Modeling the Impact of Alcohol Tax Increases in Montenegro by Socioeconomic Groups

Economics for Health Working Paper Series

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February 2025

Paper No. 25/2/1

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Suggested citation: Čizmović, M., Kovačević, M., & Ivanović, I. (2025). Modeling the Impact of Alcohol Tax Increases in Montenegro by Socioeconomic Groups (Economics for Health Working Paper No. 25/2/1). ISEA. https://www.economicsforhealth.org/research/modeling-the-impact-of-alcohol-tax-increases-in-montenegro-by-socioeconomic-groups-working-paper-series/

Acknowledgments: The Institute for Socio-Economic Analysis is funded by the Economics for Health team (formerly Tobacconomics) at Johns Hopkins University (JHU, previously housed at University of Illinois Chicago, or UIC) to conduct economic research on alcohol in Montenegro. JHU is a partner of the RESET Alcohol Initiative. The views expressed in this document cannot be attributed to, nor can they be considered to represent, the views of JHU, UIC, or RESET.

Abstract

Background

Alcohol consumption in Montenegro suppresses global and European averages, with beer and spirits being the most commonly consumed alcoholic beverages. Although Montenegro's alcohol taxes exceed the European Union (EU) minimum rates, they are comparatively low compared to many European countries, reducing their effectiveness in curbing consumption and generating fiscal revenue. Given the strong association between alcohol taxation and reduced consumption, this study investigates the impact of potential alcohol tax increases on consumption patterns across different income groups and government revenue generation in Montenegro.

Methodology

The study utilizes Montenegro's Household Budget Survey (HBS) data to estimate own-price and income elasticities of alcohol demand across three income groups (low-, middle-, and high-income households). A two-part model (TPM) is employed to separately estimate the participation (prevalence) and intensity (conditional consumption) elasticities. A simulation model further complements the analysis to evaluate the fiscal and consumption effects of excise tax increases on spirits. The simulations assume varying responsiveness to price changes across income groups.

Results

The analysis reveals that spirits consumption responds significantly to price changes, with lower-income households exhibiting the highest sensitivity to price changes. The total price elasticity of spirits demand is estimated at -0.89, with low-income households demonstrating the highest responsiveness (-1.10), while high-income households are the least responsive (-0.68). The analysis also indicated that price increases would lead to a reduction in the quantity of wine and beer consumed among low-income households, highlighting the progressive impact of taxation on this income group. Simulation results suggest that a 20% increase in spirits excise tax would

lead to a 4.18% decline in consumption and a 9.12% rise in total tax revenue, while a 30% increase would reduce consumption by 6.92% and increase revenue by 12.46%.

Conclusions

The study provides strong empirical evidence that increasing alcohol excise taxes in Montenegro would reduce consumption, particularly among lower-income households, while also boosting government revenue. These findings challenge the notion that alcohol taxes are regressive, instead highlighting their progressive potential in mitigating alcohol-related harms and promoting public health equity. To enhance policy effectiveness, the study recommends indexing excise taxes to inflation and income growth, earmarking revenue for health and prevention programs, and complementing tax policies with stricter regulations on alcohol availability and marketing. These measures would ensure that alcohol taxation remains an effective tool for reducing consumption and improving public health outcomes in Montenegro.

JEL Codes: H21, I18, D12

Keywords: Alcohol taxation, price elasticity, income elasticity, excise tax, Montenegro

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2025

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Introduction

Alcohol consumption is both widespread and culturally accepted in Montenegro. In 2019, the average alcohol intake for individuals aged 15 and older reached 10.34 liters of pure alcohol per capita, surpassing global and European averages by 4.88 and 1.43 liters, respectively (WHO, 2019). National data indicate that more than 60 percent of individuals aged 15 to 64 consumed alcohol in the past year, with beer being the preferred choice (Institute for Public Health, 2017). Youth alcohol use is particularly alarming. The European School Survey on the Use of Alcohol and Other Drugs among Young People (ESPAD) indicates that prevalence in the last 12 months among students increased from 56 percent in 2008 to 63 percent in 2019, with 28 percent reporting binge drinking (defined as consuming five or more drinks on one occasion) in the past month (Institute for Public Health, 2017; ESPAD, 2019). These trends highlight the pressing need for effective alcohol control measures.

Despite these alarming trends, taxes on beer, spirits, and sparkling wine in Montenegro remain low compared to many other European countries with similar income levels, even though they surpass European Union (EU) minimum rates. Compared to EU member states, Montenegro's excise tax rates on beer are notably low—approximately one-eighth of Finland's, which, at €38.05 per hectoliter in 2023, holds the highest beer excise rate in the EU (European Commissions, 2023). Among neighbouring countries, Bosnia and Herzegovina's beer tax rates are nearly three times higher than Montenegro's, while Serbia's rates are four times higher[1] (Mugoša et al., 2024). While Montenegro ranks 21st in the EU for excise taxes on pure alcohol (European Commissions, 2023), it has the highest excise tax rates on spirits among its regional neighbors. Given Montenegro's high levels of alcohol consumption, particularly among youth, there is a pressing need to increase taxes on alcohol to mitigate the prevalence of alcohol use.

[1] Data are taken for 2023 from the following laws: Law on Excise Taxes in Serbia, 2023; Law on Excise Tax, 2023; Law on Excise in Bosnia and Herzegovina, 2022.

The alcohol taxation system in Montenegro employs a mixed framework, taxing spirits and beer based on their alcohol content and sparkling wine by volume. Until recently, still wine was entirely exempt from excise taxation. However, Amendments to the Law on Excise Tax in September 2024, specifically Article 43, introduced a €25 per hectoliter excise duty on still wine, thereby broadening the scope of excisable products. This measure is intended to enhance regulatory oversight of still wine, both in terms of production and importation.[2] The implications of Montenegro's current alcohol taxation policy are significant for generating budget revenues. In 2023, excise revenues from alcoholic beverages totalled approximately €20.5 million, representing 6.34 percent of overall excise tax revenues and 0.30 percent of GDP. The projected fiscal impact of introducing an excise tax on still wine is estimated at €4 million annually, which would account for 20 percent of total alcohol excise revenues (Goverment of Montenegro, 2024).

When evaluating the impact of alcohol tax and price changes on consumption and budget revenues, it is essential to account for the socioeconomic status of population groups, as this significantly influences how alcohol demand responds to such changes. Evidence suggests that individuals from lower socioeconomic backgrounds are more sensitive to price changes of alcoholic beverages than their wealthier counterparts (WHO, 2023). Increasing alcohol taxes not only reduces overall consumption, but also disproportionately benefits population groups with budget constraints, who face the greatest risks of alcohol-related harm (Mäkelä & Paljärvi, 2008). These lower-income groups stand to gain the most in terms of health improvements through such policies. When designing an effective alcohol tax, policy makers should consider these beneficial effects in any equity judgment.

To better understand the effects of price and tax changes on consumption patterns and prevalence across income levels, this study estimates own-price and income participation and intensity elasticities of alcohol consumption within three distinct income groups: low-, middle-, and high-income households. Utilizing price and income elasticity specific to various

[2] The new excise tax on still wine is set to take effect in January 2025.

socioeconomic groups, the second important objective of this research is to offer evidence on the impact of alcohol excise tax increases on both alcohol consumption and government revenue. Through simulation analysis, policy makers can gain critical insights into the diverse consumption and fiscal implications of alcohol excise tax changes across different income groups, thereby enhancing their understanding of the distributional effects of alcohol tax policies.

Literature Review

There is a notable gap in studies examining own-price elasticities for alcoholic beverages across income groups, particularly in low- and middle-income countries. However, based on existing findings presented in Table 1, it can be concluded that in the lower-income group the own-price elasticity for beer is approximately -0.55, for wine it ranges from -0.18 to -0.66, and for spirits it ranges from -0.10 to -1.10. In the higher-income group, the own-price elasticity for spirits ranges from -0.09 to -1.10, for beer it ranges from -0.46 to -0.89, and for wine from -0.11 to -0.86. It is important to note that these elasticity coefficients cannot be directly compared due to the differing methodologies applied across studies.

Jiang et al. (2016) examined the price elasticities of demand for alcohol across three income groups in Australia to show how price changes affect alcohol consumption among different subgroups. Using cross-sectional data, the study found that the demand for nearly all beverage categories was significantly and negatively correlated with their own price changes for all income groups, with the low-income group showing the highest sensitivity to price changes. In contrast, Jayawardena (2024) found a different pattern in Sri Lanka when examining intensity elasticity and total elasticity for beer. Their study revealed that the responsiveness to beer price changes was more pronounced among higher-income individuals, likely because beer consumption is more commonly associated with wealthier socioeconomic groups.

Regarding the methods used for estimation, elasticities are generally obtained from demand models estimated using Tobit analysis, the Sheffield alcohol policy model (SAPM), and the two-part model.

Table 1. Review of studies analyzing price elasticity by income group

By income group					
	Author	**Methodology**	**Beverage type**	**Results (own-price elasticity)**	**LMICs/ HICs**
Lower	Holmes et al., 2014	Sheffield alcohol policy model (SAPM)	Beer	-0.54	HIC
			Wine	-0.66	HIC
			Spirits	-1.10	HIC
	Jiang et al., 2016	Tobit analysis	Beer	-0.55	HIC
			Wine	-0.18	HIC
			Spirits	-0.33	HIC
Middle	Jiang et al., 2016	Tobit analysis	Beer	-0.41	HIC
			Wine	-0.09	HIC
			Spirits	-0.05	HIC
Low and Middle	Sornpaisarn et al., 2013	The systematic review and a meta-analysis based on the 12 studies	Beer	-0.5	LMICs
			Wine	-0.79	LMICs
			Spirits	-0.79	LMICs
	Jayawardena, 2024	Two-part model	Beer	-0.41	LMICs
Higher	Holmes et al., 2014	Sheffield alcohol policy model (SAPM)	Beer	-0.89	HIC
			Wine	-0.86	HIC
			Spirits	-0.78	HIC
	Jiang et al., 2016	Tobit analysis	Beer	-0.46	HIC
			Wine	-0.11	HIC
			Spirits	-0.09	HIC

Data and Descriptive Statistics

To estimate the price and income elasticity of the quantity of alcohol used, this study utilizes data from Montenegro's Household Budget Survey (HBS). The HBS is conducted annually by the Statistical Office of Montenegro and provides detailed information on household expenditure and demographic

characteristics across a variety of goods and services. Data from the years 2005 to 2015, 2017, and 2021 are used, covering all 21 municipalities across the North, Central, and South regions. Each household is surveyed during a specific month of the year. After outliers were excluded, the final sample comprised 16,323 households.

To better understand alcohol consumption patterns, the authors calculated unit values and budget share spent on all three alcoholic beverage types: spirits, wine, and beer. Unit values were determined by dividing the monthly household expenditure on each alcoholic beverage by the quantity purchased, yielding the amount expressed in euros per liter. The total reported household budget was used as a proxy for income, and households were categorized into three income groups—low, middle, and high—based on income per household member. The share of expenditure on specific types of alcoholic beverages within the household budget was calculated for each beverage type and income group as a percentage of total monthly expenditure. All monetary values were adjusted for inflation using the Consumer Price Index to ensure consistency in real terms.

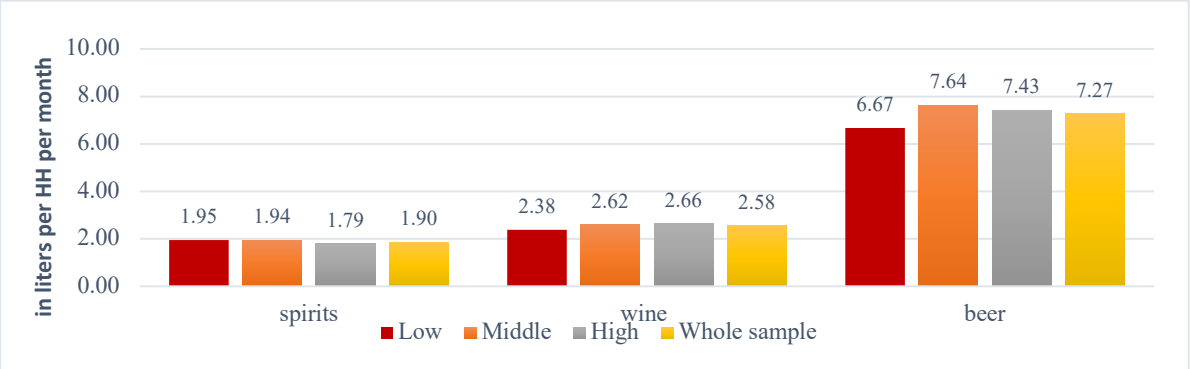
The analysis also incorporates several sociodemographic variables to account for household-level differences. These include:

- Economic activity: Households were categorized as unemployed (no employed or pensioner members), pensioners (only pensioner members), or employed (at least one employed member).
- Educational attainment: The highest number of years of education among household members.
- Male ratio: The proportion of male members within the household.
- Household size: Total number of members within the household.
- Adult ratio: The percentage of household members aged 15 or older.
- Age and gender of the household head.

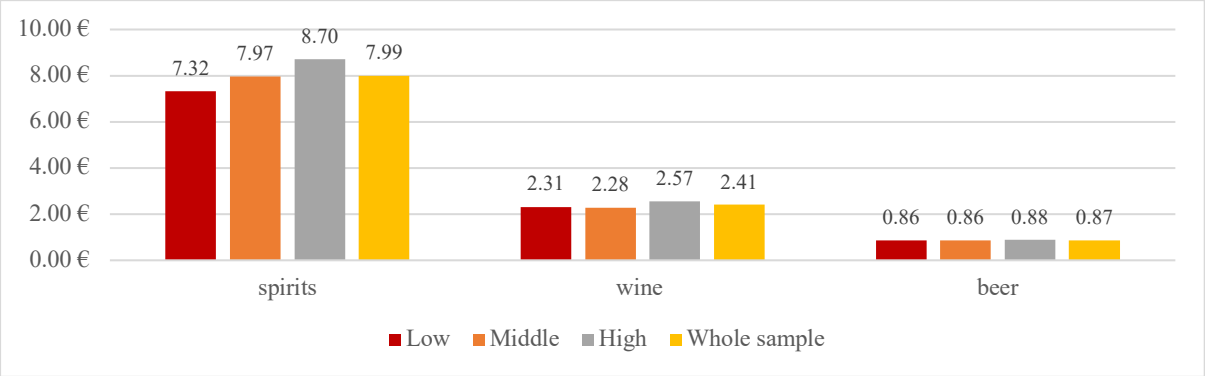
Figure 1 shows the quantity consumed, unit value, budget share, and total expenditure of all three alcoholic beverage types across income groups and the whole sample during the observed period.

Figure 1. Consumption, unit value, budget share, and total expenditure of spirits, beer, and wine across income groups

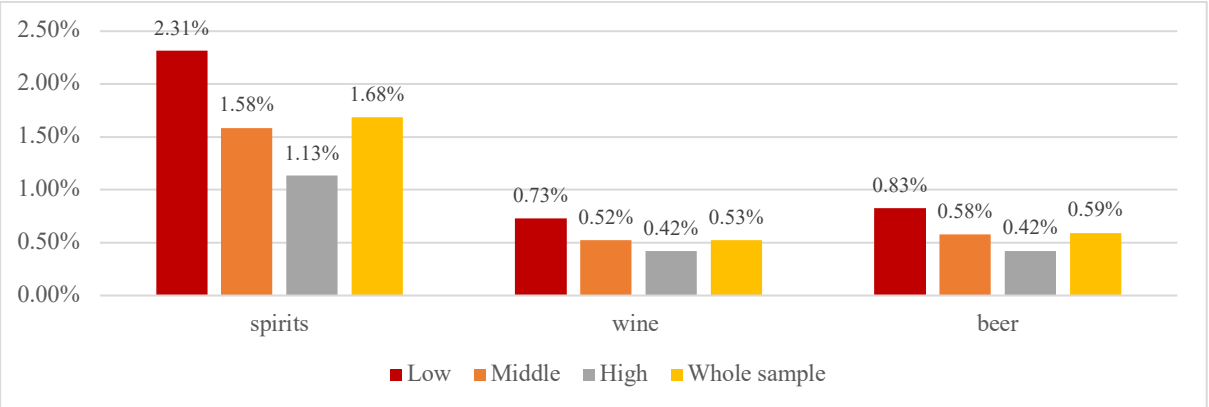
Panel a. Average monthly consumption per household



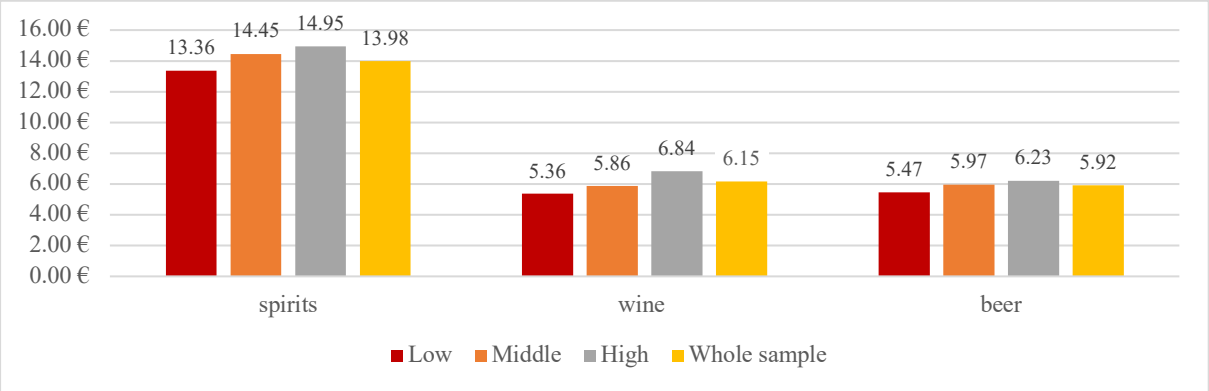
Panel b. Price per liter



Panel c. Budget share



Panel d. Average monthly real expenditures per household



Source: Monstat

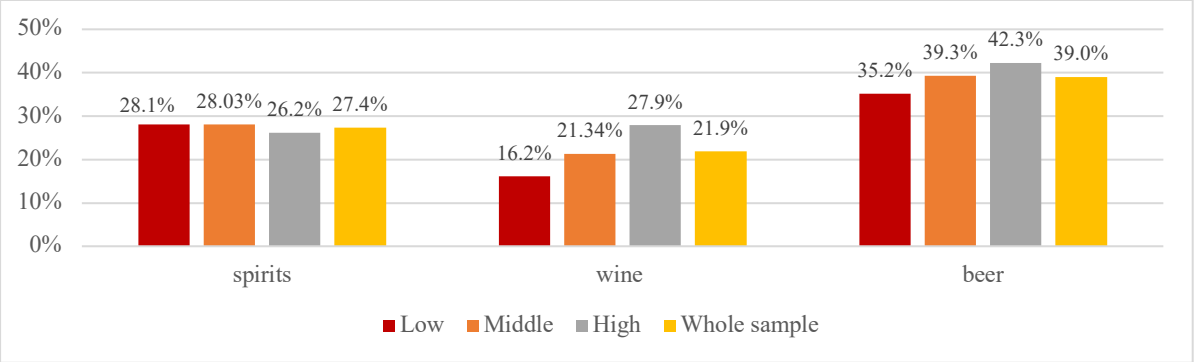
Note: Households that do not report spending on alcoholic beverages are not included in the sample.

When considering the entire sample, the highest consumption is observed in the case of beer, while the highest budget share is spent on spirits, being the most expensive beverage compared to wine and beer. The analysis of alcohol consumption patterns across income groups reveals significant differences in the quantity consumed, spending behaviors, and budgetary impact for each type of beverage. Spirits consumption is higher among lower-income households, while wine and beer consumption are more prominent in middle- and high-income households. Lower-income households dedicate a disproportionate share of their budgets to alcohol—including beer, wine, and spirits—making it a heavier financial burden. In contrast, higher-income households consume more in absolute terms, preferring premium products, as reflected in higher unit values and expenditures.

These findings underscore the progressive impact of alcohol taxation on lower-income households and the significant role of income in shaping preferences and affordability. Policy makers should address these disparities by crafting equitable alcohol taxation policies that consider the broader benefits, particularly health and other socioeconomic advantages for lower-income groups. Additionally, it is crucial to account for variations in consumption patterns and spending behaviours across income groups when designing effective interventions.

Figure 2 illustrates the percentage of households consuming different types of alcoholic beverages. Overall, the highest prevalence is evident in the case of beer, followed by spirits and wine. Among income groups, a similar highest prevalence of spirits use is found in the low- and middle-income groups, while wealthier households more commonly consume wine and beer.

Figure 2. Prevalence of households consuming spirits, wine, or beer by income group

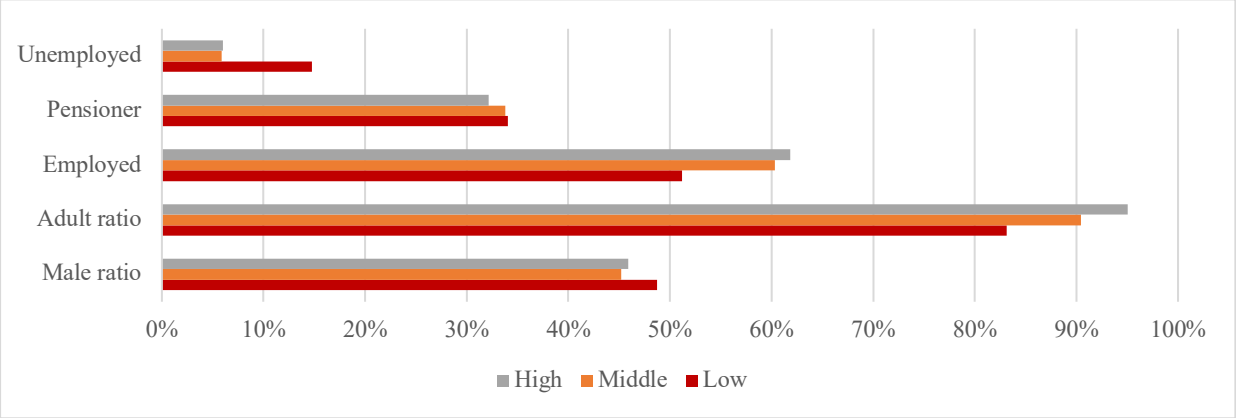


Source: Monstat

Note: Households that do not report spending on alcoholic beverages are not included in the sample. Data are given on a monthly average per household.

The analysis of sociodemographic characteristics across income groups reveals notable differences. In the wealthiest group, 95 percent of household members are older than age 15 with an average age of 52, the highest among all income groups. This group also has the largest proportion of households with employed members, reflecting higher income stability and economic activity. Conversely, low-income households show distinct trends, with the highest share of members classified as pensioners or unemployed, underscoring their economic vulnerability. Moreover, these households have the largest average size and the highest number of male members per household. More details are given in Figure 3 and Table A1 in the Appendix.

Figure 3. Sociodemographic characteristics of households by income groups



Source: Monstat

Another critical factor for assessing the impact of tax changes on government revenues and alcohol consumption is the retail price of alcoholic beverages. Table 2 provides an overview of the retail prices for the most-sold spirits and beer per unit of sale and per standard drink (two categories of alcoholic beverages classified as excisable goods under the Law on Excise). The price data were obtained from the two largest retail chains in the Montenegrin market.

Table 2. Price of most-sold spirits and beer, per unit of sale and standard drink

Spirits (0.7 l)	**ABV***	**In grams of alcohol**	**Pure alcohol**	**No. of standard drinks**	**Price in EUR**	**Price of standard drink (EUR)**	**International dollar**
2023	40.0%	552.30	220.92	22.09	14.99	0.68	1.82
2022	40.0%	552.30	220.92	22.09	13.99	0.63	1.76
2021	40.0%	552.30	220.92	22.09	12.56	0.57	1.62
2020	40.0%	552.30	220.92	22.09	11.7	0.53	1.52
Beer (0.33 l)	**ABV**	**In grams of alcohol**	**Pure alcohol**	**No. of standard drinks**	**Price in EUR**	**Price of standard drink (EUR)**	**Price/int dollar**
2023	4.6%	260.37	11.98	1.20	1.09	0.91	2.45
2022	4.6%	260.37	11.98	1.20	0.99	0.83	2.30
2021	4.6%	260.37	11.98	1.20	0.8	0.67	1.91
2020	4.6%	260.37	11.98	1.20	0.77	0.64	1.84

Source: Authors' calculations based on market price data

Note: The most-sold alcoholic beverages are also the least expensive options available in the market. Standard drinks are calculated based on the guideline that one standard drink contains 10 grams of pure alcohol, as defined by the World Health Organization (Babor & Higgins-Biddle, 2001).

*ABV stands for alcohol by volume.

The most frequently purchased spirits are typically sold in 0.7-liter bottles containing approximately 221 grams of pure alcohol, equivalent to about 22 standard drinks. The cost per standard drink for spirits is estimated at €0.68, with the retail price per bottle increasing over the last four years from €11.70 to nearly €15. For beer, the most popular product is sold in 0.33-liter bottles, containing roughly 12 grams of pure alcohol. If the price per standard drink is compared, beer is relatively more expensive than spirits.

Table 3 shows a decreasing trend in the excise tax share of the retail price for both types of alcoholic beverages over the past four years, attributed to the absence of adjustments in excise rates. This trend highlights the importance of regularly revising the excise rate to maintain the effectiveness of tax policies in reducing consumption and increasing revenue.

Table 3. Spirits and beer excise share per unit of sale

Spirits (0.7 l)	***Excise in EUR**	**VAT (21%)**	**Sum**	**Price**	**Excise share**	**Excise + VAT**
2023	3.5	2.60	6.10	14.99	**23%**	**41%**
2022	3.5	2.43	5.93	13.99	**25%**	**42%**
2021	3.5	2.18	5.68	12.56	**28%**	**45%**
2020	3.5	2.03	5.53	11.7	**30%**	**47%**
Beer (0.33 l)	**Excise in EUR**	**VAT**	**Sum**	**Price**	**Excise share**	**Excise + VAT**
2023	0.08	0.19	0.27	1.09	**7.1%**	**24%**
2022	0.08	0.17	0.25	0.99	**7.8%**	**25%**
2021	0.08	0.14	0.22	0.8	**9.7%**	**27%**
2020	0.08	0.13	0.21	0.77	**10.1%**	**27%**

Source: Authors' calculations

Note: The absolute excise amount is calculated based on the unit of sale for each beverage. For spirits sold in 0.7-liter bottles, the excise is determined using the rate defined by the Law

on Excise (€1,250 per hectoliter of pure alcohol). Similarly, for beer sold in 0.33-liter bottles, the excise is calculated according to the rate of €5 per hectoliter of pure alcohol, as specified in the same law. VAT of 21 percent is added to the cost of goods sold, meaning 17.35 percent of the retail price.

Montenegro's income growth between 2020 and 2023, marked by a nominal average net wage increase of more than 50 percent (Goverment of Montenegro, 2024), raises the challenge of balancing higher living standards with effective alcohol excise tax policies, as rising wages may increase alcohol affordability and counteract tax efforts. As incomes rise more than alcohol prices and inflation, alcohol becomes more affordable, potentially driving higher consumption. This highlights the need for tax policies to account for both price and income effects.

The affordability indicator in Table 4 is calculated as the share of the average daily income required to purchase one unit of the most-sold spirits or beer. Compared to 2020, the affordability of spirits increased in 2023, with 16.24 percent less of the average daily income needed to buy a unit of the most-sold spirits. Similarly, beer affordability also increased, with 7.45 percent less of the daily rate required to purchase a beer bottle in 2024 compared to 2020. These results show that rising incomes and slow increases in alcohol prices have made alcohol more affordable, potentially undermining efforts to reduce consumption through taxation.

Table 4. Affordability of spirits and beer

Spirits (0.7 l)	**Price**	**Average daily rate**	**Affordability indicator**	**Annual change in affordability**	**Fixed base change in affordability (2020=100)**
2020	11.70	24.85	47.08%	-	-
2021	12.56	25.23	49.78%	5.74%	5.74%
2022	13.99	34.18	40.94%	-17.76%	-13.04%
2023	14.99	38.02	39.43%	-3.68%	-16.24%
Beer (0.33 l)	**Price**	**Average daily rate**	**Affordability**	**Annual change in affordability**	**Fixed base change in affordability**

2020	0.77	24.85	3.10%	-	-
2021	0.80	25.23	3.17%	2.33%	2.33%
2022	0.99	34.18	2.90%	-8.63%	-6.50%
2023	1.09	38.02	2.87%	-1.02%	-7.45%

Source: Authors' calculations based on market data on retail prices, and data obtained from Monstat

Note: The average daily rate is calculated based on the net average wage provided by Monstat and the official number of working days for each year within the observed period.

Methodology

To estimate the participation and intensity, price, and income elasticity across different income groups, the research employs a two-part model (TPM). This is a commonly employed approach in theoretical and empirical research in health economics, particularly for analyzing mixed discrete-continuous outcomes using HBS data on various goods, including alcohol consumption. Based on the explanation provided by Belotti et al. (2015), the TPM is a statistical technique designed to analyze outcomes with many zero values, such as healthcare expenditures or other consumption behaviors. This approach enables the separate examination of alcohol use participation and the intensity of consumption, providing critical insights for designing effective alcohol taxation policies.

In the first stage, a logit model is used to estimate the probability of alcohol consumption participation. A dummy variable is created, taking the value of 0 if there is no reported alcohol use in the household, and 1 otherwise. The logit model is expressed as:

$$P(reported\ consumption = 1) = \phi(\alpha_0 + \alpha_1 price + \alpha_2 income + \alpha_3 Z_i) \qquad (1)$$

Here, alcohol use participation depends on the price per unit of alcohol, household income (or total expenditure), and a set of sociodemographic variables (Z_i). The prevalence of alcohol consumption is estimated assuming that average prices vary across income groups. Unit values are used as an approximation for retail prices and are defined at the sub-cluster level (per municipality and year across income groups). Also, missing values are filled

with the average price per cluster. Marginal effects are used to calculate price and income participation elasticity.

In the second part, a generalized linear model (GLM) is employed with a gamma family distribution and a log link function to estimate the intensity of alcohol consumption. This approach uses the link function to transform the probabilities of categorical response variable levels onto a continuous scale ranging from (-∞, +∞):

$$E(Y) = g^{-1}(X\alpha) \quad (2)$$

Where *E(Y)* represents the expected consumption, g is the link function, and $X\alpha$ is the linear predictor. The GLM includes the same independent variables as the logit model to ensure consistency in the analysis. Marginal effects are used to calculate price and income conditional elasticity.

To derive total elasticity, we combine participation elasticity and conditional intensity elasticity. Diagnostic tests are conducted post-estimation to validate the robustness and adequacy of both model stages. While some data limitations exist, such as the unavailability of retail prices, the methodological framework effectively addresses variations in alcohol consumption and spending behaviors. The analysis offers a deeper understanding of demand across different income groups by utilizing a detailed dataset and incorporating robust sociodemographic controls.

The second part of this study uses data on retail price, consumption, and excise taxes on spirits to simulate the effects of excise tax increases on government revenues. The simulation incorporates the estimated own-price and income elasticities of demand, enabling the assessment of changes in consumption and revenue across different income groups. The following are simulation steps:

1. Initial retail price

The initial retail price of the most-sold spirits (P_0) is modeled as the sum of excise duties (ET_0), net of tax component (NOT_0), and value-added tax (VAT_0). VAT_0 is calculated as a given percentage τ of the retail price:

$$P_0 = ET_0 + NOT_0 + VAT_0 \quad (3)$$

The NOT_0 represents the income retained by the alcohol industry, calculated as the difference between the retail price and the combined tax components.

2. *Base-year tax revenue*

With known alcohol consumption (Q_0) in the base year, total tax revenue (TR_0) is computed as:

$$TR_0 = (ET_0 + VAT_0) \cdot Q_0 \quad (4)$$

This calculation is performed separately for each income group.

3. *Price changes after tax adjustments*

The new retail price (P_1) following a tax policy change is calculated as:

$$P_1 = \frac{(NOT + ET_1)}{1 - VAT\%} \quad (5)$$

Where ET_1 is the updated excise tax value increased by a defined percentage. The percentage change in price (PI) is expressed as:

$$PI = \frac{P_1 - P_0}{P_0} \cdot 100\% \quad (6)$$

4. *Consumption adjustment*

The adjusted consumption for each income group (Q_1^i) is determined by incorporating price elasticity (E_p) and income elasticity (E_{inc}), along with GDP growth (GDP):

$$Q_1^i = Q_0^i \left(1 + E_p^i \left(\frac{P_1 - P_0}{P_0}\right)\right) \cdot (1 + GDP \cdot E_{inc}^i) \quad (7)$$

Here, Q_0^i is the base-year consumption for each income group, and E_p^i and E_{inc}^i are the elasticities specific to each group.

5. ***New tax revenue calculation***

Using the updated price and consumption, the total tax revenue for each income group TR_1^i is recalculated:

$$TR_1^i = (ET_1 + VAT_1) \cdot Q_1^i, i \in \{0,1,2,3\} \quad (8)$$

Assumptions:

- *Perfectly elastic supply*: The analysis assumes a perfectly elastic supply curve, ensuring that the entire tax burden is passed onto consumers.
- *Income group variability*: Elasticities and consumption adjustments are calculated separately for each income group, reflecting differing sensitivities to price and income changes.

This approach provides insights into the fiscal impacts of excise tax adjustments, enabling policy makers to design effective tax strategies while considering affordability and consumption patterns across socioeconomic groups.

Results

Spirits own-price and income elasticity of demand by income groups

To examine spirits participation and conditional elasticity across income groups, we use a two-part model based on HBS microdata. Prevalence elasticity is estimated through logistic regression, comparing two alternative models outlined in Table A2 of the Appendix. The optimal model is selected using Bayesian information criterion (BIC), pseudo-R-squared, and log-likelihood metrics. Post-estimation diagnostic tests, presented in tables A3–

A14 in the Appendix, confirm the reliability and robustness of the selected model.

An examination of the sociodemographic characteristics of the sample from Table 5 indicates that larger households, those with a higher proportion of adult and male members, and those with a higher average age of household members are more likely to consume spirits. This trend is also evident in households where the head of the household is male. In contrast, households with more highly educated members tend to be less likely to consume spirits. When the data are analyzed by income groups, the general direction and strength of the relationships remain mostly consistent.

The results reveal that the participation elasticity for the whole sample is -0.22, indicating that a 10-percent increase in price is expected to result in a 2.2-percent decrease in prevalence. This suggests that pricing policies can effectively reduce overall prevalence rates. However, the sensitivity to price changes varies significantly across income groups. Households in the low-income group are the most responsive, with a prevalence elasticity of -0.42, implying a pronounced reduction in prevalence in response to price increases. In contrast, the high-income group is the least sensitive, with a prevalence elasticity of -0.02, reflecting minimal changes in prevalence despite price adjustments.

Table 5. Spirits prevalence elasticity by income groups

	Whole sample		**Low-income group**		**Middle-income group**		**High-income group**	
VARIABLES	Coef.	Se	Coef.	Se	Coef.	Se	Coef.	Se
Price	-0.04**	(0.02)	-0.07**	(0.04)	-0.05**	(0.02)	-0.00*	(0.00)
Expenditure	0.00**	(0.00)	0.00*	(0.00)	0.01*	(0.00)	0.01*	(0.00)
Household size	0.40***	(0.09)	0.47***	(0.13)	1.02***	(0.21)	0.24	(0.17)
Male ratio	0.62***	(0.09)	0.59***	(0.15)	0.75***	(0.16)	0.54***	(0.14)
Adult ratio	0.66***	(0.11)	0.64**	(0.27)	0.61***	(0.21)	0.56***	(0.20)
Maximum education	-0.04**	(0.02)	-0.05*	(0.02)	-0.06**	(0.02)	-0.03	(0.03)
HH activity: Employed								

Unemployed	-0.02	(0.09)	0.04	(0.17)	0.37**	(0.17)	-0.01	(0.11)
Pensioners	0.00	(0.07)	-0.09	(0.11)	0.17	(0.12)	0.18*	(0.12)
Mean age of HH members	0.01***	(0.00)	0.00	(0.00)	0.01*	(0.00)	0.01**	(0.00)
HH head gender: Female								
Male	0.35***	(0.07)	0.36***	(0.10)	0.22**	(0.11)	0.44***	(0.101)
Household head age	0.00	(0.00)	0.01	(0.00)	0.00	(0.00)	-0.00	(0.00)
Constant	-2.40***	(0.34)	-1.84***	(0.45)	-2.39***	(0.47)	-2.67***	(0.46)
Observations	15,431		5,103		5,088		5,240	
Price elasticity	**-0.22****	**(0.11)**	**-0.42****	**(0.21)**	**-0.26****	**(0.13)**	**-0.02***	**(0.01)**
Income elasticity	**0.15****	**(0.08)**	**0.09***	**(0.08)**	**0.25***	**(0.13)**	**0.16***	**(0.09)**

Source: Authors' calculations

***p<0.01, **p<0.05, *p<0.1

To estimate conditional price elasticity, we apply the GLM methodology with a gamma distribution and a log link function. Multiple diagnostic tests, detailed in tables A8–A13 in the Appendix, confirm the appropriateness of the model specification. The sociodemographic analysis in Table 6 reveals that the quantity of spirits consumed is generally higher in larger households, those with a higher proportion of male members, and those with a higher average age of household members.

The results of the conditional elasticity analysis, presented in Table 6, indicate that the overall conditional price elasticity for spirits is approximately -0.66. This suggests that a 10-percent decrease in price would result in an estimated 6.6-percent reduction in consumption. Across income groups, the elasticity for low- and middle-income households is identical, while the elasticity for the high-income group is slightly lower. However, statistical tests reveal that the differences in elasticity between the income groups are not significant.

Table 6. Spirits conditional elasticity by income groups

	Whole sample		**Low-income group**		**Middle-income group**		**High-income group**	
VARIABLES	Coef.	Se	Coef.	Se	Coef.	Se	Coef.	Se
Price	-0.08***	(0.01)	-0.08***	(0.02)	-0.08***	(0.02)	-0.09***	(0.02)
Expenditure	0.01**	(0.00)	0.01*	(0.00)	0.01*	(0.00)	0.01*	(0.00)
Household size	0.21***	(0.05)	0.22***	(0.08)	0.38***	(0.11)	0.13	(0.09)
Male ratio	0.15*	(0.08)	0.13	(0.14)	0.29**	(0.11)	0.01	(0.11)
Adult ratio	-0.13	(0.12)	-0.02	(0.23)	-0.10	(0.22)	-0.22	(0.17)
Maximum education	-0.01	(0.01)	0.00	(0.01)	-0.03*	(0.01)	-0.01	(0.02)
HH activity: Employed								
Unemployed	0.05	(0.06)	0.04	(0.13)	0.18*	(0.11)	0.06	(0.08)
Pensioners	-0.02	(0.05)	-0.02	(0.07)	0.16**	(0.08)	-0.10	(0.09)
Mean age of HH members	0.01**	(0.00)	0.00	(0.00)	0.01***	(0.00)	0.00	(0.00)
Household head gender: Female								
Male	0.03	(0.05)	0.03	(0.11)	-0.05	(0.06)	0.11	(0.08)
Household head age	0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	0.01*	(0.00)
Constant	0.76***	(0.20)	0.89***	(0.32)	0.60**	(0.26)	0.69***	(0.21)
Observations	4,661		1,489		1,582		1,590	
Price elasticity	**-0.66*** **	**(0.11)**	**-0.67*** **	**(0.15)**	**-0.67*** **	**(0.13)**	**-0.65*** **	**(0.13)**
Income elasticity	**0.11****	**(0.03)**	**0.10***	**(0.05)**	**0.13***	**(0.07)**	**0.11***	**(0.06)**

Source: Authors' calculations

***p<0.01, **p<0.05, *p<0.1

Note: Equality test: Tests showed the absence of statistically significant differences between conditional elasticity among all income groups: low-income and middle-income groups (x2(1)=0.03, prob >x2=0.87); low-income and high-income groups (cx2(1)=0.02, prob >x2=0.889); and middle-income and high-income groups (x2(1)=0.00, prob >x2=0.10).

Based on the estimated participation and conditional elasticities, the total price elasticity of demand for spirits across all households is calculated at -0.89, while the total income elasticity is 0.17 (Table 7). Analysis by income

group reveals that price changes have a more pronounced effect on spirits consumption among lower- and middle-income households compared to wealthier households. For instance, a 10-percent increase in price would result in an 11.05-percent reduction in spirits consumption among low-income households, while the corresponding decrease for high-income households would be 6.79 percent. These results align with findings from previous studies conducted in LMICs (Jiang et al., 2016; WHO, 2023), which also highlight the greater sensitivity of lower-income groups to price changes in alcohol products. In contrast, income elasticity exhibits a different pattern, with notably lower coefficients.

Table 7. Total price and income elasticity of spirits demand

	All households		Low-income group		Middle-income group		High-income group	
Elasticity	**Coef.**	**Se**	**Coef.**	**Se**	**Coef.**	**Se**	**Coef.**	**Se**
Price	-0.89***	(0.23)	-1.10***	(0.28)	-0.94***	(0.28)	-0.68***	(0.26)
Income	0.25*	(0.13)	0.19*	(0.10)	0.38*	(0.19)	0.27**	(0.14)

Source: Authors' calculations

***p<0.01, **p<0.05, *p<0.1

Beer and wine own-price and income elasticity of demand by income groups

The analysis reveals that the prevalence price elasticity coefficients for beer and wine are not significant for the entire sample or any of the three income groups. However, when examining conditional elasticity, a significant price-elasticity coefficient is found for the low-income group for both alcoholic beverage types. The estimated conditional elasticity for beer is -0.38, while a 10-percent increase in the price of wine would lead to a 7.10-percent increase in the quantity of wine consumed in the low-income group. Additionally, the two-part model shows that the price coefficient is not jointly significant in both parts of the model for both beverages, resulting in an insignificant total

elasticity for this income group. These findings indicate that price changes have a meaningful impact on the intensity of consumption of these two alcoholic beverages within the low-income group, underscoring the importance of higher taxes as an effective policy tool to mitigate the adverse effects of alcohol use in this vulnerable segment of the population (Table 8).

Table 8. Total price and income elasticity for beer and wine in low-income groups

Beer	**Prevalence**		**Conditional**		**Total**	
Elasticity	**Coef.**	**Se**	**Coef.**	**Se**	**Coef.**	**Se**
Price	-0.16	(0.23)	-0.38***	(0.12)	-0.55	(0.46)
Income	0.31***	(0.07)	0.01	(0.10)	0.31***	(0.11)
Wine						
Price	-0.98	(0.61)	-0.71***	(0.25)	-1.69	(0.68)
Income	0.33***	(0.06)	0.16**	(0.07)	0.47***	(0.08)

Source: Authors' calculations

Given that elasticities are significant only for spirits across the entire sample and all three income groups, simulations of tax changes on consumption and government revenues are conducted solely for this alcoholic beverage type.

Simulation results

The primary objective of the simulation modeling presented in this section is to provide evidence of the impact of potential excise tax increases on the consumption of spirits and government revenue in Montenegro. This analysis equips policy makers with insights to anticipate the outcomes of various tax policy scenarios. Specifically, effects are evaluated in regards to increased government revenue and reduced spirits consumption, which would undoubtedly contribute to improved public health outcomes.

To better understand spirits consumption patterns in Montenegro, the simulation is conducted across three income groups—low, middle, and high—with the following input data and assumptions:

Indicator	**Input data/Assumption**	**Source**
Excise tax	Baseline value is derived from the specific excise rate on spirits, as defined by the 2024 Law on Excise Tax, set at €12.5 per liter of pure alcohol	Ministry of Finance
Consumption	Baseline spirits consumption of 724,050 liters in total, divided by income groups (30 percent low-income, 36 percent middle-income, and 34 percent high-income)	HBS data (2021)
VAT	17.4 percent share in retail price	Ministry of Finance
Point elasticity of price and income by income groups	Estimated using a two-part model in this research	
Gross domestic product (GDP) growth	Real GDP growth 4.8 percent	Ministry of Finance (Government of Montenegro, 2024)
Price	Baseline price of the most-sold spirits is €14.99 per 0.7-liter bottle with an ABV of 40 percent	Retailer chains in Montenegro

Note: It is also assumed that NOT and the size of the illicit market does not change.

In Scenario I, a 20-percent tax increase is assumed, raising the excise tax rate from €12.5 to €15 per liter of pure alcohol. This adjustment is estimated to

result in a 5.73-percent increase in the retail price of spirits (more details of price decomposition and changes are given in Table A15 in the Appendix). The simulation results, disaggregated by income groups, are detailed in Table 9.

Table 9. Impact of spirits excise increase on consumption and government budget (Simulation I)

Income group	Share in total consumption (%)	Consumption			Total revenues			Excise revenues		
		Baseline (000 lit.)	Scenario (000 lit.)	Change (%)	Baseline (000 €)	Scenario (000 €)	Change (%)	Baseline (000 €)	Scenario (000 €)	Change (%)
Low	*30*	217.7	206.4	**-5.20**	1,328.6	1,434.3	**7.95**	762.0	861.3	**13.03**
Middle	*36*	259.6	247.4	**-4.69**	1,584.5	1,719.7	**8.53**	908.7	1,039.3	**14.37**
High	*34*	246.7	239.9	**-2.73**	1,505.4	1,667.4	**10.76**	863.4	1,007.7	**16.72**
Total	**100**	**724.0**	**693.8**	**-4.18**	**4,418.5**	**4,821.4**	**9.12**	**2,534.1**	**2,908.4**	**14.77**

Source: Authors' calculations

Scenario II assumes a 30-percent tax increase, raising the excise tax rate from €12.5 to €16.25 per liter of pure alcohol. This increase is projected to lead to an 8.53-percent rise in the retail price of spirits. The simulation outcomes, categorized by income groups, are provided in Table 10.

Table 10. Impact of spirits excise increase on consumption and government budget (Simulation II)

Income group	Share in total consumption (%)	Consumption			Total revenues			Excise revenues		
		Baseline (000 lit.)	Scenario (000 lit.)	Change (%)	Baseline (000 €)	Scenario (000 €)	Change (%)	Baseline (000 €)	Scenario (000 €)	Change (%)
Low	30	217.7	198.2	**-8.96**	1,328.6	1,461.4	**10.00**	762.0	901.9	**18.36**
Middle	36	259.6	240.5	**-7.35**	1,584.5	1,773.5	**11.93**	908.7	1,094.5	**20.44**
High	34	246.7	235.2	**-4.65**	1,505.4	1,734.2	**15.20**	863.4	1,070.2	**23.95**
Total	**100**	**724.0**	**674.0**	**-6.92**	**4,418.5**	**4,969.2**	**12.46**	**2,534.2**	**3,066.6**	**21.01**

Source: Authors' calculations

Tables 9 and 10 show that Scenario I projects a 4-percent decline in spirits consumption, while Scenario II anticipates a 7-percent reduction, both of which would contribute to meaningful public health benefits. At the same time, government revenues are expected to grow significantly, with increases of 9.12 percent and 12.46 percent under the first and second scenarios, respectively.

These results indicate that the suggested excise tax increases on spirits would make the tax system more progressive. The reduction in spirits consumption would be most pronounced among low-income households, reflecting their greater sensitivity to price changes. Consumption in this group is estimated to decline by 5.2 percent under Scenario I and nearly 9 percent under Scenario II. However, their contribution to the overall revenue increase would be smaller, with gains of 8 percent and 10 percent, respectively, due to the lower base of their consumption. In contrast, high-income households, less affected by price changes, would see smaller consumption declines but generate the highest revenue contributions. Revenue from this group is projected to rise by 10.76 percent in the first scenario and 15.20 percent in the second, reflecting their larger financial capacity and lower price elasticity.

Overall, these findings underscore the dual benefits of the tax changes—achieving public health improvements through reduced consumption among the most price-sensitive groups and securing increased fiscal revenues from wealthier households. By targeting both consumption patterns and financial outcomes, these measures ensure a more equitable and effective tax system.

Discussion and Conclusion

This study provides a comprehensive analysis of alcohol consumption patterns, alcohol demand sensitivity on price and income changes, and the effects of simulated excise tax increases in Montenegro. It highlights that lower-income households, which spend a disproportionate share of their budgets on alcohol, are the most responsive to price increases. Specifically, a 10-percent increase in the price of spirits is estimated to result in a

consumption decline of 11.05 percent among low-income households and 6.79 percent among high-income households. This challenges the industry's claim that alcohol taxes are regressive and supports the notion of the "alcohol harm paradox," wherein lower-income groups face greater harm per unit of alcohol consumed (WHO, 2023; Manthey et al., 2019). By reducing consumption in these groups, taxation not only alleviates harm but also advances equity.

The progressive nature of alcohol taxation reduces health inequities by targeting price-sensitive, lower-income households that are most affected by alcohol-related harms. Additionally, the broader societal benefits of reduced alcohol consumption—such as lower health care costs and improved productivity—further support taxation as an effective policy. Despite the clear benefits of pricing policies, it is also important to recognize that they should be part of a comprehensive approach. In addition to strong tax policy, the WHO recommends implementing complementary measures, such as restricting the availability of alcohol and enforcing bans or restrictions on alcohol marketing (WHO SAFER, 2018). While this study focuses on taxation, integrating these additional interventions could amplify the overall impact on reducing alcohol consumption and its related harms. Tax revenue should be earmarked or otherwise invested in cessation support for low-income populations to further bolster the progressive potential of tax increases.

The study also counters the industry's argument that increased alcohol taxes reduce government revenue. Evidence from Montenegro and other countries demonstrates the opposite: higher excise taxes result in increased revenues while simultaneously reducing consumption (Chisholm et al., 2018; Guindon et al., 2022). Simulation results show that a 20-percent tax increase on spirits could decrease consumption by 4 percent while increasing tax revenue by 9 percent. These dual benefits make alcohol taxation a "win-win" policy for public health and fiscal stability (WHO, 2023).

The research findings indicate a rise in alcohol affordability between 2020 and 2023, driven by slower increases in alcohol prices combined with substantial income growth. For instance, the affordability of spirits increased by 16.24

percent, and beer affordability rose by 7.45 percent. These shifts in affordability likely weakened the effects of existing excise tax policies, emphasizing the need for regular tax adjustments to prevent affordability gains that undermine public health objectives. Given the estimated positive income elasticity, further income growth could lead to even greater affordability of alcoholic beverages, posing additional risks to public health.

Recommendations for Policy Makers

1. **Increase and index excise taxes**

   Policy makers should introduce substantial increases in alcohol excise taxes, particularly targeting spirits, to effectively reduce affordability, discourage consumption, and increase government revenues. At a minimum, taxes should be indexed to inflation and income growth annually to ensure that affordability does not increase over time, maintaining the long-term effectiveness of tax policies. An even stronger policy would be to index the tax rates above the combination of inflation and income growth to ensure that alcohol products become less affordable over time.

2. **Allocate revenues for public health initiatives**

   A portion of alcohol excise tax revenue should be earmarked for prevention and treatment programs, particularly targeting vulnerable populations, including youth and those with lower incomes. Tax revenue should be also earmarked for cessation support for low-income populations to reinforce the progressive potential of tax increases. Investments in health, education campaigns, and support services can amplify the impact of tax policies and address alcohol-related harm comprehensively.

3. **Implement complementary non-price measures**

   Strengthen regulatory frameworks to complement taxation, including stricter advertising restrictions and controls on alcohol access and availability. For example, stricter age restrictions and limiting retail hours are two well proven policy interventions. Public awareness campaigns should also highlight the risks of alcohol consumption, particularly among youth.

4. **Monitor and evaluate policy effectiveness**

   Conduct research and establish robust systems for monitoring and evaluating the impact of alcohol tax policies on consumption patterns, public health outcomes, and revenue generation. Continuous assessment ensures that policies remain effective and adaptable to changing social and economic conditions.

5. **Target youth consumption**

   Given the high prevalence of youth alcohol use, introduce targeted measures, such as educational campaigns, to deter early initiation. Youth-focused interventions can have long-term benefits by reducing early exposure to alcohol and promoting healthier behaviours. Taxes are also particularly effective to address youth alcohol initiation and consumption.

6. **Address unrecorded alcohol**

   Strengthen enforcement mechanisms to combat illicit trade and unregistered alcohol production, which undermines both public health goals and government revenues. Measures should include improved border controls, stricter penalties for illegal production and distribution, and public awareness campaigns about the risks associated with unregulated alcohol. Collaboration with regional and international partners is also important to reduce cross-border illicit trade.

This study underscores alcohol excise taxation as a highly effective tool for reducing consumption and improving public health in Montenegro. Addressing rising affordability through regular tax adjustments ensures that the policy remains effective in curbing excessive alcohol use over time. Lower-income households, especially, stand to gain the most, as excise taxes help alleviate health inequities and reduce alcohol-related harms. At the same time, the substantial fiscal benefits provide governments with an additional sustainable source of revenue to fund essential services. These findings reinforce the value of alcohol taxation as part of a comprehensive strategy to achieve public health and economic goals, creating a healthier and more equitable society.

Appendix

Table A1. Sociodemographic data by income groups

Low-income group					
Variable	**Observation**	**Mean**	**St. dev.**	**Min**	**Max**
Household size	5,500	3.95	1.66	1	8
Male ratio	5,500	0.49	0.21	0	1
Adult ratio	5,500	0.83	0.21	0.37	1
Maximum education	5,500	5.18	2.02	1	9
Mean age	5,500	40.15	16.52	16	85
Economic activity: Unemployed	5,395	0.06	0.24	0	1
Economic activity: Pensioner	5,395	0.32	0.47	0	1
Economic activity: Employed	5,395	0.62	0.48	0	1
Middle-income group					
Variable	**Observation**	**Mean**	**St. dev.**	**Min**	**Max**
Household size	5,428	3.10	1.60	0	8
Male ratio	5,428	0.45	0.27	0	1
Adult ratio	5,428	0.90	0.17	0.37	1
Maximum education	5,428	5.41	2.15	1	9
Mean age	5,428	47.69	17.94	16	85
Economic activity: Unemployed	5,428	0.06	0.23	0	1
Economic activity: Pensioner	5,428	0.34	0.47	0	1
Economic activity: Employed	5,428	0.60	0.50	0	1
High-income group					
Variable	**Observation**	**Mean**	**St. dev.**	**Min**	**Max**
Household size	5,395	51.73	1.32	1	8
Male ratio	5,395	0.46	0.31	0	1
Adult ratio	5,395	0.95	0.13	0.40	1
Maximum education	5,395	6.07	2.14	1	9
Mean age	5,395	51.73	16.55	16	85
Economic activity: Unemployed	5,500	0.15	0.35	0	1
Economic activity: Pensioner	5,500	0.34	0.47	0	1
Economic activity: Employed	5,500	0.51	0.50	0	1

Source: Authors' calculations

Spirits prevalence elasticity specification

Table A2. Estimation of prevalence elasticity – different models

	Model 1		Model 2	
VARIABLES	**Coef.**	**Se**	**Coef.**	**Se**
Price	-0.04**	(0.02)		
Expenditure	0.00**	(0.00)		
ln price			-0.31	(0.27)
ln expenditure			0.10	(0.07)
Household size	0.40***	(0.09)	0.39***	(0.09)
Male ratio	0.62***	(0.09)	0.63***	(0.09)
Adult ratio	0.66***	(0.11)	0.65***	(0.11)
Maximum education	-0.04**	(0.02)	-0.04**	(0.02)
HH activity: Employed				
Unemployed	-0.02	(0.09)	0.03	(0.09)
Pensioners	0.00	(0.07)	0.04	(0.07)
Mean age of HH members	0.01***	(0.00)	0.01***	(0.00)
Household head gender: Female				
Male	0.35***	(0.07)	0.34***	(0.07)
Household head age	0.00	(0.00)	0.00	(0.00)
Constant	-2.40***	(0.34)	-2.67***	(0.51)
Observations	15,431		15,431	
AIC	18486.1		18482.2	
BIC	18577.9		18573.9	
r2_p	0.0239		0.0237	
ll	-9231.1		-9229.1	

Source: Authors' calculations

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, *p<0.1.

Table A3. Linktest

	Model 1				Model 2			
	Coef.	**Se**	**z**	**P>z**	**Coef.**	**Se**	**z**	**P>z**
_hat	0.90	0.22	4.15	0	0.88	0.21	4.1	0
_hatsq	-0.05	0.11	-0.45	0.65	-0.06	0.11	-0.58	0.56
_cons	-0.04	0.09	-0.4	0.687	-0.05	0.09	-0.52	0.61

Source: Authors' calculations

Table A4. VIF test

	Model 1
Mean VIF	2.40

Source: Authors' calculations

Table A5. Hosmer and Lemeshow goodness-of-fit test

	Model 1	
Observations	15,431	15,431
Groups	5	15
Chi2	5.31	8.53
p	0.15	0.38

Source: Authors' calculations

Table A6. Linktest of prevalence by income groups

	Low-income group				**Middle-income group**				**High-income group**			
	Coef.	**Se**	**z**	**P>z**	**Coef.**	**Se**	**z**	**P>z**	**Coef.**	**Se**	**z**	**P>z**
_hat	1.44	0.30	4.87	0.00	0.86	0.26	3.35	0.00	0.95	0.41	2.35	0.02
_hatsq	0.22	0.14	1.55	0.12	-0.08	0.14	-0.55	0.58	-0.02	0.22	-0.11	0.91
_cons	0.18	0.13	1.31	0.19	-0.04	0.10	-0.44	0.66	-0.02	0.17	-0.1	0.92

Source: Authors' calculations

Table A7. Hosmer and Lemeshow goodness-of-fit test by income groups

	Low-income Group		**Middle-income group**		**High-income group**	
Observations	5,240	5,240	5,088	5,088	5,103	5,103
Groups	5	10	5	10	5	10
Chi2	0.80	11.79	3.21	13.16	2.75	19.61
p	0.85	0.46	0.36	0.43	0.43	0.11

Source: Authors' calculations

Table A8. VIF test

	Low-income group	Middle-income group	High-income group
Mean VIF	2.60	3.23	2.21

Source: Authors' calculations

Spirits conditional elasticity estimation

Table A9. Box-Cox test of functional form

	Model 2			
	Coef.	**Se**	**z**	**P>z**
theta	-0.31	0.02	-12.79	0.00

Source: Authors' calculations

Table A10. VIF test

	Model 2
Mean VIF	2.40

Source: Authors' calculations

Table A11. Modified Park test (GLM family test)

	Model 2			
	Coef.	**Se**	**z**	**P>z**
lyhat	2.47	0.95	2.61	0.00
_cons	-0.33	0.72	-1.47	0.64
	Chi2		P > Chi2	
λ=2 (lyhat2=0)	0.25		0.61	

Source: Authors' calculations

Table A12. Pregibon's link test by income groups

	Low-income group				Middle-income group				High-income group			
	Coef.	**Se**	**z**	**P>z**	**Coef.**	**Se**	**z**	**P>z**	**Coef.**	**Se**	**z**	**P>z**
lyhat	4.55	1.70	2.68	0.01	-0.99	2.62	-0.38	0.70	-7.60	5.80	-1.31	0.19
lyhat2	-1.80	1.91	-0.95	0.34	3.02	2.28	1.32	0.19	9.58	6.39	1.50	0.13
_cons	-0.88	0.42	-2.11	0.03	0.21	0.72	0.3	0.76	1.61	1.67	0.96	0.33

Source: Authors' calculations

Table A13. VIF test

	Low-income Group	**Middle-income Group**	**High-income Group**
Mean VIF	2.60	3.23	2.21

Source: Authors' calculations

Table A14. Hosmer and Lemeshow goodness-of-fit test

	Low-income group		Middle-income group		High-income group	
Groups	5	10	5	10	5	10
Chi2	0.50	0.43	1.81	2.24	0.93	0.90
p	0.77	0.93	0.11	0.11	0.46	0.54

Source: Authors' calculations

Table A15. Price decomposition and changes

	Retail price per unit (in €)	**Excise tax per unit (in €)**	**VAT per unit (in €)**	**NoT per unit (in €)**	**Price change (%)**
Baseline	14.99	3.50	2.60	8.90	-
Scenario I	15.85	4.20	2.75	8.90	5.73
Scenario II	16.27	4.55	2.82	8.90	8.53

Source: Authors' calculations

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