The impacts of alcoholic and non-alcoholic beverage tax on different income groups in Vietnam

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Abstract

Background

Along with sustained high economic growth, Vietnam has experienced a drastic increase in the consumption of alcoholic beverages and soft drink over the last two decades.

Methods

We estimated the price and expenditure elasticities of demand for alcoholic beverages (beer and liquor) and non-alcoholic beverages in Vietnam using the Quadratic Almost Ideal Demand System (QUAIDS) and a complete food demand system. We then estimate the impacts of simulated taxes of alcoholic and non-alcoholic beverages on different income groups in Vietnam.

Findings

Our results indicate that non-alcoholic beverages, liquor, and beer are price elastic with own-price elasticities of -1.48 for liquor, -1.33 for beer, and -1.55 for non-alcoholic beverages. We estimated a simulated new excise tax of 20% for non-alcoholic beverages and an increase of 20% in the excise tax on alcoholic beverages. On average, a 20% non-alcoholic beverage tax decreased non-alcoholic beverage consumption by 31%. A 20% tax on alcoholic beverages led to a large decrease of 29.7% in the consumption of liquor and 26.6% in beer consumption. Both taxes are mildly regressive. The average tax burden for a 20% non-alcoholic tax is about 0.5% of a household's total spending for low-income households and 0.36% for high-income households. A 20% increase in tax for alcoholic beverages implies an additional tax burden of 4.7% for low-income households and 2.3% for high-income households.

Conclusion

Our results show that taxing non-alcoholic and alcoholic beverages has a statistically significant impact on reducing consumption of these unhealthy beverages. Consumers from low-income groups will be more responsive to the taxes. While the taxes are slightly regressive, the overall tax burdens are small, especially regarding the non-alcoholic tax. The proposed taxes are likely to be effective in reducing the consumption of unhealthy beverages and the associated obesity, non-communicable diseases, and deaths, particularly in the poor population. While in the short run, the taxes generate a tax burden for households, in the long run, consumers switch to a healthier diet, yielding welfare gains from reduced health expenditure and increased productive lifespan.

Keywords: Vietnam; alcoholic beverages; non-alcoholic beverages; tax; demand system

1. Background

Non-communicable diseases (NCDs) are the leading cause of death globally, killing more than forty-one million people each year. Of these NCDs, four groups of diseases account for three-quarters of the deaths: cardiovascular disease (17.9 million), cancers (9 million), respiratory diseases (3.8 million), and diabetes (1.6 million) [1]. A range of factors is contributing to the rise of NCDs. One factor is critical and preventable: unhealthy consumption patterns, particularly the consumption of tobacco, alcohol, and sugar-sweetened beverages (SSBs). Consuming these harmful products negatively affects health, labor productivity, and human capital, bringing about a loss in economic growth.

Vietnam has a large number of people consuming these harmful products. According to the Global Adult Tobacco Survey (GATS), about 15.6 million Vietnamese adults consume tobacco. Of those, 12.6 million smoke cigarettes, accounting for approximately 22.5% and 18.2% of the adult population in the country in 2015, respectively. It has been estimated that nearly 40,000 people in Vietnam die each year from tobacco-related illnesses. Without proper measures, this death toll will reach 70,000 per year by 2030 [2].

As of 2016, alcohol consumption in Vietnam reached 340 million liquor liters and 3.92 billion liters of beer, an estimated 40% increase from 2010 [3]. Per capita liquor consumption in Vietnam increased 90% from 2010 to 2017; the world's fifth-highest growth rate during the period. The country spends $3.4 billion annually on alcohol, which is equivalent to US$ 300 per capita. This alcoholic beverage expenditure is much higher than the health expenditure per capita of US$ 113 per person, according to the Ministry of Health [4]. Data from the Global Burden of Disease database show that in 2016, 12% of Vietnam's deaths were associated with alcohol use [5]. An analysis of survey data for 1,061 deaths due to road crashes in Vietnam showed that one-fifth of traffic-related deaths were caused by alcohol use [6].

In addition to the drastic increase in alcohol beverage consumption, Vietnam experienced a similar increase in sugary drink consumption, which has increased sevenfold during the last 15 years. According to the Global Dietary Database [7], SSB consumption per capita in Vietnam increased from 37.5 grams per day in 1990 to 63.1 grams per day in 2010, much higher than in China (13.4 grams in 2010) but lower than in Indonesia (68.1 grams in 2010) and the Philippines (119.2 grams in 2010). Furthermore, children and youth consume SSBs frequently. A study found that 35% of young adolescents aged 12 to 15 years in Vietnam consumed carbonated soft drinks at least once daily in 2013 [8]. Health studies agree that SSB consumption leads to energy excess that results in fat accumulation, metabolic disorders, and increased risk for non-communicable diseases, such as obesity, hypertension, and osteoporosis [9, 10]. The number of obese Vietnamese increased by 38% from 2010 to 2014, the highest increase in Southeast Asia [11]. According to a recent survey conducted by the National Institute of Nutrition on obesity in

Vietnam, 16% of adult men and 20% of adult women are overweight or obese. In addition, 11.7% of boys and 7.6% of girls between the ages of 5 and 19 are overweight [12].

As the law of demand in economics predicts, taxes raise a good's price to consumers, reducing the quantity consumed. Therefore, a tax on alcohol and SSBs should decrease consumption of unhealthy drinks and encourage consumers to switch to a healthier diet. However, several counter-arguments against such a tax have been proposed, mostly from the beverage industry [13, 14, 15]. First, there is a claim that this tax will not be effective because it is relatively small compared to a household's budget. Second, the beverage industry argues that this tax is regressive since poor people pay a greater proportion of their income than the rich.

According to the current law on excise tax in Vietnam, an excise tax is a duty that is applicable on specific goods and services that (i) are not encouraged due to their harmful effects on health; (ii) are typically consumed by high-income consumers; and (iii) are unnecessary services [16]. The current law on excise tax applies mostly to alcohol products, cigarettes, and expensive goods and services such as planes, cruise boats, and cars. As of 2020, the excise tax rate is 75% for cigarettes, 65% for medium and heavy liquor (20% of alcohol by volume or more), and 35% for light liquor (less than 20% of alcohol by volume).

The alarming SSB figures prompted the government of Vietnam to propose an excise tax of 10% on SSBs in 2017. The proposal was well received by the Ministry of Health and international health organizations, such as the World Health Organization. However, the proposed taxation has faced objections from soft drink manufacturers, citing the possible economic losses for SSB businesses and unemployment concerns. At the time of writing (August 2021), the proposal has not yet been submitted to the National Assembly for approval.

There is an increasing body of empirical evidence on the effectiveness of excise taxes against the consumption of harmful products, including tobacco, alcohol, and sugar-sweetened beverages (SSBs). While the WHO concludes that increasing the price of tobacco through higher taxes is the single most effective way to encourage tobacco consumption [17], there are extensive review studies on the impact of excise taxes on curbing alcohol and SSB consumption.

Previous studies on alcohol taxation often find that excise taxation effectively reduces alcohol consumption and related diseases and road accidents. A recent review analyzing fifty-four previous studies reports a consistent finding in most studies that increasing excise taxes leads to a reduction in alcohol consumption and a decrease in drunk driving, criminal arrests, cirrhosis, and death [18]. A meta-analysis of fifty publications found that doubling the alcohol excise tax would reduce alcohol-related mortality by 35%, traffic crash deaths by 11%, sexually transmitted disease by 6%, violence by 2%, and crime by 1.4% [19]. Another review of seventy papers found that a 10% increase in alcohol prices would result in a 3% to 10% decrease in alcohol consumption [20].

Similarly, previous studies on the impacts of an SSB tax yielded mostly consistent results. One study reviewed the evidence on SSB effects from twenty-seven studies of taxes and found that the taxes led to decreased soda consumption in most studies [21]. There is evidence that SSB taxation effectively reduces sugar consumption and non-communicable disease [22]. Evidence shows that a tax on sugary drinks that increases their prices by 20% can reduce consumption by around 20%, thus reducing the incidence of obesity and diabetes [23]. A study in the United States estimated that a tax-induced 20-percent price increase on caloric sweetened beverages could cause an average reduction of both adult obesity prevalence and child overweight prevalence by three percentage points [24]. Actual impacts would depend on many factors, including how the tax is reflected in consumer prices and the competitive strategies of beverage manufacturers and food retailers.

A study by the Lancet Taskforce on NCDs and economics [25] indicated that low-income consumers are likely to accrue considerable health benefits from a tax on unhealthy products since they generally have the strongest response to price changes. At the same time, the adverse equity effect of taxes can be mitigated by using the generated tax revenues for pro-poor use. In Mexico, where the government levied an excise tax on SSBs of one peso per liter, most studies found the tax effective in decreasing SSB consumption [26, 27], particularly among the poorest group [27]. A study estimated that Mexico's SSB tax will help to prevent 239,900 cases of obesity, 39% of which would be among children. It could also prevent 61,340 cases of diabetes, and lead to gains of 55,300 quality-adjusted life-years [28].

The objective of this paper is to contribute to the current debate on taxes on alcoholic and non-alcoholic drinks by (i) estimating the price and income elasticity of alcoholic and non-alcoholic beverages together in the same model, using the most recently available data; and (ii) analyzing the impacts of excise taxation on alcoholic and non-alcoholic beverage consumption for different income groups in the population.

2. Data and methods

2.1.Data

For the study, we used the 2018 Vietnam Household Living Standard Survey (VHLSS) collected by Vietnam's General Statistics Office (GSO) in 2018. The VHLSS is a system of nationally representative surveys with a two-stage sampling design. Households are grouped into Primary Sampling Units (PSUs), statistical units derived from national census information. The first stage in sampling is selecting PSUs, and the second stage is choosing specific households within the selected PSUs. While the first stage is probability proportional to size, the second stage is simple random sampling [29]. The surveys are conducted every two years to collect income information, expenditures, and household and individual characteristics in Vietnam. The

VHLSS contains daily food and beverage expenditures for the last four weeks, including monetary and in-kind consumption. In total, the 2018 VHLSS contains information from 9396 households.

For this study, ten mutually exclusive groups of foods and beverages were defined: (1) rice; (2) other cereals; (3) animal products; (4) vegetables & fruits; (5) liquor; (6) beer; (7) non-alcoholic beverages; (8) milk; (9) coffee; and (10) tea. This research could not disaggregate SSBs, bottled mineral water and 100% juice drinks within the non-alcoholic beverages due to data unavailability. However, SSBs are the major consumption item among non-alcoholic bottled beverages. In 2020, SSBs accounted for 80% of total non-alcoholic beverages while juice and bottled water shared the remainder equally [30]. This paper defines liquor as all liquor types except for beer, including Vietnamese traditional rice wine, wine, vodka, and spirits Because of the questionnaire design, there is no separate data consumption for wine and spirits; therefore, we cannot provide separate estimations for wine and spirits.

Food expenditure shares for each group were calculated by adding the expenditures for each group and then dividing by the total expenditure for the ten categories. The total expenditure in the ten categories accounts for over 90% of total food expenditure and only excludes food items such as condiments, cigarettes, and food purchased away from home.

2.2. Methods

We estimated the quadratic extension of the standard Almost Ideal Demand System (AIDS) developed by Deaton and Muelbauer [31]. The Quadratic Almost Ideal Demand System (QUAIDS) introduced by Bank et al. [32[allows for non-linearity in the budget shares while maintaining all other properties of the AIDS model.

The QUAIDS share equations are specified as follows:

$$w_i = \alpha_i + \sum_{j=1}^{k} \delta_{ij} D_j + \sum_{i=1}^{n} \gamma_{ij} lnP_j + \beta_i \ln ln \left(\frac{m}{a(P)}\right) + \frac{\lambda_i}{b(P)} + \varepsilon_i \qquad (1)$$

Where w_i is the expenditure share for the i[th] food category, D_j is the vector of household demographic variables; p_j is the price of the j^{th} good; and m is the total food expenditure; a(p) and b(p) are the translog and Cob-Douglass functions of prices. The specific functional form of a(p), b(p), and $\lambda(p)$ is:

$$\ln ln\, a(p) = \alpha_0 + \sum_{i=1}^{n} \alpha_i lnp_i \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} lnp_i p_j \qquad (2)$$

$$b(p) = \prod_{i=1}^{n} p_i^{\beta_i} \tag{3}$$

$$\lambda(p) = \sum_{i=1}^{n} \lambda_i ln p_i \tag{4}$$

The parameters of this demand system should satisfy the following set of restrictions: adding up, homogeneity, and Slutsky symmetry.

Adding up restrictions: $\sum_{i=1}^{n} w_i = 1,$ requires

$$\sum_{i=1}^{n} \alpha_i = 1; \sum_{j=1}^{k} \delta_{ij} = 0; \sum_{i=1}^{n} \gamma_{ij} = \sum_{i=1}^{n} \beta_i = \sum_{i=1}^{n} \lambda_i = 0 \tag{5}$$

Homogeneity condition means:

$$\sum_{i=1}^{n} \gamma_{ij} = 0 \tag{6}$$

And Slutsky symmetry:

$$\gamma_{ij} = \gamma_{ji} \tag{7}$$

Censored demand system

Since there is likely non-consumption of some food commodities by a number of households, there may be selection bias if the censored nature of the response variables is not addressed. To address censoring in the demand system, we used the two-step estimator introduced by Shonkwiler and Yen [33]. The technique consists of estimating a probit model in the first step to account for whether to purchase a particular beverage. From the first step, we can predict the cumulative distribution function ($\hat{\Phi}_i$) and the probability density function ($\hat{\phi}_i$) of the binary choice model. The calculated $\hat{\phi}_i$ is then used as an additional regressor in the system of the budget share in the second step.

The modified budget share equations in the second stage become:

$$w_i^* = \hat{\Phi}_i w_i + \theta_i \hat{\phi}_i \tag{8}$$

The elasticity measures were calculated by differentiating equations (8) with respect to prices and expenditure.

Expenditure elasticity of food item *i*:

$$\eta_i = \varepsilon_i / w_i^* + 1 \quad (1)$$

Uncompensated (or Marshallian) price elasticity of food item *i*:

$$\epsilon_{ij} = -\delta_{ij} \quad (10)$$

Where δ_{ij} is the Kronecker delta that lies between zero and one ($\delta_{ij} = 0 \; for \; i \neq j \; and \; \delta_{ij} = 1 \; for \; i = j$)

We use the QUAIDS package in STATA [34] to estimate equation (8).

Endogeneity of unit values

We derived unit prices by taking the ratio of the yearly expenditure to the yearly quantity of each food category. The unit prices are likely to be endogenous because they may reflect an unobserved preference for quality [35]. This paper used a technique to correct for quality differences, first proposed by Cox and Wohlgenant [36] then modified by Vu and Glewee [37]. First, we regressed the mean-deviated unit values on household characteristics D_j to exclude unit values' quality effects and obtain quality-adjusted prices. Next, we used the communal mean quality-adjusted prices, $\overline{p}_{i,}$ as the corrected prices in the QUAIDS model. Therefore, households in one commune face the same market price, represented by $\overline{p}_i$, for a "standard" food item, i.e., without quality effects.

In summary, we estimated the QUAIDS model and controlled for censored data as the base model, using demographic characteristics to allow for household heterogeneity. In particular, we used the age, gender, education, and ethnicity of the household head and the location (urban vs. rural), the expenditure quintile, household size, and the proportion of children in the family whose age was less than 15 years. After estimating the model, we computed the price elasticities for the mean values of the variables and then used them to stimulate tax scenarios.

For robustness checking, we used the base model without demographic controls, the base model without controlling for censored demand, and the standard AIDS model without controlling for censored demand.

Simulating the tax effect

After estimating the parameters, we used the own-price and cross-price elasticity estimates to simulate the effect of the taxes on household food consumption and the tax burden per

household. We used two tax scenarios: (1) a 20% *ad valorem* non-alcoholic tax; and (2) 20% ad valorem increase of the current excise tax on alcoholic beverages. In this analysis, we assume beverage producers entirely pass on the taxes to consumers, which means the increase in the *ad valorem* tax is fully expressed in the price of the taxed goods.

3. Results

Table 1 provides socio-economic descriptive statistics. We define a household as "low-income" if their real spending falls in the bottom 20% of the household total expenditure, "high-income" if in the top 20%, and "middle income" for the rest. On average, low-income households are less likely in rural areas. The household heads in low-income households are younger, more likely to belong to an ethnic minority, less educated, and less likely to be women. Low-income households also have a larger household size and a higher proportion of children than middle-income and high-income households.

Table 1. Demographic statistics of the sample

	Low income (2,140 obs.)			Middle income (5752 obs.)			High income (1502 obs.)		
	Mean	95% CI		Mean	95% CI		Mean	95% CI	
Urban	0.10	0.08	0.11	0.29	0.27	0.30	0.65	0.62	0.67
Ethnic minority household head	0.47	0.45	0.49	0.09	0.08	0.10	0.03	0.02	0.04
Head's age (years)	50.4	49.7	51.1	52.8	52.5	53.1	53.8	53.1	54.4
Female household head	0.20	0.19	0.22	0.25	0.23	0.26	0.35	0.33	0.38
Head finished high school	0.24	0.22	0.26	0.31	0.30	0.32	0.58	0.55	0.60
Household size	4.43	4.36	4.50	3.65	3.61	3.69	3.05	2.98	3.13
Child proportion	0.31	0.30	0.32	0.20	0.19	0.20	0.13	0.12	0.14

Table 2 provides descriptive statistics for mean expenditure shares in urban and rural areas and by income groups. Animal products (including meat, fish and seafood, and eggs) account for the highest food expenditure share, followed by rice, vegetables, and drinks. Among the beverage items, milk accounts for the highest share, followed by beer and tea. Table 2 also indicates the percentage of households with non-zero expenditure per food and beverage group. Among beverage items, coffee has the lowest percentage of households reporting purchases at

32.2%. In contrast, 73.6% of households reported purchasing liquor, 73.5% purchasing non-alcoholic drinks, and 69.4% purchasing beers.

There are significantly different consumption patterns between income groups and between urban and rural areas. Households in urban areas and high-income households spend much more on milk, beer, non-alcoholic beverages, and coffee than rural and low-income families, respectively. However, rural, and low-income households spend more on liquor than urban and high-income ones, respectively.

Table 2. Food expenditure shares

Food expenditure share (%)	All	Urban	Rural	Low income	Middle income	High income	% of non-zero consumption
Rice	15.9%	12.9%	17.5%	24.0%	15.0%	10.5%	99.5%
Other cereal	4.9%	4.6%	5.1%	5.5%	4.9%	4.5%	92.0%
Animal products	52.1%	51.4%	52.4%	50.1%	52.8%	51.8%	99.8%
Vegetables & fruits	13.5%	16.7%	11.9%	10.1%	13.4%	17.4%	99.1%
Liquor	1.3%	0.8%	1.5%	1.9%	1.2%	0.8%	73.6%
Beer	1.8%	2.0%	1.7%	0.8%	2.0%	2.3%	69.4%
Non-alcoholic beverages	1.1%	1.4%	1.0%	0.7%	1.1%	1.8%	73.5%
Milk	7.4%	8.7%	6.7%	5.4%	7.5%	9.1%	56.4%
Coffee	0.3%	0.4%	0.2%	0.1%	0.3%	0.4%	32.2%
Tea	1.7%	1.2%	2.0%	1.4%	1.9%	1.4%	72.9%

Table 3 reports the mean quality-corrected unit values. Milk is the group with the highest mean unit values, followed by coffee and tea. Among the three unhealthy beverages, beer is the most expensive, while non-alcoholic beverages are the cheapest.

Table 3. Quality-corrected unit values (thousand VND)[1]

	Mean	95% CI	
Rice	13.1	13.0	13.1
Other cereal	37.1	36.6	37.6
Animal products	48.7	48.4	49.0
Vegetables & fruits	45.5	44.8	46.2
Liquor	35.2	34.9	35.5
Beer	100.6	99.1	102.1
Non-alcoholic beverages	41.8	41.3	42.4
Milk	435.5	430.4	440.7
Coffee	288.1	286.5	289.7
Tea	261.1	258.6	263.6

[1] All the prices are evaluated in thousand VND/kg except beer, non-alcoholic beverages, and liquors, which are measured at thousand VND/litre.

Expenditure and uncompensated elasticities

Table 4 reports the expenditure and uncompensated own-price and cross-elasticities for the ten food groups. The full results of the model are presented in Table A1 in the Appendix. All of the expenditure elasticities are statistically significant. The expenditure elasticities indicate the percentage change in quantity consumed due to a 1% change in total food expenditure. Our results indicate that own-price elasticities are elastic for all of the beverages, including liquor (-1.48), beer (-1.33), and non-alcoholic beverages (-1.55). All of the own-price elasticities are significantly different from zero. Cross-price elasticities show substitution (positive cross-price elasticity) and complementarity (negative cross-price elasticity) among food and beverage groups. Rice and other cereals are the substitutes for most of the other food and beverage groups.

Among beverage items, non-alcoholic beverages, milk, and coffee are substitutes for liquor; non-alcoholic beverages, coffee, and milk are substitutes for beer; and liquor and tea are substitutes for non-alcoholic beverages. Thus, a 10% price increase in non-alcoholic beverages would reduce their consumption by 15.5% while increasing liquor consumption by 0.49% and tea by 0.84%.

We used different model specifications for sensitivity analysis: the base model without demographic variables, the base model without controlling for zero consumption, and the linear version of the base model. The results are presented in Tables A.2 to A.4 in the Appendix. The uncompensated elasticities for liquor, beer, and non-alcoholic beverages are quite similar to the base model.

Table 4. Expenditure and uncompensated price elasticities from the base model.

	Rice	Other cereal	Animal products	Vegetables & fruits	Liquor	Beer	Non-alcoholic	Milk	Coffee	Tea
Expenditure elasticities	0.603***	0.865***	1.044***	1.001***	1.031***	1.523***	0.902***	1.592***	0.988***	0.999***
	0.013	0.021	0.006	0.013	0.046	0.049	0.055	0.034	0.131	0.038
Uncompensated elasticities										
Change in quantity	*Change in price*									
	Rice	Other cereal	Animal products	Vegetables & fruits	Liquor	Beer	Non-alcoholic	Milk	Coffee	Tea
Rice	**-0.544*** **	0.101***	-0.283***	0.025***	0.012***	0.000	0.000	0.024***	0.020***	0.042***
	0.021	0.006	0.015	0.007	0.005	0.004	0.004	0.005	0.004	0.005
Other cereal	0.305***	**-1.244*** **	0.085***	-0.071***	-0.028***	0.018***	0.022***	0.009	0.016***	0.023***
	0.023	**0.014**	0.023	0.011	0.008	0.007	0.005	0.008	0.005	0.008
Animal products	-0.165***	-0.001	**-0.868*** **	-0.033***	0.000	-0.002	0.009***	0.016***	0.000	-0.001
	0.005	0.002	**0.007**	0.003	0.001	0.001	0.001	0.002	0.001	0.001
Vegetables & fruits	-0.035***	-0.033***	-0.107***	**-0.843*** **	0.010***	0.036***	-0.001	-0.011**	0.005***	-0.024***
	0.010	0.004	0.013	**0.008**	0.003	0.003	0.002	0.005	0.002	0.003
Liquor	0.084	-0.110***	0.025	0.097***	**-1.483** *	-0.004	0.049***	0.127***	0.168***	0.015
	0.070	0.027	0.055	0.027	**0.041**	0.017	0.016	0.019	0.022	0.026
Beer	-0.150***	0.015	-0.308***	0.190***	-0.009	**-1.330*** **	0.013	0.047***	0.034***	-0.025*
	0.042	0.019	0.049	0.024	0.013	**0.020**	0.010	0.020	0.008	0.014
Non-alcoholic beverages	-0.041	0.103***	0.528***	0.005	0.067***	0.032*	**-1.552*** **	-0.128***	-0.064***	0.148***
	0.062	0.026	0.061	0.030	0.021	0.018	**0.022**	0.025	0.013	0.021
Milk	-0.109***	-0.029***	-0.166***	-0.099***	0.017***	0.011**	-0.024***	**-1.214*** **	0.001	0.019***
	0.014	0.006	0.026	0.011	0.004	0.005	0.004	**0.015**	0.002	0.004
Coffee	1.153***	0.272***	-0.021	0.256***	0.814***	0.231***	-0.236***	0.056	**-3.527*** **	0.015
	0.221	0.084	0.166	0.079	0.107	0.051	0.048	0.054	**0.140**	0.089
Tea	0.331***	0.056***	-0.007	-0.176***	0.012	-0.017	0.084***	0.116***	0.002	**-1.400*** **

	0.053	0.021	0.045	0.022	0.020	0.014	0.012	0.016	0.014	**0.027**

p<0.1*, p<0.05**, p<0.01***. Standard errors are under the coefficients.

Table 5 reports own-price uncompensated elasticity, grouped by residence and income group. We find that the low-income households are more price-sensitive to beer and non-alcoholic beverages but less price-sensitive to liquor than middle- and high-income households. Similarly, rural households are less sensitive to liquor prices but more sensitive to non-alcoholic beverages and beer prices than urban households.

Table 5. Own price elasticity, by residence and income group

	Urban	Rural	Low income	Middle Income	High Income
Rice	-0.430 (0.026)	-0.582 (0.019)	-0.710 (0.014)	-0.498 (0.023)	-0.271 (0.033)
Other cereal	-1.269 (0.015)	-1.235 (0.013)	-1.221 (0.012)	-1.245 (0.014)	-1.280 (0.016)
Animal products	-0.867 (0.007)	-0.868 (0.007)	-0.866 (0.007)	-0.868 (0.007)	-0.868 (0.007)
Vegetables & fruits	-0.864 (0.007)	-0.831 (0.009)	-0.812 (0.011)	-0.844 (0.008)	-0.869 (0.007)
Liquor	-1.753 (0.063)	-1.418 (0.036)	-1.318 (0.027)	-1.541 (0.046)	-1.717 (0.060)
Beer	-1.300 (0.018)	-1.344 (0.020)	-1.747 (0.042)	-1.298 (0.018)	-1.229 (0.014)
Non-alcoholic beverages	-1.399 (0.019)	-1.639 (0.025)	-1.919 (0.038)	-1.532 (0.021)	-1.347 (0.017)
Milk	-1.165 (0.013)	-1.242 (0.016)	-1.331 (0.021)	-1.201 (0.014)	-1.157 (0.013)
Coffee	-2.759 (0.098)	-4.113 (0.173)	-6.221 (0.290)	-3.346 (0.130)	-2.756 (0.098)
Tea	-1.555 (0.037	-1.357 (0.024)	-1.482 (0.032)	-1.363 (0.024)	-1.471 (0.031)

Note: All coefficients are significant at 1% level of significance—standard errors in parentheses.

Impact of a 20% ad valorem tax on consumption of beverages

The own-price elasticities of both non-alcoholic and alcoholic beverages are elastic, i.e., an increase in these goods' prices will lead to a considerable decrease in their consumption. Therefore, increasing these goods' prices potentially reduces harmful consumption and the associated health and social costs.

Table 6 reports the effect of a hypothetical 20% increase in tax for non-alcoholic beverages and for alcoholic drinks (assuming a uniform tax for both liquor and beer). There are two types of tax effects: a direct effect or first-order effect through reduced consumption of the taxed beverage (via its own-price elasticities) and an indirect effect or second-order effect through the substitution effects from the taxed beverage to other food groups (via their cross-price elasticities). These effects are expressed as percentage changes. The impacts of statistically insignificant elasticities are treated as zero.

Table 6. Effects of taxes on the consumption of non-alcoholic beverages and alcoholic beverages.

	Direct effect	Indirect effect	Total effect (%)
Imposing 20% tax on non-alcoholic beverages			
Rice	0	0.44	0.44
Other cereal	0	0.18	0.18
Animal products	0	0	0
Vegetables & fruits	0	0	0
Liquor	0	0.98	0.98
Beer	0	0	0
Non-alcoholic	**-31.04**	0	-31.04
Milk	0	-0.48	-0.48
Coffee	0	-4.72	-4.72
Tea	0	1.68	1.68
Increase tax on alcohol products by 20%			
Rice	0	0.24	0.24
Other cereal	0	-0.2	-0.2
Animal products	0	0	0
Vegetables & fruits	0	0.92	0.92
Liquor	-29.66	0	-29.66
Beer	**-26.6**	0	-26.6
Non-alcoholic	0	1.98	1.98
Milk	0	0.56	0.56
Coffee	0	20.9	20.9
Tea	0	0	0

We then estimated the effect on low-income, middle-income, and high-income groups based on the elasticity estimates for these groups. The results, presented in Table 7, show that the effect varies by income group.

Table 7. Effects of taxes on different income groups.

	Low income		Middle income		High income	
	Direct effect	Total effect (%)	Direct effect	Total effect (%)	Direct effect	Total effect (%)
Imposing 20% tax on non-alcoholic beverages						
Rice	0	0.34	0	0	0	-0.57
Other cereal	0	0.53	0	0.42	0	0.31
Animal products	0	0.15	0	0.18	0	0.17
Vegetables & fruits	0	-0.33	0	0	0	0.00
Liquor	0	0.88	0	1.02	0	1.24
Beer	0	-0.64	0	0.32	0	0.52
Non-alcoholic	-38.38	-38.38	-30.64	-30.64	-26.94	-26.94
Milk	0	-1.09	0	-0.42	0	-0.17
Coffee	0	-10.45	0	-4.23	0	-3.22
Tea	0	1.79	0	1.60	0	1.88
Increase tax on alcohol products by 20%						
Rice	0	0.39	0	0.26	0	0.02
Other cereal	0	-0.11	0	-0.22	0	-0.36
Animal products	0	0.00	0	0	0	0
Vegetables & fruits	0	0.99	0	0.92	0	0.84
Liquor	-26.35	-26.35	-30.82	-30.82	-34.34	-34.34
Beer	-34.93	-34.93	-25.96	-25.96	-24.57	-24.57
Non-alcoholic	0	1.94	0	2.02	0	1.88
Milk	0	0.51	0	0.57	0	0.63
Coffee	0	42.59	0	19.47	0	14.56
Tea	0	0.26	0	0.00	0	0.00

Effect of a 20% non-alcoholic tax and 20% increase in alcoholic tax on the tax burden

A common concern related to alcohol and non-alcoholic beverage taxes is that the taxes are likely regressive, i.e., the poor will bear the highest burden since the budget share of non-alcoholic beverage and alcohol consumption is higher for the poor than for the rich. Table 8 shows that poor households would reduce consumption much more than high-income households when the prices of beer or non-alcoholic beverages increase.

Table 8. Tax burden for a 20% non-alcoholic and alcoholic beverage tax

	All	Low income	Middle Income	High Income

Tax burden per capita (thousand VND per year)				
Non-alcoholic tax	50	15	46	100
95% CI	[48 53]	[14 16]	[43 48]	[90 110]
Alcoholic tax	324	123	328	512
95% CI	[312 336]	[111 134]	[313 343]	[470 554]
% of total expenditure				
Non-alcoholic tax	0.46	0.50	0.48	0.36
95% CI	[0.44 0.48]	[0.45 0.55]	[0.46 0.51]	[0.33 0.39]
Alcoholic tax	3.91	4.67	4.19	2.32
95% CI	[3.74 4.09]	[4.18 5.15]	[3.97 4.42]	[2.10 2.54]

4. Discussion.

Elasticities of demand for alcoholic and non-alcoholic drinks.

There have been several previous studies on the elasticity of alcoholic beverages and non-alcoholic beverage in Vietnam. Using a linear approximation of the Almost Ideal Demand System (AIDS), Chelwa et al. [38] found that the demand for beer and wine in Vietnam is relatively inelastic with mean price elasticities of -0.283 and -0.317, while the mean expenditure elasticities are 0.401 and 0.156, respectively. Preece et al. [39] used beer data from Euromonitor, wine and spirits data from the International Wine and Liquor Record (IWSR), and the AIDS model to estimate the conditional price elasticities. They found that the own-price elasticities were beer -0.943, spirits -0.708, and wine –0.801. Both studies considered only the conditional elasticities of beer and wine, i.e., non-alcoholic beverages were not included in the model.

Our estimated own-price elasticities of liquor and beer are much higher than the earlier results by Chelwa et al. [38] and Preece et al. [39]. In addition to using a different dataset, our results have some differences from earlier studies. First, our model is based on a complete demand system of food and beverages while their estimates involve conditional elasticity. In other words, previous estimates are the elasticities for current drinkers of wine and beer and not for the entire population, while our estimates are for the entire population who consume at least one type of food and beverage. As conditional elasticities are often smaller than unconditional elasticities, this explains discrepancies in the reported findings. Second, Chelwa et al. [38] included only beer and wine and Preece et al. [39] used alcohol and other goods in the regression models, thus seriously restricting the substitutability among food and beverage groups. Third, our study applied a quality-correction method to account for the quality variations in the price data that were not examined in previous studies in Vietnam.

For non-alcoholic beverage, our elasticity estimate is higher than that of Luong and Vu [40], who found a price elasticity of non-alcoholic beverage of 1.14. On closer inspection of previous studies, results vary remarkably depending on the model choice and data used. For example, results vary from -2.26 [41] to -1.54 [42], -1.37 [43], - 1.06 to -1.28 [44], and -0.8 [45].

Simulated effect of taxes on beverage consumption and tax burdens

Table 6 indicates that a 20% non-alcoholic beverage tax reduces non-alcoholic beverage consumption by 31%. The tax increases liquor consumption by almost 1% and tea by 1.7%. The effect on beer is insignificant, while the consumption of coffee increases by 4.7%.

Meanwhile, a 20% increase in liquor tax applicable to both liquor and beer leads to a 26.6% reduction in beer consumption and a 29.7% reduction in liquor consumption. It also leads to an increase of 21% in coffee consumption and 2% in non-alcoholic beverage consumption. While coffee and non-alcoholic beverages are substitutes for alcoholic beverages, coffee is a stronger substitute for alcoholic beverages than non-alcoholic beverages. Apart from coffee and non-alcoholic beverages, the substitute effect of the alcoholic tax on other food and beverage groups is mild or insignificant.

Table 7 shows that the demand for non-alcoholic beverages is slightly more responsive to a 20% non-alcoholic beverage tax in low-income households: low-income households' reduction in non-alcoholic beverage consumption is 38.4% compared to 30.6% in middle-income and 26.9% in high-income households. The tax leads to a reduction of 10.5% in coffee consumption in low-income, 4.2% in middle income, and 3.2% in high-income households.

Meanwhile, when a tax on alcoholic beverages is increased by 20%, poor households are more likely to reduce their beer consumption while being less likely to reduce liquor consumption than better-off households. Specifically, the tax will reduce beer consumption by 34.9% in low-income households, 26% in middle-income, and 24.6% in high-income households. The same tax will reduce liquor consumption by 26.3% in low-income households, 30.8% in middle-income, and 34.2% in high-income households.

Table 8 reports the average tax burden by income group and beverage type per capita per year. On average, a 20% non-alcoholic beverage tax generates a tax burden of 50 thousand VND (US$ 2.3) per person per year. However, a 20% alcohol tax creates a much heavier tax burden for households, on average 324,000 VND (US$ 14.7) per person per year. The tax burdens are much higher in urban than rural households and in high-income than middle and low-income households for both taxes.

In terms of proportion to total household spending, the non-alcoholic beverage tax corresponds to 0.46% of the total spending. The tax is mildly regressive: the tax proportion is slightly higher in low- and middle-income households than high-income households. The increased alcohol tax proportion is 3.9%. Alcohol tax is also regressive as low-income and middle-income households

pay higher taxes relative to their total spending than high-income households. However, if we consider the lasting effects of the two taxes, such as reduced health expenditure, additional years of life and improved quality of life, particularly for the low-income groups who are more responsive to prices, then the taxes are likely progressive.

We have not calculated the indirect welfare gain from reduced health expenditure and increased productive living years induced by the taxes, which may outweigh the tax burden. A previous study on the welfare effects of tobacco taxes in Vietnam found that raising cigarette taxes can contribute to poverty reduction and equity in Vietnam, and that poor households are likely to capture the highest benefits [46]. Further studies could explore more about these benefits or investigate the impacts of different kinds of taxes, such as taxing by volume and value.

Despite our study's contribution to the literature on non-alcoholic beverage and alcohol tax, the results should be interpreted subject to some caveats. First, our data only include home beverage purchases and do not consider the beverages available at restaurants, schools, or offices. Second, the demand model used in our analysis does not include food items such as rice, meat, or vegetables. Thus, the possibility of substituting alcoholic beverages with rice, for example, is not examined in our analysis. Third, the pass-through rate of the tax may not be 100% and heterogeneous by locality. Previous studies on pass-through taxes for sugary drinks have been mixed. Some studies found a complete pass-through {47, 48, 49], while others found a partial pass-through from 11% to 94% [50], 43.1% [51], 133% [52]. Therefore, the effectiveness of the tax will depend on the pass-through rate for non-alcoholic beverages in practice.

5. Conclusion

This paper estimates the elasticities of non-alcoholic beverage and alcoholic drinks (beer and liquor) for Vietnam using the latest household survey data available, from 2018. Those estimates were obtained using the Quadratic Almost Ideal Demand System method, with quality correction for unit values and a two-step approach to control for censored demand (non-consumption). We evaluated the impacts of a hypothetical 20% increase in the excise tax for non-alcoholic and alcoholic drinks, respectively, based on the estimated own-price and cross-price elasticities. Our main finding is that both non-alcoholic beverage and alcoholic beverages are price elastic, especially for low-income households. A 20% increase in the price of non-alcoholic beverages via an *ad valorem* tax would result in a remarkable decrease of 31% of non-alcoholic beverage consumption.

Similarly, a 20% increase in the prices of alcoholic beverages leads to a large decrease of 29.7% in the consumption of liquor and 26.6% in the consumption of beer. We also find that low-income households are more responsive to prices changes for non-alcoholic beverages and

liquors than better-off households. However, the former are less responsive to a price change for beer than the latter. Furthermore, we find that both taxes are regressive. The average non-alcoholic beverage tax burden for a 20% non-alcoholic beverages tax is about 0.5% of the household's total spending for low-income households and 0.36% for high-income households. A 20% increase in tax for alcoholic beverages implies an additional tax burden of 4.7% for low-income households and 2.3% for high-income households.

Our study can inform the government's future policy directions. Firstly, the evidence we present here suggests that the demand for soft drinks and alcoholic drinks is elastic in Vietnam. Therefore, taxes are likely to be effective in curbing harmful beverage consumption and yielding future health benefits by reducing obesity, non-communicable diseases, and deaths. We also find that consumers from low-income groups are more responsive to taxes and decrease their consumption relatively more. While the taxes are slightly regressive, the overall tax burdens are small, especially with regard to the non-alcoholic beverage tax. The adverse equity effects of the taxes can be mitigated by using the additional fiscal revenue to support the poor; for example, by increasing spending on healthcare or nutrition.

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Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to data restrictions but are available from the corresponding author on reasonable request.

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Authors' contributions

LHV and ANN conceptualized and developed the model. LHV acquired, analyzed, and interpreted the data. LHV, ANN drafted the article and revised the article. All the authors have approved the submitted version. They have agreed to be personally accountable for the author's contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even those in which the author was not personally involved.

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