The impact of price policy on demand for alcohol in rural India

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Abstract

Whether raising the price of addictive goods can reduce its burden is widely debated in many countries, largely due to lack of appropriate data and robust methods. Three key concerns frequently raised in the literature are: unobserved heterogeneity; omitted variables; identification problem. Addressing these concerns, using robust instrument and employing unique individual-level panel data from Indian Punjab, this paper investigates two related propositions (i) will increase in alcohol price reduce its burden (ii) since greater incomes raise the costs of inebriation, will higher incomes affect consumption of alcohol negatively. Distinct from previous studies, the key variable of interest is the budget share of alcohol that allows studying the burden of alcohol consumption on drinker's and also on other family members. Results presented show that an increase in alcohol price is likely to be regressive, especially on the bottom quartile, with a rise in the budget share of alcohol given budget constraint. This outcome is robust to different econometric specifications. Preliminary explorations suggest that higher per capita income increases the odds of quitting drinking. Results reported have wider implications for the effective design of addiction related health policies.

Keywords: Alcohol; Price; India; Econometrics; Sobriety

1. Introduction

Since the theory of rational addiction (Becker and Murphy, 1988), in nearly every country, taxes on addictive goods are imposed to regulate its consumption (WHO, 2014). Yet, tobacco worldwide continues to kill nearly 6 million each year and alcohol related illnesses are cause for 3.3 million deaths globally in the year 2012 alone (WHO, 2014). From this evidence, it is unclear if the key prediction holds good of the most economic models of addiction, including the widely accepted rational addiction model pioneered by Becker and Murphy (1988) – that is, a higher price of the addictive good (due perhaps to a larger tax) reduces its burden in both the short and long run.

In this paper, we examine whether raising the price of alcohol can reduce its burden on drinkers and their families. This study uses individual level panel data from carefully designed and implemented several rounds of individual and household surveys in the Indian state of Punjab. More specifically, we use the longitudinal surveys among randomly selected sample of 895 alcohol drinkers and non-drinkers in the year 2008, and followed for six years tracking their alcohol drinking behaviour. During this period, three surveys each with a gap of two years were implemented to collect both individual and household information. Using the panel data, we implement fixed effect regressions to examine the impact of alcohol price policy on household burden. Results show that an increase in alcohol price is likely to be regressive, especially on the bottom quartile, with a rise in the budget share of alcohol given budget constraint. Our results are robust to different model specifications.

A number of recent studies have examined different models of alcohol addiction using data on price paid and quantity consumed of alcohol (price-quantity relationship) from both developed and developing countries, applying a range of econometric methods. Yet, these studies suffer from concerns related to lack of appropriate data and robust methods. Addressing these concerns our paper makes three novel contributions to existing literature. First, studies

typically specify the price-quantity demand relationship to estimate the own-price elasticity for alcohol (Grossman et al. 1998; Baltagi and Griffin 2002; Shrestha 2015). However, the estimated parameter do not satisfy the restriction imposed (budget constraint that limits total expenditure) on them by demand theory (Sadoulet and de Janvry 1995). Distinct from previous studies, our key variable of interest is the budget share of alcohol, which allows studying the household burden of alcohol consumption, not just on drinkers. Unlike quantity of alcohol consumed, the advantage of using alcohol budget shares is that it satisfies the budget constraint limiting household total expenditure.

Second, the identification of the demand equation from supply is difficult in existing studies. Recent studies estimating the price-quantity demand for alcohol relationship employ a range of econometric models. For instance, Manning et al. (1995) estimate quantile regressions, Ayyagari et al. (2013) use finite mixture model, while Shrestha (2015) estimates both two-part and finite mixture model on individual panel data. Although novel in some respect, these studies do not address the identification concerns. Some other studies however have tried to address the identification concern with instrumental variables, yet the instrument used by these studies did not uniquely shift supply without affecting demand (Bopp, 1983; Baruch and Kannai, 2011).

We address the identification problem, which is our primary focus and the main contribution to the literature, using the price of key input that strongly affect supply but not demand. We identify the price of the key ingredient *gur* as an important predictor of the price of alcohol. Detailed information was collected during field surveys on all the inputs used in the production of country liquor. One key ingredient in the production is *gur* (jaggry), which is purchased entirely from outside the village. The price of *gur* is a major determinant of supply of alcohol, and a potential predictor of the price of alcohol. Given that it is unlikely to affect the demand

for alcohol significantly, price of *gur* appears to be a reasonably good instrument for the price of alcohol.

Third, most existing data sets on alcohol consumption for developed countries are collected through telephone interviews or mail surveys with little reliability checks (Grossman et al. 1998; Shield and Rehm 2012), while for developing countries they are collected as part of household consumption data, often with no information on who within the household drinks (McKenzie, 2002; John, 2008; Guindon et al, 2011; Jumrani and Birthal, 2017). Generally, households have only one or two drinkers, so any estimates based on this data are biased downwards showing lower consumption, although money spent on consumption of this good is much higher. Since poor households tend to have larger family size, the downward bias is much higher and serious. Besides, aggregate-level demand estimates for alcohol will mismeasure individual-level price responsiveness. The individual-level panel data contains both individual consumption and purchase price of alcohol within the same database, providing consistency across information.

Finally, results from this paper have the potential to inform alcohol policy in India. Different states in India have followed various policy options, ranging from prohibition (Gujarat, Bihar and Nagaland) to government provision (Tamil Nadu), and private provision (Delhi) of alcohol. Besides, higher tax rates to regulate production and consumption of alcohol have also been imposed (Saldanha 1995). Despite these policies, per capita consumption of alcohol by adults in recent years have increased by 115 percent (Rahman 2002). Given that higher taxes are likely to be regressive, prohibition may be an attractive policy for India. However, enforcement and unintended consequences such as crime and corruption may pose a greater challenge (Thornton 1991). An income policy with the potential to increase the cost of inebriation such as cash transfer programs or employment programs could perhaps enhance the welfare of poor households.

2. Methods

2.1. Study design and data sources

Data used in this study is based on the initial survey conducted by the National Council of Applied Economic Research (NCAER), New Delhi with selection of households in the respective villages based on stratified random sampling. Subsequent surveys were implemented in collaboration with the Institute for Social and Economic Change (ISEC), henceforth; we will refer to the data as NCAER-ISEC panel data set. Historically, the district of Patiala in the Indian Punjab is known for its extravagant military culture and strong "pegs of whiskey", popularly known as Patiala Peg. The state of Punjab has the highest alcohol consumption figures in contemporary India. From this district, three villages were randomly selected that are representative of the district in several dimensions, including alcohol consumption. Based on stratified random sampling method, about 150 households were randomly selected from these villages.

All households in the three villages were first stratified into cultivating and non-cultivating households, and then the cultivating households were stratified in terms of marginal farming households (less than 2.5 acres); small farming households (2.51 to 5.0 acres), medium farming households (5.01 to 10.0 acres) and large farming households (above 10.0 acres). From each village, approximately 10 households were randomly selected for each category. Thus, about 40 households were selected from each village with a total of 120 farm households selected from all the three villages. In addition to cultivating households, a total number of 10 landless agricultural labour households were also randomly selected from every village. The aggregate sample consists of 895 alcohol drinkers and non-drinkers from 150 households surveyed.

The survey collected two types of information: (a) Household survey: Survey recorded household level information for all the sample households. The head of the household was

interviewed to gather detailed item wise monthly information on food and non-food consumption, household assets owned, land owned, and information on the demographic characteristics of each household members. Monthly expenditures for all the food and non-food items consumed by all the households were recorded for the past month to arrive at the total monthly expenditure. Information on food includes about 33 items including food consumed both inside and outside the house, including wages and gifts received. The non-food items were of two types with items that are purchased regularly every month (such as expenditure on fuel and electricity, products for cleaning and personal care and telephone bills) and the other annual (such as clothing and footwear, medicine and health cost, ceremonies, education and taxes).

(b) Individual survey: The alcohol drinkers were interviewed and closely followed for six years, monitoring and recording the type of alcohol consumed, quantity consumed, price paid, year started to drink, and reasons for drinking. Similar information was also collected for smoking, although its prevalence in general is very low. Two alcohol types are consumed, Indian made foreign liquor (IMFL) and country liquor. Although individuals across quartiles drink both types of alcohol, drinkers from the bottom quartile largely consume country liquor (85 percent) while IMFL are consumed mostly by the top quartile (25 percent). The country liquor is manufactured either within the village or just outside using *gur* as the key ingredient, while IMFL are imported from the urban centres. About 83 percent of the alcohol consumed across all three villages and quartiles are country liquor and the rest IMFL. We focus our analysis on individuals aged 15 years or older because of the presence of strong taboo, so either the children do not consume alcohol or they are miss-reported. Since income is often a more sensitive topic than consumption in developing countries, we follow Deaton (2000) in using household total consumption expenditure as proxy for household income. We combine data from both household and individual surveys to derive total consumption expenditure.

The data used in this paper has several advantages compared to previous studies in the literature. First, our paper utilizes panel data that allows for controlling of individual heterogeneity by estimating individual fixed effect regressions. All data relating to the variables come from single source, rigorously collected three times over the six-year period. The advantage is that all the information relating to the drinking cohort on consumption and prices are implemented using a single coherent methodology. In most studies in the literature key variables like alcohol prices, taxes and consumption come from different data sources, employing different methodology and are unrelated to consumption cohort, or based on pseudo panel data (Nelson, 2013).

Second, most studies in this literature are based on family expenditure surveys, collecting alcohol data as part of household expenditure that do not indicate individual alcohol consumption or discrete alcohol prevalence among household members (McKenzie, 2002). The data we use in this paper are individual consumption data that includes gifts and unpaid consumption, mainly gathered through in-depth interviews and follow-up surveys with alcohol drinkers on the variety, quantity and price of alcohol consumed. The collection of comprehensive data following each drinker over several years was made possible only because of the thin spatial spread of the chosen villages. However, a compensating advantage of our data is the rigorous implementation of in-depth interviews tracing and tracking each drinker over several years, highly improbable in large scale surveys.

Third, we collected three rounds of data across different months during the years to accommodate any seasonality in consumption. Seasonal variations are substantial in many regions of the developing countries, reflecting the often-observed tendency for price elasticity to be higher for lower-income households (Behrman and Deolaliakar, 1989). The NCAER-ISEC data collected is long enough panel to accommodate any consumption dynamics cloaked in the shorter panels. Majority of alcohol consuming individuals tend to drink every day, more

or less the same quantity, but there seem to be some variation across seasons during the year. Since consumption is higher during the festival season, we spread the data collection across different seasons. In the year 2008, the survey was carried out at the beginning of the agricultural season when households are generally impoverished. The next survey in 2011-12 was implemented in the middle of the season with households having some cash flow. The third survey in the year 2013-14 was done at the end of the season when most households have no liquidity constraints. There is no sample attrition with all the households and individuals appearing across all the years, except three drinkers who died after the second survey, hence do not appear in the third survey. See online appendix for details on variable definition.

2.2. Significance of alcohol consumption

The significance of alcohol consumption in total food consumption of the selected households is reported in Table 1. Alcohol consumption in all three villages is substantial accounting for about 15 percent of the total food expenditure on average and is higher in the village of Dhanori. Even among the bottom quartile, a large share of about 14 percent is spent on alcohol. However, income shares spent on alcohol reported in Schilbach (2015) are much higher at 43 percent in their study among low-income men in the south Indian city of Chennai.

More than half of the households in the villages report consuming alcohol with higher prevalence (63 percent) in Ajnauda Kalan village. High prevalence is also reported by Chowdhury et al. (2006), who study the impact of alcohol use employing ethnographic method in six villages in the Indian state of West Bengal. Similarly, Schilbach (2015) report high mean prevalence (76 percent) of alcohol consumption among low-income men. Although the expenditure on alcohol across quartiles are not very different, a larger percentage of households from the top quartile report consuming alcohol compared to the bottom quartile.

Table 1

2.3. Tabulations: food consumption patterns and profile of drinkers

Like-for-like comparison of results presented in Table 2 from another large All India sample survey, conducted for the same year 2011-12 by the National Sample Survey Organisation (see online appendix for details on NSSO) (Government of India, 2011), shows how consumers allocate their budgets looking at the disposition of broad categories of expenditures for rural Punjab, and how much each food costs. The first two columns show the expenditure shares from NSSO and NCAER-ISEC data, respectively. Next the expenditure patterns across bottom and top quartiles in Columns 3 and 4 are expressed as shares of the budget from the NCAER-ISEC data.

Table 2

Column 2 shows that the largest budget shares are for dairy products, fruits and vegetables, and alcohol. Similar pattern is also reflected in the NSSO 2011-12 data in Column 1 of Table 2 for rural Punjab; except that the shares of cereals are higher while fruits and vegetables, and alcohol are lower in the NSSO. This is more a reflection that households in the selected villages are more prosperous than the average household in the NSSO samples from rural Punjab. The household budget going to alcohol consumption in the NCAER-ISEC samples is almost five times more than the NSSO estimates. The underestimate of alcohol consumption in the NSSO is perhaps a reflection of the limitations of large scale general surveys to capture the consumption of goods like alcohol and tobacco.

Unit values paid for pulses, dairy, oils and fats, and meat are regressive, while for all other consumption items the top quartiles pay higher on average. Since most households in the top quartile produce their own food, it is not unlikely that they report a lower unit value. Given that part of the output produced in their farm are sold at the farm gate price, these household report consumption expenditures evaluated at farm gate prices, which is lower than the retail prices.

Table 3 presents descriptive statistics for all key variables separately for drinkers and non-drinkers. The drinker households seem to be on average older, mostly males with lower education levels and come from lower family size. Moreover, they tend to have slightly more children and fewer adults within the household and have higher per capita per month expenditure. The land owned is lower among drinkers who are mostly self-employed in agriculture and belong to Sikh religion, and come from forward caste. Among drinkers, a larger percentage are in the bottom quartile (27 percent).

Table 3

2.4. Model specification and estimation

The model estimated takes the following general form:

$$\mathrm{C}_{\mathrm{it}}^{\mathrm{a}} = \beta_1 \ \mathrm{P}_{\mathrm{it}}^{\mathrm{a}} + \ \beta_2 \ Z_{it} + \ \delta_i + \ \delta_t + \ \epsilon_{it}$$

where C_{it}^{a} is the consumption of alcohol by individual *i* at time *t* and P_{it}^{a} is the price of alcohol paid by individual *i* at time *t*. Other household and village characteristics (Z_{it}) are included as controls. Village fixed effects (δ_i) are included to control for omitted and time-invariant characteristics of villages. We also include year fixed effects (δ_t) to control for time-varying trends. The term ϵ_{it} is an error term. Since our focus is on examining the household burden of alcohol consumption, we primarily estimate the above equation with budget share of alcohol as the dependant variable. Budget share is the ratio of total alcohol expenditure for each household to its total household consumption expenditure. However, to examine the robustness of the results we also report using quantity of alcohol consumed and expenditure on alcohol as dependant variables. For the estimation strategy to address the identification problem, we rely on comparison of estimates from OLS to the estimates from the instrumental variable models. See online appendix for more details of the different models estimated.

2.5. Identification strategy

Endogeneity is a serious concern in the above equation when estimating the relationship between consumption and price of alcohol, since price is the equilibrium of a system of simultaneous equations. Our strategy here in addressing this identification concern is to instrument the price of alcohol with one of the input prices, namely, the price of *gur*. The locally brewed alcohol, consumed by most households, requires two major inputs. The first input is the *gur*, an extract of sugarcane imported from outside the village, while water is the second input available locally often for free. To identify demand, we use the price of *gur* as instrument that is unlikely to influence demand but strongly affects supply, given that *gur* is the key ingredient in its production. However, apart from *gur* being used in the production of country liquor, it is also consumed directly by the households. Consequently, there could be some concerns about the influence on demand for alcohol. The price of *gur* also affects the demand for alcohol through the household budget, apart from affecting the price of alcohol directly. Given the small share of *gur* in the overall food budget (mean share of 1.03 percent) and occasionally consumed during festivals, it is unlikely that it will have a big influence on the demand for alcohol. More details of the estimation strategy are provided in the online appendix.

3. Results

3.1. Main findings

Table 4 presents the elasticities for different models with quantity of alcohol in ml (Columns 1-4) and budget share of alcohol (Columns 5-8) as dependant variable. For some regressions, we present standard errors clustered at the household level and controlling for village and year fixed effects. Although, given data collection across different seasons over the years, we are able to control for both year and seasonal fixed effects, but unable to distinguish their individual

effects. The distinction however is not necessary for our analysis. Column (1) to Column (4) confirm the predictions of negative price elasticity in the Becker and Murphy model. Column (5), reports regression results for model with additional socio-economic controls but excluding fixed effects, shows that a 10 percent increase in the price of alcohol causes a 10 percent increase in the budget share of alcohol consumption. This estimate is statistically significant at the conventional 1 percent level. The estimates are robust to additional controls (fixed effects) and inclusion of clustered standard errors across models in Columns 6 to 8. One potential consequence of the significant positive elasticity for the alcohol consuming households is that consumption of alcohol could impose a squeeze on the overall household budget, crowding out necessities like health and education (Rajaraman 2007; Jumrani and Birthal 2017).

Table 4

The per capita total expenditure across all models for budget share of alcohol are negative and statistically significant at 1 percent – increasing incomes raise the cost of inebriation, affecting consumption of alcohol negatively. The negative effect on earnings of alcohol consumption is likely to be greater when earnings are greater. Similarly, demographic changes within the households also have a significantly negative effect on alcohol consumption. The increase in non-drinker members within the household through birth or marriage reduces alcohol consumption of the existing drinker members. Interestingly, education has a significantly negative effect on the budget share of alcohol.

Table 5

Further, we disaggregate the analysis here by separating households per different expenditure levels. In Table 5, we present results for the two expenditure categories: bottom quartile and top quartile. For convenience, we also present in Column 1, OLS results from a variant of the model presented in Table 4 for the full sample. In Columns 3 and 5, OLS results

for the bottom quartile and top quartile, respectively are reported. The price elasticity for the bottom quartile shows that a 10 percent increase in the price of alcohol increases the budget share by 16 percent. Comparatively, the price elasticity for the top quartile is almost half at 9 percent. Interestingly, results reported for per capita per month expenditure displays income elasticity that is statistically significant across all groups. Both bottom and top quartiles tend to indulge less in alcohol consumption as income increases.

3.2. Robustness

Using the full sample, we next pursue the robustness of our results using instruments (IV) that are reported alternatively in Columns 2, 4 and 6 of Table 5. Our identification strategy uses *gur* price as an instrument for the price of alcohol. Though comparison of IV elasticities with OLS estimates reported for full sample shows marginal difference, estimates reported for the bottom quartile shows large difference. In contrast, results reported for the top quartile does not show much difference between the estimates. Thus, OLS overestimates the impact of alcohol price on the budget share of alcohol for the bottom quartile. We also report F-statistic from first stage at the bottom of Table 5, which has a value greater than 10 for all three IV models. The null hypothesis of regressor exogeneity is rejected by the Hausman test. The instrument thus satisfy both the relevance and the exclusion conditions.

One impending concern with the above specifications is the corner solution for a large proportion of individuals who do not report alcohol consumption. Since corner solutions do not satisfy the first order conditions for an interior optimum of the underlying utility maximization problem, the above estimation does not apply to observations with zero expenditure on alcohol. Alcohol consumption are thus estimated using tobit regressions, whereby observed consumption equal notational or desired consumption when the latter are positive, and are zero otherwise. The advantage with tobit regressions is that it uses all observations, both those at the limit and those above it (McDonald and Moffitt, 1980).

However, we are assuming here that all zero expenditures are the result of corner solutions and that a sufficiently large change in income or relative prices would create positive expenditures for any household. This may seem unrealistic given that many do not consume alcohol even if it was for free because of health or social reasons. The results from the tobit model are presented in Table 6 along with the results from the IV tobit model. The estimates for the price of alcohol reveal that budgetary share of alcohol increases with the increase in its price which is significant at 10 percent level. Both household size and years of schooling are individually significant but not per capita per month expenditure. For the IV tobit model, the above results do not change much except for per capita per month expenditure that becomes significant at 10 percent level. Since results reported here are not very different from the estimates presented previously across different models, we do not show the marginal effects. However, interested readers can request these from the authors.

Table 6

3.3. Robustness: results from restrictive sample

We further check the robustness of our results considering the two-year sub-sample. The results presented in Table 7 show that price elasticity is significantly positive and much larger than previously observed in the full sample. The elasticity from the instrumental variable regression is even larger and significant. The results from the tobit model and IV tobit also report significantly positive coefficients. In summary, the result presented so far contradicts the predictions of the rational addiction model that higher taxes of the addictive goods will be able to reduce the burden of alcohol consumption.

Table 7

3.4. Sobriety and drinking

Preliminary analysis of the odds that individuals in the drinking population (current alcohol drinkers and ex-drinkers) quit is now undertaken. A summary of the descriptive statistics for variables used in the analysis is presented in Table 8. About 24 percent of the total drinkers in the sample quit drinking. The sober are generally older, have lower years of schooling, come from smaller family size, and have less number of children and fewer adults. The per capita incomes are somewhat lower but the land and assets owned seem to be higher for the sober. Most sober belong to higher caste and a large difference in age and education with the household head, and more interestingly, the medical costs seem to be higher for the sober.

Table 8

We next examine the odds-ratios presented in Table 9. Technical details of the estimation strategy are presented in the online appendix. The estimates that higher alcohol prices increase the odds of quitting alcohol are reflected across all the models. However, none of the estimates seem to be significant, showing that price is not a significant determinant of going sober. The insignificant effect across most models for years of education supports the view that increases in schooling might not result in individuals going sober. The positive and significant coefficients for age in some models show that the shadow price of health increases with age as does the price of drinking alcohol.

Table 9

From policy point of view, it is interesting to observe that per capita income is a highly significant determinant of quitting drinking across all the models. This is in line with another proposition in the Becker and Murphy model which suggests that the negative effect on earnings of increased alcohol consumption is likely to be greater when earnings are greater. So an income policy such as cash transfer programs or employment programs that increases the cost of inebriation could be a useful alternative to the price policy. It is important to note that

this policy prescription is consistent with both budgetary share of alcohol consumption and odds of going sober.

4. Discussion

Our results show that higher alcohol prices increase the budget share of alcohol across all households by 10 percent while for the bottom quartile, it increases by 16 percent for a 10 percent increase in alcohol price. Although, also increasing for the top quartile, the impact of alcohol prices on the budget share of alcohol is lower. However, correcting for econometric issues using IV method corroborates both the direction and significance level of the estimates, but the estimates for the bottom quartile are much lower in comparison to the OLS estimates. An increase in alcohol price is associated with higher alcohol budget shares and greater household burden defy the predictions of the rational addiction models that considers price policy to be welfare-enhancing. This outcome is robust to different econometric specifications.

Results reported have wider implications for the effectiveness of minimum alcohol pricing policy under consideration in several countries including the developed. An increase in the minimum price of alcohol will adversely affect households across all income categories. Nevertheless, the bottom quartile will be relatively worse off given higher budget shares and lower per unit prices of alcohol. Under budgetary constraints, spending on alcohol has enormous opportunity cost because other desirable goods must be forgone (Jumrani and Birthal 2017).

The inelastic nature of the demand for addictive goods impose double burden on the deprived households - minimum pricing policy will not only make the poor even poorer but also crowd out essential consumption. Prior literature suggests that expenditure on addictive goods will reduce expenditures on necessities such as food, health care, education and energy intake (John, 2008). Can prohibition of alcohol be an important alternative policy to increased tax rates in

India? Results presented in Subramanian et al. (2005) and Rehman (2003) suggest that prohibition policy have little effect on alcohol use by men in India. Though further research is required to understand the effect of cash transfer on alcohol consumption, such income policies with the potential to increase the cost of inebriation could be welfare-enhancing for the poor households. Finally, we advocate care in generalizing our results given that our samples are drawn from fewer villages.

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Appendix A. Supplementary information

Supplementary information related to this article can be found online.

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Table 1. Significance of alcohol consumption in total food consumption

	Sample means			
	Total food expenditure (Rs.)	Expenditure on alcohol (Rs.)	Col.(2) as % of Col (1)	% of households reporting alcohol intake
	(1)	(2)	(3)	(4)
Full sample	9,481	1,396	14.72	57.73
By village				
Ajnauda kalan	9,941	1,518	15.27	63.16
Dhanori	8,409	1,554	18.48	53.53
Simro	9,924	1,113	11.22	56.47
By income groupings				
Bottom quartile	9,534	1,360	14.26	44.19
Top quartile	10,017	1,474	14.71	58.19

Notes: Table based on household level information. Expenditure is calculated on household basis with at least one household member reporting consumption of alcohol and is averaged over all appropriate consuming households from the household panel data. Year specific quartiles are applied to the panel for income groupings.

Table 2. Food expenditure patterns and unit values, rural Punjab, year 2011-2012

	Expenditure shares				Unit value in Indian Rupees per kilogram/litre/packet		
	NSSO mean	Mean	Bottom quartile	Top quartile	Mean	Bottom quartile	Top quartile
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cereals	13.26	7.82	9.37	6.80	15.97	15.84	16.07
Pulses	4.66	4.88	5.62	4.58	72.79	75.81	71.12
Dairy	36.00	33.08	31.52	34.92	41.69	46.80	38.42
Oils and fats	6.41	6.01	8.53	4.41	82.05	84.44	80.14
Meat	1.05	5.17	4.98	4.96	29.38	31.28	17.06
Fruits and vegetables	12.14	25.78	22.87	27.87	49.23	44.10	52.31
Sugar	6.81	8.32	9.75	7.41	45.34	41.90	44.73
Alcohol	2.08	11.62	9.99	12.74	0.27	0.26	0.31
Smoking	0.66	2.19	2.53	2.37	5.06	5.06	5.91
Other food	16.93	6.37	7.47	5.86	358.23	371.91	405.32

Notes: (1) The expenditure shares in Column 1 are based on the most recent NSSO 68th round (July 2011 – June 2012). All the other expenditure shares in columns 2-4 are from the NCAER-ISEC second survey for the same year with the household averages across each expenditure categories. Mean refers to mean over the whole sample but conditional on consumption. Year specific quartiles are applied to the panel for income groupings. (2) Unit values in columns 5-7 are averages over consuming households. Unit values for cereals, pulses, meat, fruits and vegetables, sugar are for Indian rupees per kilogram. Dairy and oils and fats unit values are for rupees per litre. Since for alcohol and smoking individual information on consumption and prices were collected, we report here prices rather than unit values. Mean alcohol prices are Indian rupees per millilitre and smoking are rupees per packet. Other food includes processed food, non-alcoholic beverages, cooked food bought from outside or received as wages, etc. Most consumption of food items reported in this table for the top quartile is from self-production evaluated at farm gate prices. Since unit values of pulses, dairy, oils and fats, and meat for the top quartile are based on farm gate prices they are generally lower than the market prices.

Table 3. Descriptive statistics: drinkers and non-drinkers

	All				
	Obs.	Mean	S.D.	Min.	Max.
	(1)	(2)	(3)	(4)	(5)
log(quantity of alcohol in ml)	424	7.400	1.034	3.912	9.998
log(alcohol price per ml)	424	-1.330	0.278	-2.120	-0.210
log(budget share of alcohol)	424	-3.264	0.925	-6.478	-1.213
log(price of input gur)	1830	3.846	0.474	3.091	5.298
Age	2335	39.618	16.030	16	95
Sex(1-male; 0 – otherwise)	2335	0.531	0.499	0	1
Years of schooling	2335	3.366	1.936	1	8
Household size	2335	6.580	2.729	1	16
Number of children	2335	1.681	1.324	0	6
Number of adult	2335	4.898	1.936	1	12
log(per capita per month expenditure in Rs.)	2335	7.967	0.398	6.739	9.330
log(land owned in acres)	1880	1.301	1.050	-1.609	3.258
log(value of total assets owned)	2155	12.525	1.350	7.313	15.297
Primary occupation – labor (1-labor; 0 –otherwise)	2335	0.095	0.293	0	1
Primary occupation – self employed (1- self-employed in farm and non-farm work; 0 – otherwise)	2335	0.305	0.460	0	1
Religion (1 – Sikh; 0 – otherwise)	2335	0.899	0.300	0	1
Caste (1- forward; 0 – otherwise)	2335	0.717	0.450	0	1
Percentage in bottom quartile	27.06%				
Percentage in top quartile	22.91%				
			Drinkers		
log(quantity of alcohol in ml)	424	7.400	1.034	3.912	9.998
log(alcohol price per ml)	424	-1.330	0.278	-2.120	-0.210
log(budget share of alcohol)	424	-3.264	0.925	-6.478	-1.213
log(price of input gur)	544	3.966	0.524	3.091	5.298
Age	544	45.308	14.086	16	95
Sex (1-male; 0 – otherwise)	544	0.996	0.060	0	1
Years of schooling	544	3.121	1.848	1	8
Household size	544	6.329	2.821	1	16
Number of children	544	1.724	1.316	0	6
Number of adult	544	4.604	2.046	1	12
log(per capita per month expenditure in Rs.)	544	8.012	0.381	6.739	9.240
log(land owned in acres)	426	1.180	1.095	-1.609	3.258
log(value of total assets owned)	482	12.427	1.415	7.313	15.297
Primary occupation – labor (1-labor; 0 –otherwise)	544	0.237	0.425	0	1
Primary occupation – self employed (1- self-employed in farm and non-farm work; 0 – otherwise)	544	0.641	0.479	0	1
Religion (1 – Sikh; 0 – otherwise)	544	0.926	0.261	0	1
Caste (1- forward; 0 – otherwise)	544	0.676	0.468	0	1
Percentage in bottom quartile	26.65%				

Percentage in top quartile	21.87%				
		Non-drinkers			
log(alcohol price per ml)	0	-	-	-	-
log(budget share of alcohol)	0	-	-	-	-
log(price of input gur)	1286	3.796	0.442	3.091	5.298
Age	1791	37.890	16.188	16	90
Sex (1-male; 0 – otherwise)	1791	0.390	0.487	0	1
Years of schooling	1791	3.440	1.956	1	8
Household size	1791	6.656	2.697	1	16
Number of children	1791	1.668	1.327	0	6
Number of adult	1791	4.987	1.893	1	12
log(per capita per month expenditure in Rs.)	1791	7.953	0.403	6.739	9.330
log(land owned in acres)	1454	1.336	1.034	-1.609	3.258
log(value of total assets owned)	1673	12.553	1.330	7.313	15.297
Primary occupation – labor (1-labor; 0 –otherwise)	1791	0.0519	0.221	0	1
Primary occupation – self employed (1- self-employed in farm and non-farm work; 0 – otherwise)	1791	0.203	0.402	0	1
Religion (1 – Sikh; 0 – otherwise)	1791	0.891	0.311	0	0
Caste (1- forward; 0 – otherwise)	1791	0.730	0.443	0	1
Percentage in bottom quartile	27.20%				
Percentage in top quartile	23.24%				

Notes: Table based on individual level data with sometimes more than two drinkers coming from the same household.

Table 4. Effect of alcohol prices on its consumption: village-time fixed effect OLS regressions on full sample

Dep. Var.:	log(quantity of alcohol in ml)				log(budget share of alcohol)			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
log(alcohol price per ml)	-0.594***	-0.597**	-0.627**	-0.627***	0.982***	0.987***	0.988***	1.007***
	(0.166)	(0.209)	(0.203)	(0.166)	(0.079)	(0.080)	(0.067)	(0.071)
log(per capita per month expenditure in Rs.)	0.753***	0.730***	0.799***	0.773***	-0.618***	-0.606***	-0.451***	-0.558***
	(0.164)	(0.166)	(0.211)	(0.171)	(0.080)	(0.086)	(0.106)	(0.085)
log(years of schooling)	-0.110	-0.104	-0.110	-0.112	-0.078**	-0.078**	-0.067**	-0.072**
	(0.074)	(0.073)	(0.078)	(0.072)	(0.033)	(0.034)	(0.032)	(0.032)
log(age)	0.370*	0.391**	0.363*	0.373**	0.057	0.047	0.042	0.058
	(0.196)	(0.192)	(0.197)	(0.187)	(0.088)	(0.091)	(0.107)	(0.097)
log(household size)	0.496**	0.473**	0.530**	0.508	-0.331***	-0.323***	-0.233***	-0.301***
	(0.161)	(0.172)	(0.188)	(0.160)	(0.075)	(0.077)	(0.072)	(0.064)
Constant	-1.245	-1.115	-1.618	-1.292	-2.719**	-2.642***	-4.194***	-3.486
	(1.541)	(1.560)	(1.990)	(1.533)	(0.718)	(0.787)	(0.754)	(0.633)
Other socio-economic controls	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Year fixed effects	Yes	No	Yes	Yes	No	Yes	Yes	No
Village fixed effects	Yes	Yes	Yes	No	No	No	Yes	Yes
Clustered SE	No	Yes	Yes	No	No	No	Yes	Yes
Observations	424	424	424	424	424	424	424	424
R^2	0.204	0.199	0.214	0.201	0.822	0.823	0.838	0.832

Notes: All regressions are based on individual level data. Other socio-economic controls include religion, caste and main occupation of the drinker. Robust standard errors reported are in parentheses and ***, ** and * indicate significance at 1 percent, 5 percent and 10 percent level, respectively.

Table 5. Effect of alcohol prices on its consumption: IV-OLS regressions

Dep. Var.: log(budget share of alcohol)	Full sample		Bottom quartile		Top quartile	
	OLS	IV-2SLS	OLS	IV-2SLS	OLS	IV-2SLS
	(1)	(2)	(3)	(4)	(5)	(6)
log(alcohol price per ml)	1.021***	1.193**	1.641**	0.764**	0.914***	0.901***
	(0.077)	(0.446)	(0.542)	(0.390)	(0.061)	(0.096)
log(per capita per month expenditure in Rs.)	-0.545***	-0.992***	-0.881**	-0.770***	-1.078***	-1.067***
	(0.074)	(0.083)	(0.456)	(0.162)	(0.054)	(0.040)
Years of schooling	-0.029**	-0.007	-0.202**	0.010	0.008	0.011
	(0.013)	(0.017)	(0.067)	(0.019)	(0.008)	(0.013)
log(age)	0.039	-0.125	-0.111	-0.004	0.045	0.075
	(0.087)	(0.094)	(0.391)	(0.003)	(0.053)	(0.077)
log(household size)	-0.284***	-1.015***	-0.786*	-0.837***	-1.202**	-1.356***
	(0.073)	(0.048)	(0.408)	(0.179)	(0.369)	(0.405)
Constant	-3.366***	0.737	7.925*	-1.848	0.289	0.213
	(0.698)	(1.431)	(4.287)	(1.923)	(0.421)	(0.346)
Other socio-economic controls	Yes	Yes	No	Yes	Yes	Yes
Year fixed effects	Yes	No	Yes	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Clustered SE	No	Yes	Yes	Yes	Yes	Yes
Observations	424	424	128	128	58	58
R^2	0.835	0.964	0.531	0.965	0.998	0.998
F statistics first stage; (pval)		11.65 (0.000)		15.70 (0.000)		15.03 (0.000)
Hausman test (pval)		7.15 (0.007)		3.84 (0.050)		87.56 (0.000)

Note: Regressions control for age, education, household size, number of adults and children, religion, caste, quantity of alcohol consumed, number of alcohol users, occupation, year and village fixed effects, and per capita income. Alcohol prices are instrumented with price of the key input raw material gur in the production of alcohol. Robust standard errors are in parentheses and ***, ** and * indicate significance at 1 percent, 5 percent and 10 percent level, respectively.

Table 6. Robustness check: Tobit and IV Tobit models

	Dependent Variable: budget share of alcohol	
	Random effect Tobit model	IV Tobit model
	(1)	(2)
log(alcohol price per ml)	0.015*	0.204**
	(0.008)	(0.083)
log(household size)	-0.025***	-0.049***
	(0.006)	(0 .012)
log(age)	0.041**	0 .034
	(0.020)	(0 .029)
Age square	-0.000*	-0.000
	(0.000)	(0.000)
log(years of schooling)	-0.007**	-0.027**
	(0.003)	(0 .010)
log(per capita per month expenditure in Rs.)	-0.009	-0.035*
	(0.009)	(0 .018)
Constant	-0.075	0.616
	(0.102)	(0.294)
Year fixed effects	Yes	No
Village fixed effects	Yes	Yes
Observations	424	1357
Log likelihood	704.776	
Wald chi2 (pval)	65.49(0.000)	10.76(0.0010)

Notes: Alcohol prices are instrumented with price of the key input raw material Gur in the production of alcohol. Standard errors are in parentheses and ***, ** and * indicate significance at 1 percent, 5 percent and 10 percent level, respectively.

Table 7. Robustness check: two years subsample analysis

	Dependent Variable: budget share of alcohol			
	OLS	IV-OLS	Random effect Tobit	IV Tobit
	(1)	(2)	(3)	(4)
Elasticity, Price of alcohol	0.891***	2.627*	0.651***	0.598*
	(0.017)	(1.542)	(0.035)	(0.342)
Constant	7.491***	2.998	0.225	0.152
	(1.971)	(3.383)	(0.117)	(0.186)
Year fixed effects	Yes	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes	Yes
Clustered SE	Yes	Yes	Yes	Yes
Wald chi2 (pval)		32.98 (0.001)		52.91(0.000)
Log Likelihood			140.474	
Observations	155	155	1357	1357
R-squared	0.235	0.287		

Note: All regressions are based on individual level data. Models in columns 1 and 3 controls for household size and total expenditure per capita. In columns 2 and 4, prices of alcohol is instrumented with the price of gur controlling for household size, total expenditure per capita, age, age square and years of schooling. Robust standard errors are reported in parentheses and ***, ** and * indicate significance at 1 percent, 5 percent and 10 percent level, respectively.

Table 8. Descriptive statistics: sobriety and drinking

	All				
	Obs.	Mean	S.D.	Min.	Max.
	(1)	(2)	(3)	(4)	(5)
	Sober				
log(alcohol price per ml)	0	-	-	-	-
log(budget share of alcohol)	0	-	-	-	-
log(age)	129	3.924	0.265	2.995	4.317
log(years of schooling)	129	0.852	0.726	0	2.079
log(household size)	129	1.624	0.479	0	2.639
log(number of children)	96	0.531	0.484	0	1.791
log(number of adult)	129	1.346	0.443	0	2.302
log(per capita per month expenditure in Rs.)	129	8.007	0.453	6.739	9.240
log(land owned in acres)	117	1.303	0.985	-0.693	2.890
log(value of total assets owned)	120	12.730	1.118	9.615	15.297
Caste (1- forward; 0 – otherwise)	129	0.705	0.457	0	1
Agedifhead	129	2.767	2.396	-2	10
Edudifhead	129	0.806	1.463	-1	5
log(medical cost)	53	7.885	2.277	3.401	13.017
Percentage sober	24%				
	Drinker				
log(alcohol price per ml)	415	-1.329	0.281	-2.120	-0.210
log(budget share of alcohol)	415	-3.264	0.933	-6.478	-1.213
log(age)	415	3.714	0.317	2.772	4.553
log(years of schooling)	415	0.924	0.726	0	2.079
log(household size)	415	1.792	0.411	0.693	2.772
log(number of children)	342	0.656	0.521	0	1.791
log(number of adult)	415	1.450	0.466	0	2.484
log(per capita per month expenditure in Rs.)	415	8.014	0.357	7.086	9.172
log(land owned in acres)	309	1.133	1.131	-1.609	3.218
log(value of total assets owned)	362	12.327	1.489	7.313	14.946
Caste (1- forward; 0 – otherwise)	415	0.667	0.471	0	1
Agedifhead	415	2.469	3.333	-25	22
Edudifhead	415	0.626	1.433	-3	5
log(medical cost)	109	7.155	2.128	3.912	11.512
Percentage drinkers	76%				

Notes: Given that all the sober are males, we exclude sex from this table. Agedifhead and Edudifhead is the difference in age and education, respectively between the drinker (sober) and the household head. If the drinker is also the household head then we take the difference from the "next in command", who is usually his wife.

Table 9. Reasons for sober: logit estimates for sobriety

	Dependent Variable: sober							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
log(alcohol price per ml)	2.321	1.051	4.541	1.365	1.793	1.822	1.967	2.153
	(3.220)	(0.427)	(7.188)	(0.782)	(0.786)	(0.834)	(0.935)	(1.152)
log(per capita per month expenditure in Rs.)		14.012**	9.973**	13.596***	16.359**	17.029**	17.311**	11.835*
		(14.080)	(9.055)	(11.028)	(16.464)	(17.588)	(18.128)	(15.119)
log(land owned in acres)					1.611	0.937	1.013	0.956
					(0.781)	(0.308)	(0.313)	(0.320)
log(years of schooling)		1.205	0.561	0.853	0.895	0.787	0.689	0.520
		(0.492)	(0.218)	(0.478)	(0.576)	(0.488)	(0.470)	(0.555)
log(age)		0.517		2.266	18.272**	20.507**	19.433**	12.128
		(0.560)		(3.056)	(18.817)	(21.559)	(21.632)	(19.450)
log(number of children)				3.003	6.962**	8.945**	9.280**	8.341*
				(2.144)	(6.212)	(8.867)	(10.068)	(9.154)
log(number of adult)				0.552	0.701	0.679	0.885	0.773
				(0.331)	(0.576)	(0.5858)	(0.746)	(0.684)
log(household size)		5.271*	0.178**					
		(5.133)	(0.156)					
Caste						4.932**	3.902	5.422**
						(3.676)	(3.318)	(4.241)
Agedifhead			0.780***					1.068
			(0.049)					(0.104)
Edudifhead			4.737***				1.324*	1.310
			(1.661)				(0.207)	(0.213)
log(medical cost)			1.937***					
			(0.361)					
Constant	144.916**	2.270**	0.002	8.370**	3.940**	1.150**	1.060**	1.740
	(282.665)	(2.010)	(0.002)	(6.300)	(4.360)	(1.300)	(1.240)	(2.790)
Year fixed effects	No	No	No	No	No	No	No	No
Clustered SE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Observations	424	424	110	348	261	261	261	261

Notes: The dependent variable is an indicator variable Sober with “0” for an individual being sober, and “1” otherwise. Robust standard errors are in parentheses and ***, ** and * indicate significance at 1 percent, 5 percent and 10 percent level, respectively.

Appendix A. Supplementary information

Online appendix

The impact of price policy on demand for alcohol in rural India

Variable definitions and descriptions

The NSS consumer expenditure surveys are quinquennial surveys conducted by the National Sample Survey Organisation (NSSO) that is set up to conduct all India surveys by the Government of India since the year 1950. The NSSO conducts regular consumer expenditure surveys as part of its "rounds", each round being normally of a year's duration. The surveys are conducted through household interviews, using a random sample of households covering all the 35 States and Union Territories. The NSS survey that we compare here is based on the data from the sixty-sixth round (2009-10) for the rural Punjab. The sample consists of 3118 households from 196 villages (Government of India, 2011).

Outcome variables

Budget share of alcohol in total expenditure. Two types of data were collected. (a) Monthly expenditures for all the food and non-food items consumed by each household were recorded for the past month to arrive at total monthly expenditure. This excluded expenditures on alcohol and tobacco. Information on food comprises of about 33 items containing food consumed both inside and outside the house, including wages and gifts received. The non-food items were of two types with items that are purchased regularly every month (expenditure on fuel and electricity, products for cleaning and personal care, telephone bills, etc.) and the other annual (clothing and footwear, medicine and health cost, ceremonies, education, taxes, etc.). (b) For each household members consuming alcohol and tobacco products, individual specific information on quantity consumed and price paid were recorded. These were summed up for each household to arrive at the total household expenditure on alcohol and tobacco. Budget share of alcohol is the share of total alcohol expenditure for each household to its total household expenditure, including expenditure on alcohol and tobacco.

Price variables

Price of alcohol. Alcohol prices depend on the type with country liquor priced lower than the Indian made foreign liquor (IMFL). Since IMFL is imported from outside the village they are highly expensive. Alcohol type specific information were collected for each drinking household member separately along with the respective prices paid and quantities consumed. There seem to be considerable heterogeneity in prices in both types. Further interrogation of the drinkers suggests that the prices varied from seller to seller and their relationship with them.
Price of Gur. Gur as the key raw material for the production of country liquor is also consumed by the households so gur has competing uses. It is mostly consumed by the bottom quartile while the top quartile consume the finer version of gur that is sugar. The share of gur in the expenditure budget for both top and bottom quartiles are low.

Household variables

Bottom quartile: All the sample households were sorted in ascending order by their per capita per month total expenditure and then first 25% of the households were chosen to be in the bottom group. Alcoholics in this group consist of 27% of the total alcoholics in the sample.

Top quartile. Similarly, in the same sorting by ascending order of household per capita per month total expenditure the last 25 percent represent the top group. Alcoholics in this group consist of 21 percent of the total alcoholics in the sample.

Per capital per month total expenditure. It includes both food and non-food expenditure for the past 30 days for each household in the sample. However, certain in-frequent expenditures for some non-food items like expenditures on clothing, medicine and health costs, ceremonies, education, taxes paid are collected for the past 12 months. These annual expenditures are divided by 12 to calculate monthly expenditures and added to the food expenditure to calculate per month total expenditures for each household. This figure for each household is further divided by its household size to calculate per capita per month total expenditure.

Total irrigated land owned in acres. The total area owned by each household is collected with areas under irrigation in acres and sources of irrigation. The area owned of irrigated land includes land cultivated by him (or her) and land leased out completely/partially.

Total unirrigated land owned in acres. The total area owned by each household was also collected for unirrigated land but almost no area under this category exists in these villages.

Present value of total assets owned. All the assets owned by the households are listed along with the current value of all the assets owned considering its vintage.

Household size. This includes all individuals living under one roof and eating from the same kitchen. This does not exclude servants and guests living on a permanent basis.

Number of children. Total number of all individuals within the household below the age of 18 living under one roof and eating from the same kitchen.

Number of adults. Number of all individuals within the household over the age of 18 living under one roof and eating from the same kitchen.

Individual variables

Age. Number of years since birth for each individual within the household.

Sex. The sex of each individual either male or female is recorded with the code male = 1 and female = 0.

Occupation. The main occupation has 9 categories with self-employed farming, self-employed non-farming, salary, pensioner, agricultural wages, non-agricultural wages, dependent, household work, and student. This is determined by asking the households for the main (larges) source of income.

Education. There are 8 educational categories with illiterate, below primary, primary, middle, Secondary, technical, graduate and post graduate and above.

Estimation strategy

Our basic strategy is to regress consumption of alcohol on a vector of market prices, household size and per capita total expenditures. Using a panel of individual consumption, we also split the sample by whether a household is in bottom quartile or top quartile, and estimate the regression separately for each expenditure categories. We estimate

$$\mathrm{C}^{\mathrm{a}}_{\mathrm{it}} = \beta_1 \ \mathrm{P}^{\mathrm{a}}_{\mathrm{it}} + \ \beta_2 \ Z_{it} + \ \delta_i + \ \delta_t + \ \epsilon_{it}$$

where C^a_{it} is the consumption of alcohol by individual *i* at time *t* and P^a_{it} is the price of alcohol paid by individual *i* at time *t*. We estimate three variants of C^a_{it} (a) monthly quantity in millilitres of alcohol consumed (b) monthly expenditure share of alcohol in total expenditure (share measure) (c) monthly expenditure on alcohol in rupees. Other household and village characteristics (Z_{it}) are included as control. Village fixed effects (δ_i) are included to control for omitted and time-invariant characteristics of villages. We also include year fixed effects (δ_t) to control for time-varying trends. The term ϵ_{it} is an error term.

Using the full sample, we next pursue the robustness of the results with alternative specifications including the instrumental-variables (IV-2SLS).

Robustness checks

IV- 2SLS regressions

Our identification strategy uses gur price as an instrument for the price of alcohol. The price of gur is a good instrument because gur is a key determinant of alcohol supply with no direct implications for demand. Below, we show that gur price is a significant determinant of the alcohol price. Our first-stage equation models the relationship between gur price and alcohol price:

$$\mathrm{P}^{\mathrm{a}}_{\mathrm{it}} = a_{1i} + \mathrm{D}_1 \, \mathrm{P}^{\mathrm{g}}_{\mathrm{it}} + \ D_2 X_{it} + D_3 \, year_t + \mu_{it}$$

In the above equation, gur price ($\mathrm{P}^{\mathrm{g}}_{\mathrm{it}}$) is the household specific price associated with the individual member i used to instrument alcohol price ($\mathrm{P}^{\mathrm{a}}_{\mathrm{it}}$) paid by individual *i* in year *t*. Here a_{1i} is village fixed effects, X_{it} is a vector of household and individual control variables and μ_{it} is the error term.

$$\mathrm{C}^{\mathrm{a}}_{\mathrm{it}} = \ \propto_{1i} + \beta_1 \ \mathrm{P}^{\mathrm{a}}_{\mathrm{it}} + \ \beta_2 \ X_{it} + \beta_3 year_t + \ \omega_{it}$$

The second-stage equation estimates the elasticity of alcohol price (β_1) by regressing the predicted price of alcohol from the first stage on budget share of alcohol (C_{it}^{a}) along with individual and household controls. Year and village fixed effects are included along with the error term ω_{it}.

Tobit models

One impending concern with the above specifications is the corner solution for a large proportion of individuals, with approximately only 11 percent of sample households reporting positive alcohol consumption. Since corner solutions do not satisfy the first order conditions for an interior optimum of the underlying utility maximization problem, the above estimation does not apply to observations with zero expenditure on alcohol. Alcohol consumption are thus estimated using tobit regressions, whereby observed consumption equal notational or desired consumption when the latter are positive, and are zero otherwise (**McDonald and Moffitt, 1980)**.

Given that data on demand for alcohol often have values clustered at zero, Tobit technique uses all observations, both those at the limit and those above it. The following model is specified as an unobserved latent variable y*:

$$y^* = X_i\beta + \emptyset_i \qquad if\ X_i\beta + \emptyset_i > 0$$

$$= 0 \qquad if\ X_i\beta + \emptyset_i \leq 0$$

where i = 1, 2, …..N, and X_i is a vector of independent variables, and $\emptyset_i$ an independently distributed error term assumed to be normal with zero mean and constant variance σ^2. The above equation is estimated using maximum likelihood estimator.

Logit model

To fix ideas, consider the following regression model:

$$S_{it}^{a} = \emptyset_1 + \emptyset_2 P_{it}^{a} + \emptyset_3 Z_{it} + u_{it}$$

where S_{it}^{a} = 0 for individual i being sober and 1 otherwise. P_{it}^{a} is the price of alcohol and Z_{it} are other socio-economic controls included in the regression.

The logistic model has the form

Logit(S) = In $(\frac{\pi}{1-\pi})$ = $\emptyset_1 + \emptyset_2 P_{it}^{a} + \emptyset_3 Z_{it}$

Therefore,

π= Probability (S = outcome of interest | $P_{it}^{a} = p_{it},\ Z_{it} = z_{it}$)

$$= \frac{e^{\emptyset_1 + \emptyset_2 p_{it} + \emptyset_3 z_{it}}}{1 + e^{\emptyset_1 + \emptyset_2 p_{it} + \emptyset_3 z_{it}}},$$

where π is once again the probability of the event, $\emptyset_1$ is the intercept, and $\emptyset_2$ and $\emptyset_3$ are regression coefficients that are typically estimated by the maximum likelihood method.

Now π / (1-π) is simply the odds ratio in favour of going sober – the ratio of the probability that the individual will quit alcohol consumption to the probability that he will not quit drinking.

Table S1: Effect of alcohol prices on its consumption: First stage regressions

IV First stage			
Dep. Var.: log(budget share of alcohol)	Full Sample	Bottom quartile	Top quartile
	(1)	(2)	(3)
log(Price of input gur)	0.008**	0.011**	0.717**
	(0.004)	(0.005)	(0.358)
Constant	-2.813***	-3.432***	-5.638
	(0.410)	(0.769)	(3.508)
Other socio-economic controls	Yes	Yes	Yes
Year fixed effects	No	Yes	Yes
Village fixed effects	Yes	Yes	Yes
Clustered SE	Yes	Yes	Yes
Observation	424	128	58
R^2	0.192	0.552	0.559
F statistics first stage; (pval)	11.65 (0.000)	15.70 (0.000)	15.03 (0.000)

Note: Regressions control for age, education, household size, number of adults and children, religion, caste, quantity of alcohol consumed, number of alcohol users, occupation and per capita income. Robust standard errors are in parentheses and ***, **, * indicate significance at 1 percent, 5 percent and 10 percent level, respectively.

Table S2: Effect of alcohol prices on alcohol expenditure: village-time fixed effect OLS on full sample

Dep. Var.:	log(expenditure on alcohol)			
	Model 1	Model 2	Model 3	Model 4
	(1)	(2)	(3)	(4)
log(alcohol price per ml)	0.367**	0.362*	0.336*	0.333**
	(0.166)	(0.213)	(0.207)	(0.166)
log(per capita per month expenditure in Rs.)	0.804***	0.779***	0.864***	0.831***
	(0.164)	(0.167)	(0.213)	(0.171)
log(years of schooling)	-0.110	-0.100	-0.110	-0.107
	(0.075)	(0.072)	(0.077)	(0.072)
log(age)	0.259	0.302	0.254	0.286
	(0.196)	(0.194)	(0.200)	(0.188)
log(household size)	0.502**	0.472**	0.541**	0.510**
	(0.162)	(0.171)	(0.188)	(0.160)
Constant	-1.202	-1.206	-1.690	-0.107
	(1.542)	(1.569)	(1.988)	(0.072)
Other socio-economic controls	Yes	No	Yes	No
Year fixed effects	Yes	No	Yes	Yes
Village fixed effects	Yes	Yes	Yes	No
Clustered SE	No	Yes	Yes	No
Observations	424	424	424	424
R^2	0.175	0.167	0.183	0.171

Notes: All regressions are based on individual level data. Other socio-economic controls include religion, caste and main occupation of the drinker. Robust standard errors are reported are in parentheses and ***, ** and * indicate significance at 1 percent, 5 percent and 10 percent level, respectively.

Reference

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