Article

Price Elasticity of Alcohol Demand in India

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Abstract

Aims: Using a household survey conducted in 2014, this study estimates price elasticity of demand (PED) for beer, country liquor and spirits in India.

Methods: Ordinary least-square models were used to estimate the responsiveness in alcohol demand due to price change. A large number of control variables were included to adjust for potential confounding in the model. Inter-district variation in alcohol consumption is adjusted for by including district fixed effects.

Results: Alcohol prices are negatively associated with demand for alcoholic beverages. The PED ranged from −0.14 for spirits to −0.46 for country liquor. Low level of education was positively associated with spirits consumption. The magnitude of elasticity varied by rural–urban, education and gender.

Conclusion: Results indicate that a policy mix of price controls and awareness campaigns would be most effective in tackling the adverse effects of harmful drinking in India.

Summary: The demand for beer, country liquor and spirits is negatively associated with its own price. The elasticity estimates ranged from −0.14 for spirits to −0.44 for country liquor. The elasticity estimates varied by rural–urban, gender and by education levels of the drinkers.

INTRODUCTION

Alcohol consumption in India has been rising rapidly in the last decade. On average, 30% of Indians consume alcohol, out of which 4–13% are daily consumers and more than half of those who consume alcohol are hazardous drinkers (WHO, 2014). The per capita consumption of alcoholic beverages in India increased by 38%, from 1.6 l in 2003–2005 to 2.2 l in 2010–2012 (WHO, 2012). Against the global average of 16%, ~11% of Indians were binge drinkers (binge drinking or heavy episodic drinking is described as heavy consumption of alcohol over a short period of time). Excessive consumption of alcoholic beverages has been found to have a detrimental effect on health. There is overwhelming evidence to suggest that alcohol consumption is associated with a variety of disease and disability (Lim et al., 2012; Whiteford et al., 2013). Liver cirrhosis, cancers, tuberculosis, HIV and injuries are some of the adverse health effects worsened by alcohol consumption (Baan et al., 2007; Shield, Parry & Rehm, 2013). The Global Burden of Disease Study estimates that excessive use of alcohol accounts for 3.9% of all deaths worldwide and 3% in India (Wang et al., 2016). In India alone, 360,000 deaths were attributed to alcohol consumption in 2015 (Wang et al., 2016). The percent of the global burden of disease and injury attributable to alcohol use is 2.9% in India. Recent Government of India data indicate that 15 people die every day or 1 every 96 minutes from the harmful effects of alcohol consumption in India (Crime in India, 2013). In addition to adverse health impacts, alcohol use may also contribute to poverty and impoverishment either due to diversion of resources away from productive use or increasing healthcare cost associated with alcohol-related problems (Benegal, 2005; Bonu et al., 2005; Gajalakshmi and Peto, 2009; Rathod et al., 2015).

Given the increasing evidence on the harmful effects of alcohol consumption, policymakers have resorted to either increasing alcohol prices through taxation or have put blanket bans on alcohol consumption. Alcohol consumption is completely prohibited in the Indian states of Gujarat, Bihar, Nagaland and is partially banned in Kerala and Tamilnadu. However, either the prohibition or the price...
increase can be an effective policy for reducing alcohol consumption if the demand for alcoholic beverages is price-sensitive and price-elastic (several studies have shown that alcohol price is a key determinant of consumption (Anderson et al., 2009; Wagenaar et al., 2009)). If the consumers have inelastic demand for alcoholic products, then price control through taxation may not be an effective policy instrument to curb the adverse effects of alcohol consumption. Reduced availability due to prohibition may shift the demand to underground or black market or to illicit liquor, which is expensive and more harmful than recorded alcohol. Prohibition is less desirable because it severely restricts freedom of individual choice and may have undesirable and unintended effects, as was the case in the failed alcohol ban in the USA from 1920 to 1933 (Thornton, 1991; Mahal, 2000) (the period was marked by rampant smuggling, corruption and black market).

Therefore, having reliable information on price elasticity of demand (PED), the percentage change in demand for alcohol resulting from a 1% increase in alcohol price by different characteristics of drinkers (such as gender and caste) are important for formulating appropriate tax policies to regulate alcohol consumption. There is lack of credible estimates of price elasticity for alcohol beverages in India, which is important for implementing effective interventions to reduce the harmful effects of alcohol consumption. There have not been many estimates of price elasticities for different alcoholic beverages in India to date except Mahal (2000) and using a representative cross-section of households from five states, this paper provides additional and more reliable estimates of PED for beer, spirits, and country liquor in India (these five states account for one-third of India’s population).

In high-income countries, the literature on estimation of PED for alcohol products is quite extensive but diverges markedly in the magnitude of elasticity estimates. Some studies indicate that alcohol demand is elastic (price elasticity is >1), while other studies suggest the demand to be price inelastic (price elasticity is <1). These studies find that the own-price elasticity for alcohol demand is negative and varies substantially across type of drink and socio-economic and demographic groups. Three recent meta-analyses comparing cross-beverage elasticity have found that beer, wine and spirits have different own-price elasticities, with beer appearing to be less elastic than wine and spirits (Gallet, 2007; Wagenaar et al., 2009; Fogarty, 2010). Gallet (2007) and Wagenaar et al. (2009) reported an average PED for alcohol of −0.5, meaning that a 20% increase in alcohol price would reduce the demand for alcohol by 10%. In UK, Meng et al. (2014) found the price elasticity estimates to range from −0.08 to −1.27, and beer was the most elastic beverage.

The dearth of research on estimation of PED for alcoholic beverages in low and lower-middle-income countries, including India, calls for additional research. To the best of my knowledge, I am only aware of the following three studies that deal with the estimation of PED for alcohol in India. Musgrave and Stern (1988), using NSS surveys for Karnataka in 1973–1974 and 1977–1978, estimate arrack price elasticities in the range of −0.47 and −0.62. In a simulated study, Mahal (2000) found that the own-price elasticity of participation in moderate to heavy alcohol consumption is 1.00 for individuals between 15 and 25 years old and 0.50 for individuals 25 years old and above. The estimates in Mahal (2000) are smaller than estimates for one state (Andhra Pradesh) by Reddy et al. (1999), Reddy et al. (1999) found an arc elasticity of demand for arrack (local liquor) in the range of −1.23 to −1.36, but this analysis was carried out on a very small sample of 86 moderate to heavy alcohol consumers of arrack in Andhra Pradesh. The PED estimates in these three studies lie in the mid-range of estimates reported in developed countries.

In India, the prevalence of alcohol consumption has been on the rise and policymakers are struggling to design an appropriate tax system to reduce alcohol consumption. In several instances, higher alcohol prices have led to consumption of spurious alcohol by poor households thereby resulting in premature loss of lives. Given the complex socio-economic conditions of households and lack of credible estimates of PED for alcohol in India, findings of this study will be important to design alcohol price strategy so that harmful effects of alcohol consumption can be minimized.

MATERIALS AND METHODS

Data

The data used in this study are from the Survey of Unrecorded Alcohol in India (SURA) collected in 2014. Data collection for this cross-sectional survey was funded by the International Alliance for Responsible Drinking (IARD) in order to assess the prevalence of unrecorded alcohol drinking in India. The survey sampled ~1200 respondents in each of the following five states—Andhra Pradesh, Kerala, Madhya Pradesh, Maharashtra and West Bengal. The sample was selected under a semi-purposive, multi-stage probability design and oversampled respondents in rural areas. In the first stage, two districts were randomly selected based on the socio-economic profile of the districts in each state (districts were stratified based on proportion of schedule caste and tribe population, female literacy rate and percentage of households belonging to lowest wealth quintile). In the second stage, 10 urban wards/towns and 20 rural villages were selected from each district using the probability proportional to size sampling method. Urban wards/towns and rural villages formed the primary sampling units. Finally, in Stage 3, 20 respondents were selected from each primary sampling unit in each district. In addition, 50 respondents were purposively sampled from 2 randomly selected slums in each of the sampled urban wards/towns. The overall response rate was ~85%, and there was no significant difference in response rates between the rural and urban samples.

The survey covered individuals 15 years old and above. Among the eligible individuals in the households, the member with the most recent birth date was selected for the interview. Our initial sample included 6088 individuals. Of these respondents, 3988 (65%) respondents resided in rural areas while 2100 (35%) respondents resided in urban areas. The survey included questions about past and current drinking, and about the frequency and quantity of alcohol use in the past year. Of the total sample, 38.6% were current drinkers, 53.6% were lifetime abstainers and 7.8% were former drinkers. Among drinkers, alcohol per capita consumption (APC) in litres of pure alcohol per year is 11.6, which translates into consumption of 25.1 g of pure alcohol per day. There is significant geographic variation in the average consumption of pure alcohol. The average consumption of pure alcohol is 21.6 and 30.3 g per day in rural and urban areas, respectively. The average consumption among males is ~2 times more than that of females (26.2 g for males and 14.2 g for females) (APC is defined as the per capita amount of alcohol consumed in litres of pure alcohol in a given population). APC in litres of pure ethanol per year can be converted into grams per day as follows: g/day = APC × 1000 × 0.793/365 days. Six percent of drinkers are heavy drinkers, consuming >48 g of pure alcohol per day.

Detailed questions about the drinking habits, patterns and beverage type were asked to current drinkers only. The survey collected
information on the socio-economic and demographic characteristics of the respondents, such as age, gender, caste, marital status, income and family size. Price information was collected for the “most consumed drink (MCD)”. Using the information in beverage-specific alcohol consumption module, the MCD is identified as the beverage with highest consumption by volume (quantity × frequency). Price and quantity data on the MCD were used to estimate PED for different types of alcoholic beverages. Analysis is restricted to the sample of respondents who reported beer, spirits and country liquor as their MCD. Price information about homemade alcohol drinks was missing for a large number of homemade alcohol respondents, therefore, homemade drinkers were excluded from the analysis. Price data were missing for 3.75% of the spirits drinkers and 0.18% of country liquor drinkers, but as long as price data is missing randomly, this will not bias our analyses.

Estimation
The standard approach to estimate PED is to quantify the empirical relationship between price and alcohol demand, after adjusting for socio-economic characteristics of the respondents including income. Socio-economic characteristics are able to capture differences in tastes and preferences across individuals. The linear relationship between price and demand is transformed into logarithmic (log) form, and the estimated model can be represented by the following equation for each beverage:

$$\log(\text{Quantity}_{id}) = \alpha + \beta \log(\text{Price}_{id}) + \gamma X_{id} + \eta_d + \epsilon_{id}$$  \hspace{1cm} (1)

where Quantity_{id} is the dependent variable measuring quantity consumed of each beverage (beer, spirits, country liquor) by respondent i in district d and state s; the main independent variable is log of price of each beverage; \(X_{id}\) is a vector of socio-economic and demographic characteristics of the respondents that can potentially affect alcohol demand (for example, age and gender of the respondent, education level of the respondent, monthly income of the respondent, whether respondent lives in the rural area); \(\eta_d\) represents district fixed effects so that time invariant characteristics of district that may affect alcohol demand can be adjusted for; and finally \(\epsilon_{id}\) is the idiosyncratic error terms in individual-level alcohol consumption, which are uncorrelated with other covariates included in the model. Standard errors are clustered by district to adjust for the possibility that residuals are not independent and identically distributed.

In Equation (1), \(\beta\) is PED for beer, spirits and country liquor. In econometric models, where both the dependent and the independent variables are log-transformed, the regression parameter \(\beta\) is interpreted PED. The magnitude of \(\beta\) shows the percentage change in alcohol demand for a specific beverage by respondent \(i\) in response to a percentage change in price of that specific beverage:

$$\beta = \frac{\delta \{\log(\text{Quantity}_{id})\}}{\delta \{\log(\text{Price}_{id})\}} = \frac{\%\Delta(\text{Quantity}_{id})}{\%\Delta(\text{Price}_{id})}$$  \hspace{1cm} (2)

Some prior studies have used average alcohol price or community-level price instead of beverage-specific actual price paid by individuals (Ayyagari et al., 2013; Goryakin et al., 2015). Alcohol prices in these studies were aggregated due to unavailability of individual-level data on actual price paid by the respondents to reduce measurement error in individual prices. Since the SURA survey had information on actual price paid by the drinkers for specific beverage, I use unit-level self-reported price data in the analysis. The negative relationship between price and demand means that the value of \(\beta\) will be a negative number, meaning that individuals may reduce the demand or shift their consumption to a substitute drink as a result of increase in price.

RESULTS
Sample characteristics
Table 1 shows the summary statistics of the variables used in the analysis for current drinkers only. I define current drinking status in terms of whether an individual has consumed alcohol in the past...
12 months. Using drinking frequency, number of drinks and size of the drink, annual consumption of each beverage in litres was calculated. The annual consumption is transformed in natural log. The average log price of alcoholic beverages ranged from 5.32 to 6.44. Distilled spirits are the most expensive drink type. The majority of current drinkers are male (91%) and the average age of current drinkers is 41 years. About two-fifths of current drinkers are illiterate, and ~60% of the respondents who are current drinkers live in rural areas. Close to two-fifths of the analytical sample earns <4000 rupees (equivalent to USD $65) per month. The average daily alcohol consumption is 25 g of pure ethanol in rural areas and 30 g of pure ethanol in urban areas.

Table 2 reports the percentage of current drinkers by sociodemographic characteristics of the respondents. Spirits is the MCD in rural areas, while consumption of country liquor is highest among illiterate drinkers (50%). On average, >90% of the drinkers are male. Seventy and seventy-six percent of spirits and beer drinkers are literate, respectively.

### Price elasticity of demand

In Table 3, I report the results on PEDs for beer, country liquor and spirits from the ordinary least-square method for current drinkers. Each column reports results from separate regression models. In general, the results in Table 3 indicate that an increase in price has a small negative effect on alcohol demand. The estimated PED for beer and country liquor are ~0.33 and ~0.46, respectively. The elasticity estimates for beer and country liquor are statistically significant and are consistent with estimates reported in the USA and other developed countries and are well within the range of previous estimates (Wagenaar et al., 2009). The magnitude of ~0.33 means that a 1% increase in the price of beer is associated with a 0.33% reduction in beer consumption. The PED for spirits is 0.139. However, it is not significantly different from zero. The absolute value of all elasticities is <1, indicating that alcohol demand is not very sensitive to price change. Male and age are positively associated with alcohol demand, but the coefficients are statistically insignificant except for spirits drinkers. Education is positively associated with spirits demand: illiterate individuals consume more spirits than literate individuals. Household monthly income is positively associated with demand, while rural households have lower alcohol demand compared to urban households.

### Elasticities by drinkers’ characteristics

In Figs 1–3, I analyse the heterogeneity in the impact of price on alcohol demand. In Fig. 1, own-price elasticity of alcohol demand by rural versus urban residents is reported. PED is higher for rural drinkers compared to urban drinkers except for spirits demand. The elasticities for beer and spirits are not statistically significant in urban areas, while country liquor demand responds significantly to price change in urban areas. Rural drinkers seem to be most responsive to price than urban drinkers, and the magnitude of response is highest for country liquor followed by beer. The higher elasticity of country liquor may be due to the availability of substitute drinks, which may result in switching behavior by drinkers.

A substantial amount of research on developing countries has established that there are consistent differences in drinking patterns between men and women. Men are more likely to consume alcohol than women (Wilsnack et al., 2000; Parry et al., 2005); male drinkers consume larger quantities of alcohol than female drinkers do (Hao et al., 2004) and male drinkers experience more behavioral problems related to their drinking than female drinkers do (Nolen-Hoeksema, 2004). Since females differ in their behavior and preferences from males, it is important to understand whether responsiveness in alcohol demand due to price change varies by gender too. Ex ante, one would imagine that females would be more price sensitive than males, and therefore will have higher elasticity than males.

In Fig. 2, elasticity estimates by gender are reported, and there is no inter-gender differential in PED by gender. Most estimates of alcohol price elasticity are insignificant, except for males who are

### Table 3. Determinants of alcohol consumption by beverage type (in logs of annual consumption in litres, ordinary least-square model)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Beer (1)</th>
<th>Country liquor (2)</th>
<th>Spirits (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log price per litre</td>
<td>-0.330*</td>
<td>-0.459*</td>
<td>-0.139</td>
</tr>
<tr>
<td>Male</td>
<td>0.625</td>
<td>0.150</td>
<td>1.222***</td>
</tr>
<tr>
<td>Age</td>
<td>0.00852</td>
<td>0.0175</td>
<td>-0.003</td>
</tr>
<tr>
<td>Education (illiterate)</td>
<td>0.142</td>
<td>-0.0908</td>
<td>0.329**</td>
</tr>
<tr>
<td>Monthly income (in Rupees)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rs. 2001–4000</td>
<td>0.484</td>
<td>0.422**</td>
<td>0.207</td>
</tr>
<tr>
<td>Rs. 4001–6000</td>
<td>0.487**</td>
<td>0.680</td>
<td>0.424</td>
</tr>
<tr>
<td>Rs. 6001–8000</td>
<td>0.828**</td>
<td>1.042***</td>
<td>0.631*</td>
</tr>
<tr>
<td>Rs. 8001–10,000</td>
<td>1.223***</td>
<td>1.258**</td>
<td>0.894**</td>
</tr>
<tr>
<td>Rs. 10,001–12,000</td>
<td>0.628**</td>
<td>1.665**</td>
<td>0.687**</td>
</tr>
<tr>
<td>&gt;Rs. 12,000</td>
<td>1.712***</td>
<td>1.221***</td>
<td>0.835**</td>
</tr>
<tr>
<td>Rural</td>
<td>-0.158</td>
<td>-0.731****</td>
<td>-0.594***</td>
</tr>
<tr>
<td>Observations</td>
<td>413</td>
<td>521</td>
<td>933</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.54</td>
<td>0.26</td>
<td>0.38</td>
</tr>
</tbody>
</table>

Notes: Robust standard errors clustered by district are reported in parentheses. All columns include district fixed effects. Sample includes only current drinkers.

** **P < 0.01, ** **P < 0.05, *P < 0.1.

### Table 2. Percentage of current drinkers by sociodemographic characteristics

<table>
<thead>
<tr>
<th></th>
<th>Rural</th>
<th>Urban</th>
<th>Male</th>
<th>Female</th>
<th>Illiterate</th>
<th>Literate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beer drinkers (%)</td>
<td>55</td>
<td>45</td>
<td>94</td>
<td>6</td>
<td>24</td>
<td>76</td>
</tr>
<tr>
<td>Country liquor drinkers (%)</td>
<td>57</td>
<td>43</td>
<td>93</td>
<td>7</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Spirits drinkers (%)</td>
<td>62</td>
<td>38</td>
<td>97</td>
<td>3</td>
<td>30</td>
<td>70</td>
</tr>
</tbody>
</table>
PED does not mean that price control will be an ineffective policy, especially when the goal of policymakers is to control the price of alcohol through taxation to reduce alcohol consumption. This study is one of a handful of studies to estimate PED in India against the backdrop of rising alcohol consumption. Prices do seem to affect behavior. However, the effect size is modest and small. Among three alcoholic beverages, spirits consumption is least elastic (−0.14), while consumption of country liquor is most elastic (−0.46). The lower magnitude of PED does not mean that price control will be an ineffective policy, rather it implies that the reduction in consumption due to price increase will be modest but economically meaningful. The elasticity estimates have important policy implications in the context of a recent ban on alcohol consumption in a few states in India. If alcohol demand is not very price responsive, then prohibition may not be a good strategy to limit consumption as it may lead to the emergence of black market, smuggling and consumption of illicit beverages.

Taxes on alcoholic beverages is considered regressive because low-income households have to pay a higher fraction of their income as tax. Given that the demand for spirits (whiskey, vodka and Indian-made foreign liquor) is less elastic in rural areas than urban areas, the tax burden would disproportionately affect rural households.

Our estimates compare well with findings in other countries. In a recent meta-analysis, ~26% of all studies had own-price elasticity of beer that was either insignificant or <0.2 (Fogarty, 2010). The majority of the studies in this meta-analysis were from high-income countries, which may not compare well to a middle-income country like India. In a recent study in China, a middle-income country, the PED for beer was estimated to be −0.036 and was statistically insignificant (Tian and Liu, 2011). Furthermore, I find some evidence of heterogeneous impacts of price change on alcohol consumption. The elasticity estimates varied by rural–urban, gender, and to some extent by education levels of the drinkers, though no consistent pattern emerged across different types of alcoholic beverages.

This study is not free from limitations, and the most important one is the cross-sectional and non-experimental nature of the data. The negative relationship between price and alcohol demand is merely an association between the two variables and should not be understood to have a causal interpretation. Although our models include several confounding variables and district fixed effects, the model still suffers from omitted variable bias and endogeneity. Second, due to lack of relevant data, this study is unable to estimate the cross-PED in order to understand the switching and substituting behavior of drinkers. The number of switchers is very small and, therefore, the sample lacks the power to estimate the cross-PED. Third, the frequency, quantity of drinks and price were self-reported by the respondents. This self-report may suffer from measurement error, as respondents tend to underreport alcohol consumption.

Our findings contribute to the debate on the effectiveness of demand- versus supply-side interventions to limit alcohol consumption. Price control is a supply-side policy instrument. Our results suggest a modest negative association between price and demand, implying that drinkers are not very responsive to price change. In this case, price controls alone may not be effective in reducing the adverse impacts of alcohol consumption, rather it should be...
complemented with demand-side intervention such as educating the population about the impact of harmful alcohol consumption. A policy mix of supply- and demand-side programs will go a long way in addressing the issue of increasing alcohol consumption in India. The harmful effect of alcohol consumption on health may become severe if demand for illicit liquor increases due to tax hike or prohibition. Future research should consider economic, social and health consequences of tax increase or prohibition in a country with significant consumption of unrecorded alcohol.

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DISCLAIMER

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CONFLICT OF INTEREST STATEMENT

None declared.

REFERENCES


