variable linearly depends on $P_j$ (own price and prices of other types of beverages) via a parameter which determines the relationship between the independent variable $P_j$ and the latent variable $Q_i^*$. In addition, there is a normally distributed error term $\varepsilon_i$ to capture random influences on this relationship. The observable variable $Q_i$ is defined to be equal to the latent variable whenever the latent variable is above zero, and to be zero otherwise.

$$Q_i^* = C_i + \sum_{j=1}^{11} \alpha_{i,j} P_j + \beta_i X + \gamma_i Y + \delta_i Z \ldots + \varepsilon_i$$

$$Q_i = \begin{cases} Q_i^* & \text{if } Q_i^* > 0 \\ 0 & \text{if } Q_i^* \leq 0 \end{cases}$$

where $Q_i^*$ is demand or consumption of beverage $i$, $P_j$ are prices of the different types of beverages (in total 11 categories in our analysis), $\alpha_{i,j}$ are coefficients of prices of difference beverages and $C_i$ are constants of regression models. $X$, $Y$, $Z$ are confounding factors, including age, gender, household income, regional variations, etc., which can affect alcohol demand and the initial decision to consume alcohol or not. We use the raw, untransformed data in our analyses here. The Appendix provides a full discussion of the model selection process and a comparison of this model, an OLS model and a log-log Tobit model.

In theory, people may be less willing to buy alcohol due to many reasons, e.g. prices, health condition, religious or other reasons. The coefficient of a Tobit regression model represents consumers’ willingness to buy alcohol. But in the real world people can choose not to purchase alcohol because they dislike it or the price is not affordable for them. Thus, consumers who had negative willingness to buy alcohol were constrained. The price elasticities of demand for alcoholic beverages were calculated based on the marginal effect of consumers’ willingness to buy alcohol at a certain price. The marginal effect is a combination of the response of alcohol demand to the price change when consumers consumed alcohol and the probability of making a decision to buy alcohol or not for those who had no alcohol expenditure in the past 6 months. The computing method of the marginal effects of alcohol demand to price changes is elaborated in the Appendix.
Both alcohol consumption and purchasing data were used in the analysis. Of the 2020 respondents, 1789 reported they consumed alcohol in the last 6 months and 1823 reported they purchased alcohol either from on- or off-premise, although 70 of them did not report purchasing expenditures. Respondents who did not consume or purchase alcohol in the survey period (abstainers or no alcohol consumption or purchasing; n=267) are censored as a consumption choice problem. Furthermore, when estimating price elasticities for beverage type “A”, respondents who consumed other types of beverages without consuming any “A” in the last 6 months were also censored as a corner solution in the regression (A consumer may consume good “X” but not consume “Y” by saying that “I wouldn't buy Y at any price” or ”I will do X no matter the cost”, and this consumption choice is called a “corner solution” in microeconomics). The volume and total costs of consumption and purchasing were doubled in the analysis to give an annual amount, comparable to other Australian survey analyses. Since the six months before the survey fieldwork included the seasons when more alcohol is consumed, annual consumption is likely to be slightly overestimated.

Due to limited observations, on-premise cask wine and on- and off-premise cider purchases were excluded in the price elasticity analysis. In subpopulation analyses, alcohol consumers were classified into three groups: moderate drinkers (≤14 ASDs per week for men and women), hazardous drinkers (>14–42 ASDs for men and >14–35 ASDs for women), and harmful drinkers (>42 ASDs for men and >35 ASDs for women). The three drinking levels follow definitions in Australian Guidelines to Reduce Health Risk from Drinking Alcohol (National Health and Medical Research Council, 2009). The total population was also split into three income groups with fairly equal observations based on the annual income in the respondent’s household: lower income (<$47k), middle income ($47–90k) and higher income (>90k). The price elasticities of demand among three different drinking levels and income levels were evaluated in our models in order to understand how price changes could affect alcohol demand among different subgroups of consumers.

When estimating price elasticities by level of drinking and income level, we combined cask wine and bottle wine into one group, “wine”, while regular-beer and low-mid strength beer were combined as “beer”, in order to increase price variations, thus enhancing estimation performance in subpopulation groups. Additionally, control variables and instrumental variables that can affect demand and consumption choice were included in estimating models (missing data were found in some control variables and multiple imputation techniques were applied to impute missing data in our analyses, see Appendix). For example, a consumer’s gender, age, household income, education levels, number of household aged 18 and over, marital status and regional variations can affect drinking preferences, affordability for alcohol products (Treno et al., 2006; Morrison et al., 2015). Due to data availability, some confounding factors were not included in our estimation, such as respondent’s health conditions and religious affiliation (the full list of variables used in the estimation and robustness checks and discussion of alternative methods are detailed in the Appendix). Two sample t-tests were utilised to test the differences in mean price per ASD between different beverages, and one-way ANOVA tests were conducted to test for differences in the average amount of alcohol purchased and mean price per ASD across different drinker and income groups. All analyses presented in this study are on data weighted to benchmarks from the Australian Bureau of Statistics 2011 Census (ABS, 2011).

**Results**

On average, Australians aged 16 and overconsumed a higher volume of off-premise bottle wine and off-premise regular beer than the nine other categories of beverage (shown in Table 1), and consumed higher volumes of regular beer and bottle wine than other types of beverages in both on- and off-
premises settings. The average price per ASD of all beverage types purchased off-premise is one-third (0.34) of the average price of an on-premise drink, and off-premise cask wine is the cheapest beverage ($0.65AUD per ASD; t=12.36, p<0.001) among the 11 categories. Harmful drinkers purchased four times the average number of ASDs in the form of cheaper alcohol than hazardous and moderate drinkers (F(2)=652.18, p<0.001). Lower income consumers drank a lower average amount of alcohol annually than a higher income group, also consuming cheaper beverages than middle and higher income consumers (F(2)=11.64, p=0.003).

The Tobit regression outputs for the 11 beverage categories are presented in Appendix Table A.3. The own- and cross-price elasticities of demand among 11 categories of on- and off-premise beverages are calculated based on the mean of the marginal effects and then summarized in Table 2. The results indicate that nearly all prices were negatively and significantly associated with the beverage’s own demand (own price elasticities highlighted as dark cells), except for on-premise RTDs. Off-premise cask wine has the highest own-price elasticity (coefficient=-1.35), followed by off-premise regular beer with -1.15. The results for cross-price elasticities suggest that the prices of off-premise beverages were significantly and positively associated with demand for the same beverage on-premise.

The own-price elasticities of alcohol demand among three types of drinkers and eight categories of beverage are summarized in Table 3. The elasticity values suggest that harmful drinkers are more price responsive than hazardous and moderate drinkers across nearly all on- and off-premise beverages (except for on-and off-premise RTDs). The own-price elasticities of demand for on –premise beer, off-premise beer, wine and spirits are over 1 in the harmful drinkers model, indicating that the harmful drinkers’ demand for these four types of beverages are price elastic and more price responsive than for other beverage categories.

Table 4 shows the own-price elasticities of alcohol demand among three income groups and 8 categories of beverage. The results suggest that absolute values of own-price elasticities of demand for nearly all beverages are higher among lower income drinkers than among middle and higher income drinkers. Price elasticities of demand for on-premise beer and wine are similar across three household income groups.

Discussion
The own-price elasticities estimated in this study are similar to those reported in the previous meta-analyses; 0.46 to -0.83 for beer, -0.69 to -1.11 for wine and -0.36 to -1.09 for spirits (Gallet, 2007; Wagenaar et al., 2009; Fogarty, 2010). The estimated elasticities in our study are not directly comparable with most previous estimates, because the beverage categories included are more detailed than most previous studies. Another possible reason for the heterogeneity of the elasticity estimates in the literature is due to the mix of tax elasticity and price elasticity; tax elasticity is different from price elasticity, as tax is only a fraction of price (Xuan et al., 2015). Beverage-specific negative elasticities
estimated in the Australian study of Srivastava et al. (2014) are much higher than our estimations, but this study did not differentiate on- and off-premise purchases. Conversely, our estimates are broadly in line with some previous disaggregated studies [i.e. Doran et al. (2013) and Meng et al. (2014)], revealing that off-premise beverages are generally more price responsive than beverages sold on-premise. Meng et al. (2014) suggested that off-premise beer is more price responsive than off-premise wine, spirits, and RTDs, and on-premise beer is more elastic than on-premise wine. A similar pattern is also observed in our study, while our estimations further suggest that off-premise cask wine -- the cheapest form of alcohol in Australia, but never discussed in previous elasticity studies -- is the most price responsive beverage in the current analysis.

The own- and cross-price elasticities estimated in this study can be utilised to estimate the effects of price-based interventions on alcohol consumption and related harms in Australia -- allowing detailed examination of change in beverage-specific demand in response to changes in price in the on- and off-premise sectors. For example, the present study yields an estimate that if off-premise regular beer and cask wine prices increased by 10%, demand for the two beverages will decrease by 14% and 12% respectively, and demand for on-premise regular beer will increase by 7%.

The effectiveness of price-based intervention is further supported by our findings on own-price elasticities, suggesting that an increase in alcohol price or tax will effectively reduce the demand for alcohol, particularly for off-premise cask wine, bottle wine, spirits and regular beer. In contrast, demand for on-premise low-to-mid strength beer, spirits and RTDs would not be significantly affected by own price changes. The estimated cross-price elasticities show complex substitution and complementary relationships among different categories of beverage, suggesting that alcohol price policies should not be focused on particular types of beverage (the complexity of the Australian alcohol taxation system is explained in the Appendix), but rather on a uniform price or tax policy, such as a minimum price per standard drink or a volumetric taxation system based on alcohol content (Jiang and Livingston, 2015). As absolute own-price elasticities of off-premise beverages are estimated to be greater than on-premise beverages and off-premise venues sell cheaper priced alcohol than on-premise venues, it can be expected that price policies will have a greater proportional reduction on off-premise alcohol consumption than on on-premise alcohol consumption.

A recent policy debate in Australia has posed the question whether any increase in the alcohol price or tax would disproportionately affect moderate drinkers (Australian Government, 2010; Sharma et al., 2014). This study provides evidence that harmful drinkers are more price responsive than hazardous and moderate drinkers, suggesting an increase in alcohol price or tax will achieve a greater reduction in alcohol consumption for harmful drinkers and a considerably smaller reduction in hazardous and moderate drinkers. This is consistent with findings in the U.K. (Holmes et al., 2014) and a longitudinal study in the US (Farrell et al., 2003), though it differs from an earlier cross-sectional quintile regression analysis involving the same group in the US (Manning et al., 1995).

Previous studies show that disadvantaged groups are generally less likely to report alcohol use, but experience more severe health outcomes at all levels of consumption compared to those with a higher socioeconomic status (Jefferis et al., 2007; Schmidt et al., 2010). Our research findings suggest that lower income drinkers are generally more price responsive than middle and higher income drinkers, particularly for on- and off-premise beer and wine, and off-premise spirits. Therefore, an increase in alcohol price or tax, or the introduction of a minimum unit price, would have a greater effect on lower income drinkers than on middle and higher income drinkers, especially since lower income drinkers are
more likely to consume cheaper alcohol than the other two income groups. These findings are unsurprising, as alcohol price changes will more significantly affect the spending money of more disadvantaged drinkers – one of the reasons that excise taxes are generally considered regressive. However, the regressiveness of alcohol taxes needs to be considered against the potential reductions in health inequalities (Jiang et al., 2015), which our findings suggest could be substantial.

**Limitations**

There are some limitations in this study. One limitation pertains to recall bias. Respondents were asked to report their usual alcohol consumption and purchasing in the last 6 months, thus costs and volumes of consumption and purchasing reported may not be completely accurate. However, this method of questioning yields results closer to measured consumption than other methods (Livingston and Callinan, 2015). Furthermore, as noted in the method, close examination of the prices paid yielded a very small number of implausible responses, lending support to the method. It is worth noting that the present study’s low response rate is similar to the response rates for other population surveys in Australia, including other alcohol surveys, such as the National Drug Strategy Household Survey (32.7%) (Australian Institute of Health and Welfare, 2014), and the Alcohol’s Harm to Others Survey (35.2%) (Laslett et al., 2011). There are no temporal variations in the cross-sectional data, which may affect the magnitude of alcohol prices, consumption and purchasing. Doubling of 6-month data to calculate annual rates without considering seasonality of alcohol purchasing and consumption may affect the price elasticity estimation, but the impact of this will be small. The term elasticity generally implies a causal relationship. However, since the price elasticities estimated in the study are based on cross-sectional data, there needs to some caution about assuming that they accurately model how behaviour will change in response to changes in price.

**Conclusions**

This study expands beyond the existing studies in the U.K. (Holmes et al., 2014), the U.S. (Farrell et al., 2003) and Australia (Srivastava et al., 2014) by utilising a Tobit approach to estimate price elasticities of demand for alcohol. Using national survey data on both reported alcohol consumption and purchasing, the own- and cross-price elasticities of demand for 11 categories of beverage were estimated. On the basis of its cross-sectional data, the study found demand for nearly all beverage categories significantly and negatively correlated to their own price changes, except for on-premise RTDs. Raising alcohol price or tax could help to reduce alcohol consumption, and is likely to be particularly effective for reducing consumption among harmful drinkers and lower income drinkers. Increases in alcohol prices are likely to particularly affect purchases from off-premise outlets, due to the lower price of alcohol sold from these settings. However, separating price effects for the off-premise and on-premise sectors has been relatively rare in the literature. The present survey, recording price, consumption and purchasing data for a wide range of beverages at on- and off-premises, thus gives a more nuanced picture of price elasticities in different segments of the populations.
References
Ally, A.K., Meng, Y., Chakraborty, R., Dobson, P.W., Seaton, J.S., Holmes, J., Angus, C., Guo, Y.,
Babor, T., Caetano, R., Casswell, S., Edwards, G., Giesbrecht, N., Graham, K., Grube, J., Hill, L.,
Casswell, S., Meier, P., MacKintosh, A.M., Brown, A., Hastings, G., Thamarangsi, T., Chaiyasong, S.,


National Health and Medical Research Council, 2009. Australian guidelines to reduce health risks from drinking alcohol. NHMRC, Canberra.


### Table 1 Mean value of quantity of standard drinks purchased and price paid per standard drink from on- and off-premise venues among three types of drinkers and eleven beverage categories

<table>
<thead>
<tr>
<th>(n)</th>
<th>Quantity of purchasing (ASDs)</th>
<th>Price ($) *</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean 95% CIs</td>
<td>Mean 95% CIs</td>
</tr>
<tr>
<td><strong>On-trade (2020)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular beer (ref)</td>
<td>65 52-77</td>
<td>4.41 4.24-4.58</td>
</tr>
<tr>
<td>Mid-strength beer</td>
<td>10 7-13</td>
<td>5.99 5.62-6.37</td>
</tr>
<tr>
<td>Bottle wine #</td>
<td>36 26-46</td>
<td>6.25 5.80-6.71</td>
</tr>
<tr>
<td>Spirits #</td>
<td>28 22-34</td>
<td>5.34 4.76-5.91</td>
</tr>
<tr>
<td>RTDs #</td>
<td>8 5-11</td>
<td>6.35 5.90-6.79</td>
</tr>
<tr>
<td><strong>Off-trade (2020)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular beer (ref)</td>
<td>346 190-502</td>
<td>1.57 1.51-1.63</td>
</tr>
<tr>
<td>Mid-strength beer</td>
<td>48 33-64</td>
<td>2.31 2.01-2.62</td>
</tr>
<tr>
<td>Bottle wine #</td>
<td>273 231-316</td>
<td>1.96 1.78-2.13</td>
</tr>
<tr>
<td>Cask wine #</td>
<td>39 24-55</td>
<td>0.65 0.47-0.83</td>
</tr>
<tr>
<td>Spirits</td>
<td>122 89-156</td>
<td>1.67 1.52-1.83</td>
</tr>
<tr>
<td>RTDs #</td>
<td>17 12-23</td>
<td>2.79 2.46-3.12</td>
</tr>
<tr>
<td>**Types of drinkers *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate (1071)</td>
<td>385 316-454</td>
<td>2.87 2.58-3.15</td>
</tr>
<tr>
<td>Hazardous (576)</td>
<td>1440 1308-1574</td>
<td>2.45 2.26-2.64</td>
</tr>
<tr>
<td>Harmful (373)</td>
<td>4920 3346-6495</td>
<td>2.23 2.01-2.45</td>
</tr>
<tr>
<td>**Consumer’s income levels *</td>
<td></td>
<td></td>
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<tr>
<td>Lower income (489)</td>
<td>816 622-1012</td>
<td>2.17 1.95-2.39</td>
</tr>
<tr>
<td>Middle income (442)</td>
<td>810 672-948</td>
<td>2.69 2.41-2.97</td>
</tr>
<tr>
<td>Higher income (791)</td>
<td>1413 943-1882</td>
<td>2.63 2.43-2.83</td>
</tr>
</tbody>
</table>

*Respondents reporting they had alcohol expenditure on specific types of beverages were included in the mean price analysis (n=1823); Mid-strength beer includes low- and middle-strength beer; cask wine is wine packed in a big box or cask.

# p<0.05, two sample t-statistics were conducted to compare difference of mean price between each beverage and the referenced beverage (ref) at on- and off-premises separately.

*p<0.05, one-way ANOVA analysis were conducted to test the difference in terms of average numbers of standard drinks and of average price per standard drink purchased among different drinker types and income levels.
Table 2 Own- and cross-price elasticities among eleven beverage categories at on- and off-premises

<table>
<thead>
<tr>
<th>N=2020</th>
<th>on-regbeer</th>
<th>on-midbeer</th>
<th>on-botwine</th>
<th>on-spirits</th>
<th>on-RTDs</th>
<th>off-regbeer</th>
<th>off-midbeer</th>
<th>off-botwine</th>
<th>off-caskwine</th>
<th>off-spirits</th>
<th>off-RTDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>P(on-regbeer)</td>
<td>-0.63****</td>
<td>-0.01</td>
<td>0.20</td>
<td>-0.00</td>
<td>-0.00</td>
<td>0.69***</td>
<td>0.00</td>
<td>0.20</td>
<td>0.02</td>
<td>-0.06</td>
<td>-0.02</td>
</tr>
<tr>
<td>P(on-midbeer)</td>
<td>-0.05*</td>
<td>-0.11***</td>
<td>0.26</td>
<td>-0.02</td>
<td>0.00</td>
<td>0.09</td>
<td>0.06**</td>
<td>0.03</td>
<td>-0.05</td>
<td>-0.03</td>
<td>-0.08*</td>
</tr>
<tr>
<td>P(on-botwine)</td>
<td>-0.01</td>
<td>0.00</td>
<td>-0.14***</td>
<td>-0.00</td>
<td>0.00</td>
<td>-0.08</td>
<td>0.00</td>
<td>0.48***</td>
<td>0.04</td>
<td>0.06</td>
<td>-0.01</td>
</tr>
<tr>
<td>P(on-spirits)</td>
<td>-0.02</td>
<td>0.00</td>
<td>0.08</td>
<td>-0.10***</td>
<td>-0.01</td>
<td>-0.04</td>
<td>-0.02</td>
<td>0.01</td>
<td>-0.06</td>
<td>0.10**</td>
<td>-0.01</td>
</tr>
<tr>
<td>P(on-RTDs)</td>
<td>-0.02</td>
<td>0.01</td>
<td>0.06**</td>
<td>0.01</td>
<td>-0.06</td>
<td>-0.23</td>
<td>-0.02</td>
<td>0.07</td>
<td>-0.09</td>
<td>0.00</td>
<td>0.03*</td>
</tr>
<tr>
<td>P(off-regbeer)</td>
<td>0.40***</td>
<td>0.02</td>
<td>0.17</td>
<td>0.04</td>
<td>-0.05</td>
<td>-1.15***</td>
<td>0.42**</td>
<td>-0.09</td>
<td>0.04</td>
<td>0.13</td>
<td>0.01</td>
</tr>
<tr>
<td>P(off-midbeer)</td>
<td>-0.14</td>
<td>0.10***</td>
<td>-0.07</td>
<td>-0.05</td>
<td>-0.02</td>
<td>0.27***</td>
<td>-0.82***</td>
<td>-0.03</td>
<td>-0.16</td>
<td>-0.24</td>
<td>-0.02</td>
</tr>
<tr>
<td>P(off-botwine)</td>
<td>0.01</td>
<td>-0.01</td>
<td>0.16***</td>
<td>0.00</td>
<td>-0.10</td>
<td>-0.14</td>
<td>-0.04</td>
<td>-0.98***</td>
<td>-0.07</td>
<td>0.02</td>
<td>-0.04</td>
</tr>
<tr>
<td>P(off-caskwine)</td>
<td>-0.29</td>
<td>0.06</td>
<td>-0.19</td>
<td>-0.13</td>
<td>-0.01</td>
<td>0.12</td>
<td>0.10</td>
<td>-0.37</td>
<td>-1.35***</td>
<td>0.82**</td>
<td>-0.07</td>
</tr>
<tr>
<td>P(off-spirits)</td>
<td>-0.03</td>
<td>0.01</td>
<td>-0.07</td>
<td>0.11***</td>
<td>0.02</td>
<td>0.23</td>
<td>0.05</td>
<td>0.05</td>
<td>0.09</td>
<td>-0.85***</td>
<td>0.12</td>
</tr>
<tr>
<td>P(off-RTDs)</td>
<td>-0.00</td>
<td>0.01</td>
<td>-0.02</td>
<td>0.06*</td>
<td>0.02</td>
<td>0.18</td>
<td>0.02</td>
<td>-0.47*</td>
<td>0.08</td>
<td>0.08</td>
<td>-0.26*</td>
</tr>
</tbody>
</table>

Note: * p<0.05, ** p<0.01 and *** p<0.001; own price elasticities are highlighted as dark cells; P(*) are prices of beverages; regbeer is regular strength beer; midbeer is middle- or low-strength beer; botwine is bottle wine; RTDs is ready to drinks; caskwine is wine packed in a big box or cask.
Table 3 Own-price elasticities of demand for alcohol beverages, for three drinker types

<table>
<thead>
<tr>
<th></th>
<th>on-beer</th>
<th>on-wine</th>
<th>on-spirits</th>
<th>on-RTDs</th>
<th>off-beer</th>
<th>off-wine</th>
<th>off-spirits</th>
<th>off-RTDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate drinker</td>
<td>-0.07</td>
<td>-0.03</td>
<td>-0.05</td>
<td>0.02</td>
<td>-0.65***</td>
<td>-0.15**</td>
<td>-0.41*</td>
<td>-0.05</td>
</tr>
<tr>
<td>Hazardous drinker</td>
<td>-0.36**</td>
<td>-0.11</td>
<td>-0.17</td>
<td>-0.03</td>
<td>-0.97***</td>
<td>-1.13***</td>
<td>-0.95**</td>
<td>-0.01</td>
</tr>
<tr>
<td>Harmful drinker</td>
<td>-1.31***</td>
<td>-0.29***</td>
<td>-0.29**</td>
<td>-0.07</td>
<td>-1.46***</td>
<td>-1.53***</td>
<td>-1.26***</td>
<td>-0.07</td>
</tr>
</tbody>
</table>

Note: * p<0.05, ** p<0.01 and *** p<0.001; beer includes regular strength beer and middle- or low-strength beer; wine includes bottle and cask wine; RTDs is ready to drink beverages.
Table 4 Own-price elasticities of demand for alcohol beverages, for three income levels

<table>
<thead>
<tr>
<th></th>
<th>on-beer</th>
<th>on-wine</th>
<th>on-spirits</th>
<th>on-RTDs</th>
<th>off-beer</th>
<th>off-wine</th>
<th>off-spirits</th>
<th>off-RTDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower income</td>
<td>-0.55***</td>
<td>-0.18***</td>
<td>-0.33***</td>
<td>-0.13</td>
<td>-1.61***</td>
<td>-1.48***</td>
<td>-1.05***</td>
<td>-0.32**</td>
</tr>
<tr>
<td>Middle income</td>
<td>-0.41***</td>
<td>-0.09**</td>
<td>-0.05</td>
<td>-0.06</td>
<td>-0.82***</td>
<td>-0.83***</td>
<td>-0.56***</td>
<td>-0.03</td>
</tr>
<tr>
<td>Higher income</td>
<td>-0.46***</td>
<td>-0.11**</td>
<td>-0.09</td>
<td>-0.01</td>
<td>-0.49***</td>
<td>-0.26</td>
<td>-0.24***</td>
<td>-0.05</td>
</tr>
</tbody>
</table>

Note: * p<0.05, ** p<0.01 and *** p<0.001; beer includes regular strength beer and middle- or low-strength beer; wine includes bottle and cask wine; RTDs is ready to drink beverages.