How do prices of manufactured cigarettes and roll-your-own tobacco affect demand for these products? Tobacco price elasticity in Western Balkan countries

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ABSTRACT

Background and objective Numerous studies have indicated that tobacco taxation is one of the most important policies to reduce tobacco consumption. However, its effectiveness crucially depends on consumer responses to price increases, that is, tobacco price elasticities. This paper analyses tobacco price elasticity in six Western Balkan countries.

Data and methods We estimate own-price and cross-price elasticities of manufactured cigarettes (MCs) and roll-your-own (RYO) tobacco by using the methodological framework of the two-part model, regional variation in prices and 2019 Survey on Tobacco Consumption in Southeastern European countries (STC-SEE). STC-SEE provides a uniquely comparable nationally representative data on smoking behaviour for adult (18–85 years old) population for each country.

Results Results suggest that higher prices of MCs are associated with lower prevalence of MC use, while higher prices of RYO are associated with lower intensity of RYO use. Furthermore, regions with higher MC prices have a higher likelihood of using RYO over MC, suggesting that RYO is used as a cheaper alternative to MC. Lastly, lower smoking prevalence and intensity are associated with more smoking restrictions and support for tobacco price increases.

Conclusion Results suggest that, aiming to decrease smoking prevalence and intensity, governments should increase excises on all tobacco products. Since RYO is a cheaper alternative to MC, the increase of excises on RYO should be higher, so that after excise increase, the prices of the two products are approximately the same. To further reduce tobacco consumption, governments should combine increasing taxes on tobacco products with non-price measures, such as stricter smoking restrictions and smoke-free regulations.

INTRODUCTION

Compared with the European Union (EU), Western Balkan (WB) regions characterised by high levels of tobacco consumption, resulting partially from low prices of cigarettes. According to Zubovic and Vladisavljevic,[1] in 2019, prevalence rates range from about 32% in Albania to 46% in Kosovo (2017 data), while the prices of the most-sold brand of manufactured cigarettes (MCs) in 2020 were between €1.5 in North Macedonia and €2.3 in Montenegro. For comparison purposes, the EU average prevalence has been estimated at 25% of the adult population (15 years and over), while only 2 out of 28 EU members—Greece (42%) and Bulgaria (38%), recording higher prevalence if compared with the WB average.[2] The most popular brand of MC is the most expensive in Ireland (€14) and the cheapest in Bulgaria (€2.7).[3] High tobacco consumption imposes a significant economic burden on households in the region, while at the same time tobacco consumption has serious health consequences as approximately half of smokers die from tobacco-related diseases.[4]

Numerous studies indicate that tobacco taxation is one of the most important policies to reduce tobacco consumption. The effectiveness of taxation depends on consumer responses to price increases, that is, price elasticities of demand for tobacco products. Previous studies find negative tobacco price elasticities, clustering around −0.5 for low/middle-income countries.[4] Similar research dealing with WB countries, and focusing on within-country price elasticities of MCs, find negative elasticities ranging from −0.387 in Kosovo to −1.065 in Montenegro, with an average elasticity of about −0.712,[1] with consumers decreasing both prevalence and intensity of MC use as a result of the price increase.

In this research, we provide additional arguments to support increasing tobacco taxes as an effective tool for reducing tobacco consumption in WB countries. We provide several novelties compared with the previous research. First, we examine price elasticities of the two most frequently used tobacco products in the region: MCs and roll-your-own (RYO) tobacco, while previous research for the WB focuses only on MCs. Second, we present first evidence of the cross-price elasticities in the region, that is, we examine how MC prices affect RYO consumption, and vice versa. Third, unlike previous studies for the WB, which focus on within-country estimates and use household-level data, we use cross-country variation in prices and tobacco consumption and use individual-level data that have not been available for the WB region before. To achieve this aim, we use a unique dataset from the Survey on Tobacco Consumption in Southeastern European countries (STC-SEE) from 2019, which contains the data from six WB countries: Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia. We use methodological framework of the two-part model,[5 6] to investigate the impact that tobacco prices have on smoking prevalence and intensity.

Main findings of our research are that higher prices of MC are associated with lower prevalence of MC use, RYO in the WB region is used as a cheaper alternative to MC, and that higher prices of RYO tobacco lower its use. Research findings

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suggest that, in order to decrease smoking prevalence and intensity, governments should increase the excises on all tobacco products. Since RYO is a cheaper alternative to MC, the increase of excises on RYO should be higher, so that after the increase of the excises, the prices of the two products are approximately the same. At the same time, in order to gain stronger control of RYO prices, governments should work to enforce regulations to reduce the informal RYO market.

The remaining part of the paper is structured as follows. Section 2 describes the data used and presents descriptive statistics and variables used. Section 3 describes the methodology, while section 4 presents the results of the analysis. In section 5, we present the conclusions and policy recommendations.

DATA, VARIABLE DEFINITION AND DESCRIPTIVE STATISTICS BY COUNTRY

STC-SEE data, collected in 2019, provide a nationally representative sample of adults (18–85 years old) for each country.[1] The sample size was 1000 respondents per country, apart from Serbia where 2000 respondents were interviewed . The data contain detailed information on tobacco consumption, expenditures, and prices as well as attitudes towards tobacco consumption, prices and other control measures, and sociodemographic characteristics of the respondents. For the purpose of this research, STC-SEE data are divided into 23 statistical regions (s-regions).

Prevalence for each tobacco product is based on self-assessed smoking status, which is based on the question, 'For each of tobacco smoking products, please indicate whether you are current smoker, former smoker, have tried it but have never consumed it continually for 2–3 months or longer, or you have never tried it'. Those who report that they are current smokers are regarded as smokers (and therefore take the value 1 in prevalence variable), while other categories are regarded as non-smokers (NS) (and therefore take the value 0 in prevalence variable). Two tobacco products have a sufficient number of consumers to be analysed in a demand model: MC (2,527 people) and RYO (352 people), while the prevalence of other products is below 1% (electronic cigarettes 0.4%, heated tobacco 0.4%, smokeless tobacco 0.01%, waterpipe with tobacco 0.6%). Table 1 presents the (weighted) prevalence of MC and RYO use by country. On average, about 32.8% of adults in the WB countries smoke MC, with prevalence rates varying from 19.8% in Albania to 44.5% in North Macedonia. On the other hand, the prevalence of RYO use is 6.3% on average, ranging from 1.4% in Kosovo to 9.7% in Bosnia and Herzegovina. The overall prevalence of using either MC or RYO is 37.6%—only slightly lower than the sum of prevalence rates of the two products, indicating a relatively small overlap in consumption of the two products.

Table 1 Prevalence of MC and RYO by country

Country	MC	RYO	Total
Albania	19.8%	6.0%	24.7%
Bosnia and Herzegovina	33.9%	9.7%	41.9%
Kosovo	35.6%	1.4%	36.7%
Montenegro	38.8%	2.9%	41.0%
North Macedonia	44.5%	6.1%	48.9%
Serbia	32.8%	6.3%	37.4%
SEE region	**32.8%**	**6.3%**	**37.6%**

In column 'Total', the sum of MC and RYO prevalence does not add up to total prevalence, as smokers can smoke both products.
Source: authors' calculation based on the 2019 STC-SEE data.
MC, manufactured cigarette; RYO, roll-your-own; STC-SEE, Survey on Tobacco Consumption in Southeastern European countries.

Table 2 Smoking intensity (conditional on smoking) by country (in cigarettes per day)

Country	MC	RYO	Total
Albania	14.9	18.2	16.4
Bosnia and Herzegovina	14.5	11.9	14.5
Kosovo	20.8	15.8	20.8
Montenegro	19.5	17.7	19.7
North Macedonia	14.6	11.4	14.7
Serbia	17.1	15.6	17.7
SEE region	**16.5**	**14.4**	**16.8**

Column 'Total' represents the average of cigarettes (MC or RYO) smoked by an individual.
Source: authors' calculation based on the 2019 STC-SEE data.
MC, manufactured cigarette; RYO, roll-your-own; STC-SEE, Survey on Tobacco Consumption in Southeastern European countries.

On average, current MC users in the SEE region smoke 16.5 cigarettes per day, while RYO users smoke 14.4 cigarettes per day (table 2). For easier presentation, intensity variables in table 2 are transformed to daily levels, while smoking intensity is recorded in weekly use of MC and RYO. Both MC and RYO intensity were measured via the question, 'What is the number of MC/RYO cigarettes smoked per week'. Although RYO is not purchased in cigarette packs, this is a standard way of estimating the intensity of RYO intensity in standard international surveys (e.g., Global Adult Tobacco Survey). Country differences in smoking intensity are less pronounced than differences in prevalence. Current MC users smoke from about 14.5 MCs per day in Bosnia and Herzegovina to 20.8 per day in Kosovo, while the range of RYO smoked by RYO users is from 11.4 in North Macedonia to 18.2 in Albania (table 2).

Prices of tobacco products are calculated as s-regional averages of the unit values reported by tobacco users. Unit value represents a ratio of weekly expenditure on cigarettes and number of cigarettes purchased within a week. We check the robustness of the results to the presence of extreme values by also using median s-regional prices. This robustness check was performed in order to ensure that the effect of the price variable is not due to extreme values of prices in our data. In cases where the s-regional mean (median) is based on less than 10 observations, it is replaced with the national mean (median). The average calculated price of the MC pack of 20 cigarettes in 2019 was about €2.2 (table 3). The MC prices vary significantly: from €1.6 in Macedonia to €2.7 in Bosnia and Herzegovina, and they roughly correspond to the prices of the most-sold brand, available from the administrative data (table 3). On the other hand, the average estimated price of 20 RYO cigarettes was about €1.5 with relatively smaller variation in mean or median prices. RYO is not sold in 20-cigarette packs, but in order to have the comparable level of prices for both products, this study uses this unit for the RYO prices. Detailed prices by s-regions are presented in online supplemental table A1.

Although in some previous research, authors estimating cross-country price elasticities have corrected the prices by purchasing power parity (PPP),[7] in this study, due to data limitations, we cannot explicitly control for PPP and instead we account for country differences in purchasing power by controlling for income level. An alternative strategy would be to correct both prices and income for PPP, however, since the income variable in this survey is collected in intervalsPPP correction cannot be done in a meaningful way. In this case, PPP correction for prices only would lead to underestimation of the differences in affordability of cigarettes across countries, and therefore to a specification error. The country differences in PPP are not pronounced and range between 0.342 in North Macedonia and 0.391 in Serbia (€ to international $ PPP).

Figure 1 presents the s-regional level correlation between tobacco prices and demand indicators. In general, panels indicate a negative correlation between the prevalence and intensity of MC and RYO use and own prices of these products, with the exception of correlation between the prices and smoking intensity for MC where there is no correlation. Cross-s-regional correlations (based on 23 observations, one per s-region) suggest a negative correlation between product prices and prevalence: −0.12 for MC and −0.17 for RYO, while the correlation for RYO intensity is negative, at −0.36. However, only the last correlation is statically significant, due to the small sample size .

Evidence presented in figure 1 is only a first step in the investigation of the link between tobacco prices and demand. In order to investigate this link in a more rigorous manner, econometric techniques will control for other factors that might affect tobacco demand aside from the prices; and provide stronger evidence that tobacco prices have a causal impact on the demand of tobacco products.

METHODOLOGY: ESTIMATION OF PRICE ELASTICITY IN THE SEE REGION

The model of the price elasticity in SEE region

Tobacco consumption is characterised by a large proportion of NS, for which the variable describing consumption takes a zero value, while the remaining outcomes are strictly positive. More formally, the distribution can be described as:

$$y_{ij} = 0, n = 0, 1, n_i$$

$$y_{ii} > 0, n = n_{i+1}, n_{i+2}, n_N \quad j = mc, ryo. \quad (1)$$

Table 3 Mean and median price (in € per 20 cigarettes) by country

Country	Most-sold brand	MC mean	MC median	RYO mean	RYO median
Albania	1.9	2.2	2.1	1.3	0.8
Bosnia and Herzegovina	2.4	2.7	2.6	1.2	0.9
Kosovo	2.1	2.2	2.0	1.6	0.9
Montenegro	2.3	1.9	1.7	1.6	1.0
North Macedonia	1.5	1.6	1.4	1.5	1.0
Serbia	2.1	2.4	2.3	1.5	1.2

Source: Most-sold brand: administrative sources by countries. Other prices, authors' calculation based on the 2019 STC-SEE data.
MC, manufactured cigarette; RYO, roll-your-own; STC-SEE, Survey on Tobacco Consumption in Southeastern European countries.

This research analyses the distribution of two tobacco products: MC and RYO, noted by index $j=(mc, ryo)$. The distribution of tobacco products reflects the fact that when faced with market prices and budget constraints, given the utility that they derive from smoking, individuals face two connected decisions: (1) whether or not to smoke; and (2) if they decide to smoke, how much to smoke. The literature suggests that these two decisions should be modelled independently within the two-part model,.[8] This particularly applies in the cases where y=0 is observed frequently, which is the case with cigarette use, as smoking prevalence in this sample is about 34% for MC and about 5% for RYO (see table 1).

Therefore, for both products, two models are estimated:

$$P\left(y_{rij} > 0\right) = f\left(\beta_1 p_{rj,mc} + \beta_2 p_{rj,ryo} + \Gamma' X_{rij} + \Theta' H_{rij} + \Delta'_{rj}\right) \quad j = mc, ryo \quad (2)$$

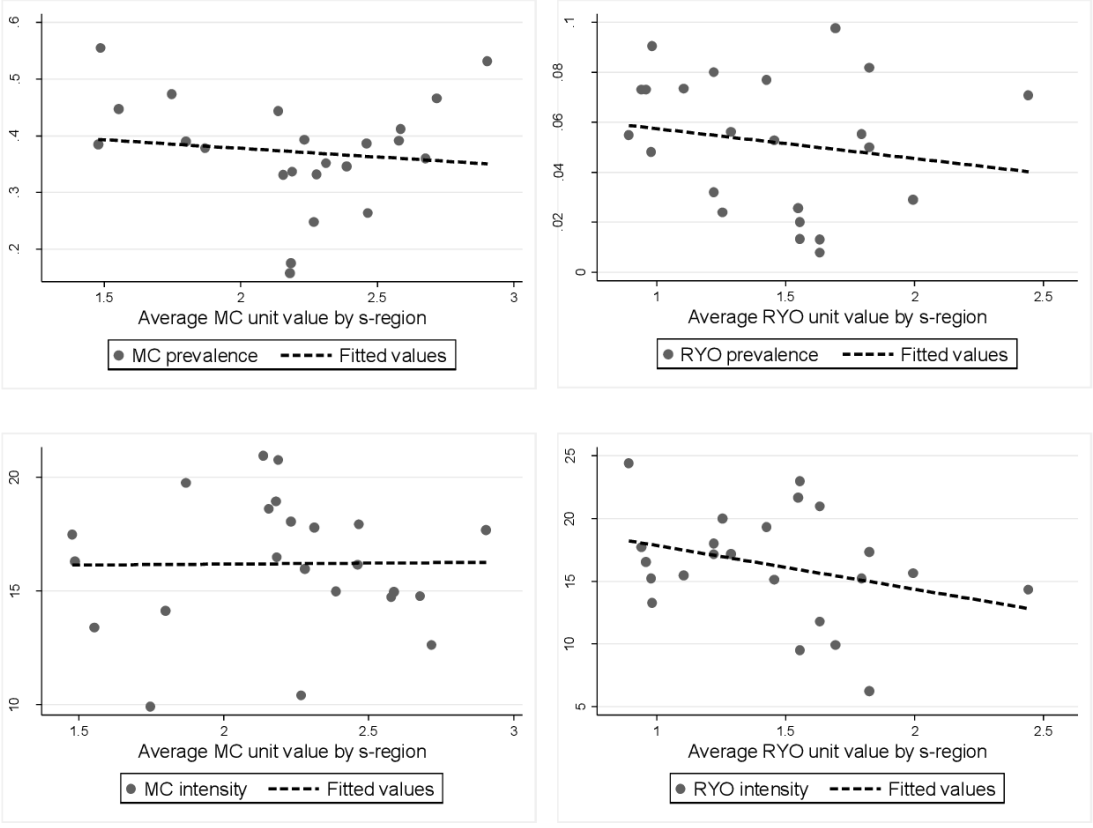

Figure 1 Correlation between prices and smoking prevalence (top panel) and intensity (bottom panel). (Source: authors' calculation based on the STC-SEE data). MC, manufactured cigarette; RYO, roll-your-own; s-region, statistical region; STC-SEE, Survey on Tobacco Consumption in Southeastern European countries.

$$E\left(y_i|y_i>0\right)=\beta_1 p_{rj,mc}+\beta_2 p_{rj,ryo}+\Gamma' X_{rij}+\Theta' H_{rij}+\Delta'_{rj}\quad j=mc,ryo; \quad (3)$$

where equation (2) represents prevalence, and equation (3) represents intensity models. Both MC and RYO prices appear in both models, since the prices of one product can affect the demand of another. Coefficients β_1 and β_2 are estimating the impacts of MC and RYO prices on the demand of both products, which are then used to obtain the own-price and cross-price elasticities. Own-price elasticities are expected to be negative as higher prices lead to decrease in the prevalence and intensity of smoking, while cross-price elasticities are expected to be positive, as for example, higher prices of MC could push smokers towards RYO, if the products are substitutes.

An important issue to address when estimating price elasticities is the potential endogeneity between prices and demand indicators, as prices can affect demand, but demand can also affect prices. Previous studies that have tested exogeneity of tobacco prices concluded that tobacco prices can be treated as exogenous,[9–11] even if coming from the same level of aggregation.[12] A further argument to support the exogeneity of prices in this research is the fact that s-regional (*r*) averages (medians) are used to construct a market-level price measure, a strategy applied in numerous previous studies.[13 14] The higher aggregation level is also one of the cornerstones in arguing price exogeneity in Deaton's demand model.[15] Finally, prices in the WB region are largely determined by the state as excises have a large share in the price and since prices in the region are heavily influenced by the process of harmonisation with the EU.

Equations (2) and (3) additionally control for the set of personal (X_{ri}), and household (H_{ri}) characteristics (as only one individual per household is interviewed, household variables are effectively also on the individual (*i*) level) as well as the set of local environment (*r*) variables. Personal characteristics include age, age squared, gender, level of education (three categories: primary, secondary, and tertiary), labour market status (three categories: employed (including agriculture, part-time and occasional workers), unemployed and inactive (including students, pensioners and homemakers)), and marital status (single or married), while the set of household characteristics includes household size, number of adults, and number of younger (0–5 years old) and older children (6–15 years old). The set of control variables also includes household and personal income variables. The master questionnaire includes a scale of 11 income categories and is expressed in euros. During the data collection process, these intervals were transformed to local currencies, and the respondents chose based on local currency intervals. As the data contain large number of missing values, intervals are imputed based on other personal and household characteristics in order to avoid sample attrition. Imputation procedure is presented in more detail in online supplemental appendix B. Descriptive statistics of personal and household characteristics are presented in online supplemental table A2.

The purpose of local environment (*r*) variables is to control for other s-regional characteristics (other than price) that could impact the estimated elasticities. For example, countries with negative attitudes towards tobacco could have lower demand, while at the same time have lower prices. Therefore, not controlling for these variables could overestimate the impact of prices on the demand.[7] Given that STC-SEE data extensively measure attitudes on tobacco consumption, there are several indicators available as controls for a country heterogeneity. Starting from individual survey responses, s-regional-level indicators are constructed as s-regional averages (RAs). The indicators are divided into three groups. First group includes variables measuring attitudes towards tobacco control measures: (1) support for tobacco price increases (RA for NS and all), (2) usefulness of tobacco control measures (RA for NS and all), (3) complaints to smokers about smoking behaviour (RA for smokers). The second group includes variables measuring smoking restrictions and permissions: (1) restrictions at home (RA for NS and all), (2) frequency of people smoking in public places (university, public offices, etc) and cafes/restaurants (RA for NS and all), (3) restrictions for smoking (RA for smokers). Finally the third group includes variables realted to tobacco advertising: (1) observed sponsored events (RA for NS and all) and (2) observed tobacco promotion activities (RA for NS and all). Descriptive statistics of local environment indicators are presented in online supplemental table A2.

Although country-fixed effects (CFEs) can additionally be applied to account for the remaining unobserved country-level heterogeneity (not controlled by local environment variables), initial estimates indicated that the between-country variation in prices is more pronounced than the within-country variation. For example, the variance of country-level mean MC prices is three times higher than variation of the variable representing regional-level deviation from country-level mean MC prices. Therefore, including CFEs effectively neutralises main source of variation in prices and would prevent the demonstration of the effects of prices on MC and RYO demand. Furthermore, introduction of the country-fixed effects increases the SEs in the model, indicating multicollinearity in the model, particularly for the effect of the MC price (model with the CFEs can be obtained from the authors upon request).

Estimation strategy

As the decisions to smoke MC and RYO are potentially connected, correlation of errors across equations is used to improve the precision of the estimators. In order to account for the correlation across the individuals, we use a bivariate probit model,[16] rather than individual logit models, to estimate prevalence elasticities. Furthermore, unlike simple logit regressions for MC and RYO, bivariate probit model estimates the associated probabilities of overlapping choices of smoking these two products: (1) not smoking; (2) smoking MC only; (3) smoking RYO only and (4) smoking both products. When described in this way, the estimation sample consists of 4226 NS, 2455 users of MCs, 253 users of RYO and 72 people using both products.

The dependent variable in intensity models (equation 3) is usually represented in a log form as it helps to stabilise non-constant error variance. However, a standard practice in health economics in this case is to use the generalised linear model (GLM) with gamma family and log link function. This method has been proposed as a more robust alternative to a log regression specification.[17] In the case of intensity models, the correction for the correlation of errors across equations is less straightforward than for the prevalence model. In the estimation sample, only about 3% of MC users use RYO at the same time (72 out of 2,527), while only 22% of RYO users use MC at the same time (72 out of 352). Therefore, estimation within a seemingly unrelated equations framework would be biased due to misspecifications in both models, since distribution would then include a high share of zero values in the equations. Instead, we opt to estimate MC and RYO equations separately.

S-regional-level cluster-corrected SEs are applied to account for the fact that prices and local environment variables are defined at higher levels of aggregation, as well as heteroscedasticity-robust

Table 4 Own-price and cross-price elasticity of MC and RYO prevalence (biprobit model)

		Model 1†				Model 2†			
		Mean price model		Median price model		Mean price model		Median price model	
Probability of smoking MC (outcome 2)‡	MC price	−0.492**	(0.243)	−0.437**	(0.182)	−0.605**	(0.254)	−0.504**	(0.215)
	RYO price	0.237	(0.210)	0.052	(0.129)	0.190	(0.176)	0.024	(0.116)
Probability of smoking RYO (outcome 3)§	MC price	1.102*	(0.598)	0.850	(0.602)	1.365**	(0.540)	1.034*	(0.541)
	RYO price	−0.260	(0.509)	0.098	(0.399)	−0.150	(0.496)	0.159	(0.367)
Bivariate correlation		−0.202***	(0.047)	−0.204***	(0.046)	−0.200***	(0.047)	−0.202***	(0.046)
Sociodemographic covariates¶		x		x		x		x	
Anti-smoking sentiment		x		x		x		x	
Smoking restrictions						x		x	

Source: authors' calculation based on the 2019 STC-SEE data.
*** p<0.01, ** p<0.05, * p<0.1.
†Model 1 includes control only for s-regional level for anti-smoking sentiment, while model 2 includes controls for both s-regional level for anti-smoking sentiment and restriction levels.
‡Coefficients for outcome 2 indicate the per cent change in probability of smoking only MC (compared with all other outcomes) resulting from the per cent change in MC and RYO prices.
§Coefficients for outcome 3 indicate the per cent change in probability of smoking only RYO (compared with all other outcomes) resulting from the per cent change in MC and RYO prices.
¶Sociodemographic controls include the following characteristics: age (and its square), gender, education, labour market status, household size and personal income category.
MC, manufactured cigarette; RYO, roll-your-own; STC-SEE, Survey on Tobacco Consumption in Southeastern European countries.

SEs to control for potential heteroscedasticity in both parts of the model.

RESULTS

Prevalence models

The results of estimated effects of MC and RYO prices on smoking MC (outcome 2) and smoking RYO (outcome 3) (as mentioned in the Methodology section, individuals face the decision between four outcomes: (1) not smoking; (2) smoking MC only; (3) smoking RYO only and (4) smoking both products) are presented in table 4 (full estimates in online supplemental table A3). The model is estimated by using both mean and median prices. Model 1, next to prices and sociodemographic characteristics, includes s-regional differences in support for the tobacco price increase. In model 2, the share of homes in which smoking is not allowed, representing s-regional differences in smoking restrictions, is added to the specification . The correlation between the residuals in two equations is significant in all the specifications, confirming a strong link between the prevalence rates of the two products.

Results suggest a negative effect of MC prices on MC prevalence. Estimated own-price elasticities range between −0.437 and −0.605, averaging at about −0.5. Given the cross-sectional nature of this study, estimated elasticities suggest that s-regions that have 10% higher prices of MC also have about 5% lower prevalence of its use. The effect of RYO prices (ie, cross-price elasticity) is insignificant, indicating that price of RYO does not affect MC prevalence.

Results also show that MC prevalence (all other things equal) is higher for men, the low-educated and employed, persons living in smaller households and persons with higher personal income. Additionally, the model suggests that MC prevalence is the lowest for younger and especially older cohorts of the population. As expected, higher support for tobacco price increases and a higher share of homes in which smoking is not allowed are associated with lower smoking prevalence (online supplemental table A3).

RYO prices have no effect on RYO prevalence, while the effects of MC price on RYO prevalence are inconclusive, as only one of four estimates is significant at the 0.05 level (table 4). However, the effects of MC and RYO prices on RYO prevalence, as defined in bivariate probit model, are not straightforward and require additional explanation. In this model, the dependent variable for RYO prevalence takes the value 1 if a person uses RYO, and takes the value 0 if the person does not use RYO. The latter group, besides those who do not smoke either MC or RYO, also includes MC users, who represent about 37% of all non-RYO users.For MC, this problem is much less pronounced as in total non-MC users, RYO users make only about 5%. To clarify this ambiguity, instead of one model, we estimate two separate models for RYO prevalence. The first model investigates the choice between smoking only RYO (outcome 3) or only MC (outcome 2). In the second model, the probability of choosing outcome 3 (smokes only RYO) rather than outcome 1 (does not smoke) is estimated. This model investigates the prevalence of RYO, conditional on non-smoking MC. Results of these two models are presented in table 5.

In the choice model, the marginal effect for the estimated coefficients for MC price is significant in all specifications, averaging about 1.3, while in the conditional RYO prevalence model the effects of MC price are not statistically significant (table 5). Therefore, smokers in s-regions where MC prices are 10% higher relative to other s-regions have about 13% higher likelihood of choosing RYO over MC. On the other hand, the variations in the prices of RYO do not have an impact in any of the models. The results also indicate that the preference for RYO compared with MC, all things equal, is higher for men, low-educated, unemployed, persons living in smaller households and persons with lower income. Similar characteristics also separate RYO smokers from persons who do not smoke (online supplemental table A4). Additionally, local environment variables are not significant in any of the specifications.

Intensity models

The estimation of the MC intensity model via GLM, presented in table 6 (see detailed estimates in online supplemental table A5), suggests that both own-price and cross-price elasticities for MC smoking intensity are insignificant, indicating that the differences in s-regional MC or RYO prices cannot explain the differences in MC smoking intensity. As mentioned previously, intensity of MC use does not vary significantly across countries (for example, when compared with MC prevalence), which

Table 5 Own-price and cross-price elasticity of a choice model and conditional RYO prevalence model (separate probit models)

		Model 1†				Model 2†			
		Mean price model		Median price model		Mean price model		Median price model	
Choice between tobacco products‡	MC price	1.341**	(0.607)	1.084*	(0.582)	1.643***	(0.597)	1.339**	(0.571)
	RYO price	−0.322	(0.591)	0.058	(0.351)	−0.236	(0.549)	0.100	(0.314)
Probability of using RYO§ (conditional on non-smoking MC)	MC price	0.596	(0.662)	0.435	(0.656)	0.746	(0.581)	0.435	(0.656)
	RYO price	0.031	(0.503)	0.158	(0.424)	0.102	(0.521)	0.158	(0.424)
Sociodemographic covariates¶		x		x		x		x	
Anti-smoking sentiment		x		x		x		x	
Smoking restrictions						x		x	

Source: authors' calculation based on the 2019 STC-SEE data.
*** p<0.01, ** p<0.05, * p<0.1.
†Model 1 includes control only for s-regional level for anti-smoking sentiment, while model 2 includes controls for both s-regional level for anti-smoking sentiment and restriction levels.
‡Dependent variable in the choice model is a dichotomous variable which takes the value 1 if person is smoking RYO and value 0 if person is smoking MC. Coefficients these rows indicate the per cent change in probability of smoking only RYO rather than smoking only MC resulting from the per cent change in MC and RYO prices.
§Dependent variable in the conditional RYO model is a dichotomous variable which takes the value 1 if person is smoking RYO and value 0 if person is a non-smoker. Coefficients these rows indicate the per cent change in probability of smoking only RYO, compared with being a non-smoker, resulting from the per cent change in MC and RYO prices.
¶Sociodemographic controls include the following characteristics: age (and its square), gender, education. labour market status, household size and personal income category.
MC, manufactured cigarette; RYO, roll-your-own; STC-SEE, Survey on Tobacco Consumption in Southeastern European countries.

could prevent the effects of the prices from being demonstrated. The robustness test of the model is performed on the sample of smokers who use only MC (excluding those who smoke both MC and RYO, 72 out of 2527) and it yields similar results (available upon request from the authors).

Results also indicate that smoking intensity is lower for women, as well as for younger and older smokers. Household income (per capita) also plays a significant role in the intensity model, as persons living in households with higher income per capita smoke more MC. This is contrary to model for MC prevalence, where personal income had a significant effect on prevalence (while household income had no impact). The effect of the support for tobacco price increases is not significant, while the average number of public places where people are seen smoking significantly decreases MC smoking intensity (online supplemental table A5). In all the countries, smoking is prohibited in public places such as: government building or offices, healthcare facilities, public transportation, and universities and schools; and this variable presents compliance to those smoking restrictions.

Similar to MC, the estimation of the price elasticities for RYO smoking intensity is estimated via GLM and the results are presented in table 7 (detailed estimates in online supplemental table A5). Own-price elasticity for RYO intensity is significant in all specifications and consistent across the specifications where it ranges between −0.355 and −0.415. This indicates that s-regions with 10% higher RYO prices have about 3.5%–4% lower intensity of RYO smoking. On the other hand, the effect of MC prices is insignificant, indicating that s-regional differences in MC prices do not have an effect on the intensity of RYO use.

Among other characteristics, female RYO smokers smoke less than men as well as younger users, while other sociodemographic characteristics have no impact on the intensity of RYO use. Average s-regional support for the increase of tobacco prices decreases RYO smoking intensity, while the share of homes which do not allow smoking, representing smoking restrictions, has a negative effect (online supplemental table A5).

DISCUSSION AND CONCLUSIONS

In this research, we analyse the effect that cross-regional differences in prices of MC and RYO cigarettes have on the demand for these products. Unlike previous research which focused only on MC, and used within-country differences and household level data, we analyse own-price and cross-price elasticities of two products: MC and RYO, by exploring cross-regional differences and individual-level data.

Results suggest that MC prevalence varies significantly, from 19.8% in Albania to 44.5% in North Macedonia, while estimated elasticities suggest that s-regions that have 10% higher prices of MC have about 5% lower prevalence of MC use. However,

Table 6 Own-price and cross-price elasticity of MC smoking intensity†

	Mean price model				Median price model			
	Model 1†		Model 2†		Model 1		Model 2	
MC prices*	0.062	(0.205)	0.117	(0.170)	0.139	(0.194)	0.178	(0.164)
RYO prices*	−0.138	(0.124)	−0.126	(0.116)	−0.129	(0.086)	−0.098	(0.082)
Sociodemographic covariates‡	x		x		x		x	
Anti-smoking sentiment	x		x		x		x	
Smoking restrictions			x				x	

Source: authors' calculation based on the 2019 STC-SEE data.
*Dependent variable in the MC smoking intensity model is the natural logarithm of number of MCs smoked per day. Coefficients indicate the per cent change in MC smoking intensity resulting from the per cent change in MC and RYO prices.
†Model 1 includes control only for s-regional level for anti-smoking sentiment, while model 2 includes controls for both s-regional level for anti-smoking sentiment and smoking restriction.
‡Sociodemographic controls include the following characteristics: age (and its square), gender, education, labour market status, household size and household income category.
MC, manufactured cigarette; RYO, roll-your-own; STC-SEE, Survey on Tobacco Consumption in Southeastern European countries.

Table 7 Own-price and cross-price elasticity of RYO smoking intensity†

	Mean price model				Median price model			
	Model 1‡		Model 2‡		Model 1		Model 2	
MC prices	0.048	(0.437)	−0.121	(0.357)	0.302	(0.398)	0.189	(0.339)
RYO prices	−0.355**	(0.157)	−0.415**	(0.183)	−0.375**	(0.169)	−0.407**	(0.173)
Sociodemographic covariates§	x		x		X		x	
Anti-smoking sentiment	x		x		X		x	
Smoking restrictions			x				x	

Source: authors' calculation based on the 2019 STC-SEE data.
*** p<0.01, ** p<0.05, * p<0.1.
†Dependent variable in the RYO smoking intensity model is the natural logarithm of number of RYO cigarettes smoked per day. Coefficients indicate the per cent change in RYO smoking intensity resulting from the per cent change in MC and RYO prices.
‡Model 1 includes control only for s-regional level for anti-smoking sentiment, while model 2 includes controls for both s-regional level for anti-smoking sentiment and smoking restriction.
§Sociodemographic controls include the following characteristics: age (and its square), gender, education, labour market status, household size and household income category.
MC, manufactured cigarette; RYO, roll-your-own; STC-SEE, Survey on Tobacco Consumption in Southeastern European countries.

research finds no effects of MC prices on MC smoking intensity. This result can be due to low variability of MC smoking intensity (from 14.5 cigarettes per day in Bosnia and Herzegovina to 20.8 per day in Kosovo), which could prevent the demonstration of the price effects, as previous research suggested that the prices do have an impact on the smoking intensity in all countries in the SEE region.[1] Additionally, given the link between high prevalence and low prices of MCs, majority of MC smokers are located in the s-regions with low MC prices, and therefore the price differences between the MC smokers have lower variablity and fail to show the impact on MC intensity. On the other hand, RYO prices have no impact on the either MC prevalence or intensity of use.

The results further suggest that higher MC prices push smokers towards using RYO rather than MC. Smokers in the s-regions with 10% higher MC prices have a 12% higher likelihood of using RYO over MC. On the other hand, s-regional differences in RYO prices have no effect on this choice. Therefore, if prices of MC are high, smokers will opt to use RYO, regardless of its price, as RYO prices are much lower than MC prices (table 3). In other words, for a number of smokers that cannot afford MCs, RYO presents a cheaper option. This interpretation is further supported by other information from the STC-SEE data which suggests that 92.8% of RYO users state lower prices as a reason for smoking RYO. The intensity of RYO smoking depends on the RYO prices, but not on the prices of MC. In the s-regions with 10% higher prices, RYO users smoke about 3.5%–4% less. As RYO smokers are concentrated in regions with relatively higher MC prices (which have motivated them to switch to RYO in the first place), they are price sensitive to begin with and differences in s-regions in RYO prices affect their smoking intensity.

This study also shows the importance of the attitudes towards tobacco control policies and smoking restrictions in reducing smoking prevalence and intensity. This research finds strong evidence that if more people agree with tobacco price increases and if more smoking restrictions are in place, prevalence and intensity of smoking may be lower. Therefore, the research shows that price and non-price measures have an independent effect on reducing smoking prevalence and intensity.

Policy recommendations

Main research findings suggest three recommendations that could further decrease the smoking prevalence and intensity in the WB region.

1. Increasing excises on MC will, via increase of its prices, lead to lower MC prevalence. As MCs represent the largest share of the tobacco market by far, this measure is the most important for reducing smoking prevalence.
2. The excises on RYO should also be increased, but to a much larger extent, to eliminate the price discrepancy between MC and RYO. RYO is typically used as a cheaper alternative to MC and if the prices of the two products are equal, MC smokers will, instead of switching to RYO as a cheaper alternative, stop using tobacco products altogether. Higher excises and prices of RYO would also lower the intensity of RYO use.
3. Since non-price factors have an independent and additional effect on reducing tobacco use, the governments should combine increasing taxes on tobacco products with non-price measures, such as introducing stricter smoking restrictions, raising public awareness of the health harms of smoking and working further to encourage positive attitudes towards tobacco control measures.

What this paper adds

- ⇒ Previous research for low/middle-income countries indicate manufactured cigarette (MC) price elasticities cluster around −0.5, while elasticities in Western Balkan (WB) region vary from −0.387 in Kosovo to −1.065 in Montenegro.
- ⇒ This research contributes to the literature by:
  - ⇒Analysing both roll-your-own (RYO) and MC price elasticities as the most frequently used tobacco products.
  - ⇒Presenting first evidence of the cross-price elasticities in the WB region.
  - ⇒Using cross-country variation in prices and consumption and individual-level data (not available in the WB region before).
- ⇒ This research provides evidence that:
  - ⇒MC prevalence varies significantly and statistical regions ('s-regions') that have 10% higher prices of MC have about 5% lower prevalence of MC use.
  - ⇒MC prices have no effect on smoking intensity.
  - ⇒Higher MC prices push smokers towards using RYO rather than MC.
  - ⇒In the 's-regions' with 10% higher prices, RYO users smoke about 3.5%–4% less.

LIMITATIONS

One of the limitations of the study is the nature and missing values of the income variable. Income variable is collected based on a scale of 11 income categories which limits the transformation possibilities of the variable, most importantly it limits recalculating the variable so that it is presented in PPP values. As income variable was not converted into PPP values, correcting prices for the PPP values would result in underestimation of the differences between the countries in cigarettes' affordability. Additionally, for about 2000 out of 7000 respondents, information about the income level is missing, and the impuation procedure was used to avoid sample attrition (explained in detail in online supplemental appendix B). The results presented in online supplemental table B2 in the online supplemental appendix B suggest that the same conclusions would be reached if no imputation procedure was applied and only respondents who reported income were included in the estimations.

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APPENDIX A:

Table A1 – Unit value averages by statistical regions (used as prices in s-regions)

region	sample size	median price	mean price	sample size	median price	mean price
East Vojvodina	74	2.31	2.39	16	1.77	2.44
West Vojvodina	112	2.35	2.46	20	0.92	1.10
Beograd	119	2.35	2.47	11	0.84	1.25
West Serbia	122	2.27	2.31	7	0.36	1.53
Central Serbia	121	2.27	2.28	8	2.10	1.99
South-East Serbia	104	2.18	2.23	10	0.72	0.98
North Albania	48	2.10	2.18	15	0.74	0.89
Central Albania	84	2.03	2.27	17	0.98	1.80
South Albania	48	2.03	2.18	20	0.69	0.94
Skopje	126	1.46	1.75	16	1.67	1.82
Eastern NM	140	1.38	1.49	12	0.36	1.29
Western NM	162	1.46	1.55	16	0.92	1.45
Vardar	28	1.38	1.48	5	0.36	0.40
Center MNE	167	1.50	1.87	5	1.00	1.00
North MNE	116	1.50	1.80	14	0.92	1.83
South MNE	111	2.20	2.14	3	1.00	1.22
Brcko	9	1.82	2.03	0	-	-
NorthEast RS	58	2.55	2.58	11	0.73	0.96
West RS	79	2.82	2.90	4	0.57	0.67
North FBIH	107	2.55	2.59	18	0.73	0.98
South FBIH	94	2.66	2.72	20	1.37	1.69
West Kosovo	120	2.00	2.16	3	0.75	0.73
East Kosovo	179	2.00	2.19	7	1.71	2.02

Table A2 – Descriptive statistics of the variables used in regression estimates

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
MC prevalence	7,006	0.36	0.48	0	1
RYO prevalence	7,006	0.05	0.21	0	1
MC intensity	2,527	2.48	0.91	-1.25	4.38
RYO intensity	325	2.28	1.09	-1.95	4.38
log price (MC, mean)	7,006	0.77	0.16	0.39	1.07
log price (RYO, mean)	7,006	0.70	0.20	0.32	1.04
log price (MC, median)	7,006	0.36	0.26	-0.12	0.89
log price (RYO, median)	7,006	-0.04	0.35	-1.03	0.74
Age	7,006	45.18	17.08	18	85
Female	7,006	0.54	0.50	0	1
Education – Primary (base category)					
Secondary	6,978	0.54	0.50	0	1
Teritary	6,978	0.24	0.43	0	1
Labour market status – Employed (base category)					
Unemployed	6,925	0.13	0.34	0	1
Inactive	6,925	0.36	0.48	0	1
Household size	7,006	3.60	1.80	1	15
Personal income category - 1 (base category)					
Personal income category = 2	6,981	0.44	0.50	0	1
Personal income category = 3	6,981	0.19	0.39	0	1
Supports price increase (regional average)	7,006	2.00	0.19	1.69	2.32
Smoking not allowed at home (regional average)	7,006	0.56	0.19	0.29	0.91

Table A3 –Own- and cross-price elasticity of MC and RYO prevalence – Bivariate probit estimate

	Model 1 - Mean prices				**Model 1 - Median prices**				**Model 2 -Mean prices**				**Model 2 - Median prices**			
VARIABLES	MC		RYO		MC		RYO		MC		RYO		MC		RYO	
log price (MC, mean)	-0.438**	(0.229)	0.429*	(0.280)					-0.537**	(0.235)	0.531**	(0.252)				
log price (RYO, mean)	0.219	(0.197)	-0.081	(0.235)					0.176	(0.168)	-0.038	(0.234)				
log price (MC, median)					-0.393**	(0.173)	0.322	(0.288)					-0.451**	(0.203)	0.395*	(0.261)
log price (RYO, median)					0.053	(0.124)	0.054	(0.187)					0.027	(0.115)	0.077	(0.178)
Age	0.045***	(0.008)	0.097***	(0.013)	0.045***	(0.008)	0.097***	(0.013)	0.044***	(0.009)	0.098***	(0.013)	0.044***	(0.009)	0.098***	(0.013)
Age squared	-0.001***	(0.000)	-0.001***	(0.000)	-0.001***	(0.000)	-0.001***	(0.000)	-0.001***	(0.000)	-0.001***	(0.000)	-0.001***	(0.000)	-0.001***	(0.000)
Female	-0.159*	(0.085)	-0.430***	(0.101)	-0.159*	(0.084)	-0.432***	(0.100)	-0.171*	(0.091)	-0.424***	(0.101)	-0.172*	(0.090)	-0.425***	(0.101)
Education, Primary, omitted																
Education, Secondary	0.058	(0.051)	-0.165**	(0.065)	0.055	(0.052)	-0.165***	(0.063)	0.038	(0.051)	-0.149**	(0.068)	0.034	(0.051)	-0.148**	(0.067)
Education Teritary	-0.118*	(0.065)	-0.361***	(0.120)	-0.118*	(0.064)	-0.367***	(0.116)	-0.109	(0.066)	-0.365***	(0.116)	-0.109*	(0.065)	-0.370***	(0.112)
Employed, omitted																
Unemployed	-0.125	(0.078)	0.392***	(0.109)	-0.121	(0.079)	0.388***	(0.114)	-0.132*	(0.077)	0.396***	(0.110)	-0.129*	(0.077)	0.393***	(0.114)
Inactive	-0.264***	(0.054)	0.124	(0.142)	-0.260***	(0.056)	0.119	(0.145)	-0.273***	(0.052)	0.137	(0.144)	-0.270***	(0.052)	0.135	(0.146)
Household size	-0.034***	(0.012)	-0.044*	(0.024)	-0.031**	(0.013)	-0.045*	(0.024)	-0.030**	(0.012)	-0.046*	(0.024)	-0.027**	(0.013)	-0.047*	(0.024)
Pers inc cat = 1, omitted																
Personal income category = 2	0.132**	(0.064)	-0.056	(0.098)	0.139**	(0.067)	-0.066	(0.100)	0.107*	(0.059)	-0.036	(0.095)	0.112*	(0.061)	-0.043	(0.096)
Personal income category = 3	0.207**	(0.086)	-0.163	(0.108)	0.214**	(0.090)	-0.169	(0.111)	0.168**	(0.078)	-0.131	(0.102)	0.171**	(0.079)	-0.134	(0.103)
Supports price increase	-0.483**	(0.204)	-0.541*	(0.288)	-0.474**	(0.215)	-0.539*	(0.287)	-0.482**	(0.202)	-0.569**	(0.279)	-0.485**	(0.219)	-0.556**	(0.276)
Smoking not allowed at home									-0.344	(0.217)	0.289	(0.233)	-0.361	(0.244)	0.313	(0.228)
Constant	0.313	(0.497)	-2.867***	(0.538)	0.301	(0.552)	-2.775***	(0.634)	0.627	(0.619)	-3.097***	(0.593)	0.598	(0.668)	-3.002***	(0.670)
rho	-0.202***	(0.047)			-0.204***	(0.046)			-0.200***	(0.047)			-0.202***	(0.046)		
Observations	6,910				6,910				6,910				6,910			

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A4 – Own- and cross-price elasticity of a choice model and conditional RYO prevalence model

	Choice model - Smokes RYO (vs. Smoking MC)								**Conditional RYO prevalence model - Smokes RYO (vs. Non-smoking)**							
	Mean prices				**Median prices**				**Mean prices**				**Median prices**			
VARIABLES	**Model 1**		**Model 2**		**Model 1**		**Model 2**		**Model 1**		**Model 2**		**Model 1**		**Model 2**	
log price (MC, mean)	1.481**	(0.672)	1.814***	(0.665)					0.632	(0.704)	0.791	(0.618)				
log price (RYO, mean)	-0.355	(0.653)	-0.261	(0.606)					0.032	(0.534)	0.108	(0.552)				
log price (MC, median)					1.197*	(0.644)	1.479**	(0.634)					0.363	(0.756)	0.461	(0.697)
log price (RYO, median)					0.064	(0.388)	0.110	(0.347)					0.130	(0.447)	0.168	(0.450)
Age	0.202***	(0.034)	0.209***	(0.036)	0.199***	(0.033)	0.207***	(0.035)	0.286***	(0.036)	0.286***	(0.036)	0.285***	(0.036)	0.285***	(0.036)
Age squared	-0.002***	(0.000)	-0.002***	(0.000)	-0.002***	(0.000)	-0.002***	(0.000)	-0.003***	(0.000)	-0.003***	(0.000)	-0.003***	(0.000)	-0.003***	(0.000)
Female	-0.882***	(0.194)	-0.818***	(0.202)	-0.886***	(0.192)	-0.819***	(0.199)	-1.324***	(0.296)	-1.325***	(0.298)	-1.323***	(0.295)	-1.324***	(0.297)
Education, Primary, omitted																
Education, Secondary	-0.513***	(0.181)	-0.461**	(0.195)	-0.509***	(0.177)	-0.455**	(0.192)	-0.503***	(0.136)	-0.480***	(0.151)	-0.501***	(0.133)	-0.478***	(0.148)
Education Teritary	-0.538	(0.349)	-0.543*	(0.328)	-0.554*	(0.334)	-0.554*	(0.320)	-0.855**	(0.373)	-0.855**	(0.370)	-0.863**	(0.362)	-0.861**	(0.359)
Employed, omitted																
Unemployed	0.737***	(0.237)	0.738***	(0.232)	0.728***	(0.246)	0.729***	(0.240)	0.717**	(0.278)	0.722***	(0.279)	0.721**	(0.291)	0.729**	(0.292)
Inactive	0.474	(0.370)	0.526	(0.366)	0.464	(0.383)	0.519	(0.374)	0.178	(0.368)	0.195	(0.366)	0.179	(0.362)	0.198	(0.362)
Household size	-0.131**	(0.052)	-0.142***	(0.053)	-0.136**	(0.053)	-0.146***	(0.055)	-0.194***	(0.040)	-0.197***	(0.042)	-0.197***	(0.041)	-0.200***	(0.042)
Pers inc cat = 1, omitted																
Personal income category = 2	-0.259	(0.220)	-0.206	(0.204)	-0.278	(0.228)	-0.226	(0.212)	-0.093	(0.234)	-0.061	(0.226)	-0.097	(0.237)	-0.065	(0.228)
Personal income category = 3	-0.924***	(0.280)	-0.844***	(0.262)	-0.927***	(0.287)	-0.848***	(0.264)	-0.701**	(0.297)	-0.655**	(0.279)	-0.698**	(0.305)	-0.650**	(0.282)
Supports price increase	-0.430	(0.827)	-0.493	(0.824)	-0.425	(0.852)	-0.456	(0.852)	-1.449**	(0.703)	-1.508**	(0.704)	-1.425**	(0.711)	-1.458**	(0.703)
Smoking not allowed at home			0.981	(0.640)			1.043	(0.694)			0.435	(0.497)			0.416	(0.489)
Constant	-6.676***	(1.804)	-7.594***	(2.114)	-6.408***	(2.052)	-7.349***	(2.320)	-5.607***	(1.453)	-5.910***	(1.510)	-5.376***	(1.634)	-5.640***	(1.655)
Observations	2,667		2,667		2,667		2,667		4,425		4,425		4,425		4,425	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A5 – Own- and cross-price elasticity of MC intensity and RYO intensity models

	MC intensity model								**RYO intensity model**							
	Mean prices				**Median prices**				**Mean prices**				**Median prices**			
VARIABLES	**Model 1**		**Model 2**		**Model 1**		**Model 2**		**Model 1**		**Model 2**		**Model 1**		**Model 2**	
log price (MC, mean)	0.062	(0.205)	0.117	(0.170)					0.048	(0.437)	-0.121	(0.357)				
log price (RYO, mean)	-0.138	(0.124)	-0.126	(0.116)					-0.355**	(0.157)	-0.415**	(0.183)				
log price (MC, median)					0.139	(0.194)	0.178	(0.164)					0.302	(0.398)	0.189	(0.339)
log price (RYO, median)					-0.129	(0.086)	-0.098	(0.082)					-0.375**	(0.169)	-0.407**	(0.173)
Age	0.021***	(0.006)	0.018***	(0.007)	0.021***	(0.006)	0.018***	(0.006)	0.005	(0.003)	0.005*	(0.003)	0.005	(0.003)	0.006*	(0.003)
Age squared	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)								
Female	-0.267***	(0.036)	-0.288***	(0.035)	-0.264***	(0.037)	-0.284***	(0.034)	-0.225*	(0.125)	-0.254*	(0.137)	-0.222*	(0.120)	-0.247*	(0.128)
Education, Primary, omitted																
Education, Secondary	-0.022	(0.043)	-0.043	(0.043)	-0.013	(0.040)	-0.035	(0.039)	0.013	(0.120)	-0.003	(0.124)	0.010	(0.127)	-0.006	(0.129)
Education Teritary	-0.127	(0.089)	-0.131	(0.087)	-0.116	(0.078)	-0.122	(0.077)	-0.027	(0.250)	-0.046	(0.245)	0.016	(0.225)	0.002	(0.221)
Employed, omitted																
Unemployed	0.026	(0.050)	0.028	(0.050)	0.024	(0.051)	0.027	(0.051)	0.069	(0.127)	0.069	(0.121)	0.061	(0.125)	0.062	(0.119)
Inactive	-0.005	(0.050)	-0.007	(0.050)	-0.006	(0.050)	-0.008	(0.050)	0.078	(0.141)	0.029	(0.116)	0.063	(0.138)	0.014	(0.119)
Household size	0.045***	(0.014)	0.045***	(0.014)	0.044***	(0.013)	0.044***	(0.013)	0.029	(0.041)	0.027	(0.038)	0.024	(0.040)	0.022	(0.037)
Log hh income per capita	0.149**	(0.061)	0.123**	(0.053)	0.143**	(0.059)	0.119**	(0.050)	0.102	(0.122)	0.079	(0.113)	0.094	(0.115)	0.074	(0.107)
Supports price increase	0.033	(0.152)	-0.029	(0.125)	0.024	(0.137)	-0.038	(0.114)	-0.348**	(0.166)	-0.367**	(0.181)	-0.363**	(0.150)	-0.384**	(0.164)
Smoking not allowed at home			-1.642***	(0.620)			-1.561**	(0.636)			-0.501	(0.380)			-0.460	(0.333)
Constant	1.480***	(0.482)	1.929***	(0.362)	1.430***	(0.497)	1.881***	(0.361)	2.858***	(0.746)	3.461***	(0.813)	2.626***	(0.707)	3.126***	(0.733)
Observations	2,481		2,481		2,481		2,481		322		322		322		322	

Robust standard errors in parentheses
** p<0.01, ** p<0.05, * p<0.1 *

APPENDIX B Imputation procedure for the income variable

The master questionnaire includes a scale of 12 income categories and is expressed in euros. During the data collection process these intervals were transformed to local currencies, and the respondents chose based on local currensy intervals.

Out of 7,000 respondents, income data was missing for 2,054. In order to avoid sample attrition, we have implemented the imputation procedure. Given there was only one variable for which the impuation is necessary, and given that this varialbe is a covariate rather than the main variable in the model, we opted to use a simple imputation procedure based on the regression prediction. Given the large number of cateogries, imputation procedure was implemented on the basis of a OLS model. Although income variable is measured on a Likert type scale (11 categories), which produces ordinal type variable, measurement literature (e.g., Norman, 2010; Brown, 2011) suggests that OLS does not differ in results or conclusions when compared to oprobit model. Table B1 bellow shows the comparison results between the two models.

We use the predictors that have proven to be singificant: age, gender, education level, labour market status, household size, number of adults in the household and the set of s-regional dummy variables. The OLS model indicated R square values of about 0.45 indicating a high prediction power of the set of variables used. After a linear prediction of income variable we round the prediction result to a nearest integer.

References

Brown, J.D., 2011. Likert items and scales of measurement. Shiken 15 (1), 10–14 .

Norman, G., 2010. Likert scales, levels of measurement and the “laws ”of statistics. Adv. Health Sci. Educ. 15 (5), 625–632 .

Table B1 Results from the income prediction procedure

VARIABLES	Oprobit	se	OLS	se
Age	-0.004**	(0.001)	-0.007**	(0.003)
Female	-0.020	(0.032)	-0.079	(0.069)
Labour market status:				
Employee in the public sector (omitted)				
Employee in the private sector	-0.174***	(0.052)	-0.386***	(0.113)
Self Employed / Agriculture workers	-0.470***	(0.084)	-1.062***	(0.181)
Occasional/ part-time worker	-0.811***	(0.110)	-1.698***	(0.235)
Student	-0.577***	(0.089)	-1.176***	(0.191)
Houseworker	-0.944***	(0.075)	-2.010***	(0.158)
Retired	-0.847***	(0.066)	-1.762***	(0.139)
Unemployed, able to work	-1.269***	(0.067)	-2.538***	(0.140)
Unemployed, unable to work	-1.432***	(0.133)	-2.550***	(0.267)
Refused	-0.681**	(0.291)	-1.158*	(0.618)
Level of education:				
No education (omitted)				
Incomplete primary school	0.324*	(0.181)	0.412	(0.359)
Primary school completed	0.596***	(0.165)	0.790**	(0.326)
Incomplete secondary school	0.669***	(0.184)	0.775**	(0.368)
Three-year professional school	0.769***	(0.169)	0.778**	(0.334)
Four-year professional school	1.064***	(0.167)	1.452***	(0.329)
Gymnasium	1.135***	(0.169)	1.620***	(0.335)
Higher school/College	1.341***	(0.176)	2.080***	(0.351)

University	1.629***	(0.170)	2.764***	(0.335)
Post Graduate (Magistracy, Doctorate)	2.112***	(0.200)	4.091***	(0.407)
Statistical region (s-region)				
Belgrade (omitted)				
Central and West Srbija	-0.533***	(0.094)	-1.175***	(0.203)
South and East Serbia	-0.609***	(0.112)	-1.362***	(0.241)
Vojvodina	-0.249***	(0.095)	-0.454**	(0.205)
Berat	-1.541***	(0.176)	-2.898***	(0.360)
Diber	-1.703***	(0.187)	-3.380***	(0.385)
Durres	-0.946***	(0.137)	-2.000***	(0.290)
Elbasan	-1.680***	(0.137)	-3.239***	(0.281)
Fier	-1.374***	(0.136)	-2.697***	(0.285)
Gjirokaster	-1.040***	(0.222)	-2.330***	(0.472)
Korce	-1.224***	(0.143)	-2.687***	(0.302)
Kukes	-0.943***	(0.209)	-2.164***	(0.445)
Lezhe	-1.912***	(0.174)	-3.764***	(0.357)
Shkoder	-1.592***	(0.146)	-3.189***	(0.302)
Tirane	-0.897***	(0.106)	-2.024***	(0.226)
Vlore	-1.204***	(0.180)	-2.473***	(0.374)
Vardar	-0.615***	(0.139)	-1.491***	(0.299)
Eastern MAC	-0.670***	(0.132)	-1.642***	(0.285)
Southwestern MAC	-1.090***	(0.134)	-2.479***	(0.285)
Southeastern MAC	-0.337**	(0.169)	-0.795**	(0.364)
Pelagonia	-0.826***	(0.134)	-1.899***	(0.287)
Polog	-0.838***	(0.124)	-2.056***	(0.267)
Northeastern MAC	-1.527***	(0.155)	-2.887***	(0.317)
Skopje	-0.953***	(0.107)	-2.237***	(0.229)
Center MNE	-0.127	(0.092)	-0.254	(0.199)
North MNE	-0.843***	(0.099)	-1.689***	(0.212)
South MNE	0.327***	(0.103)	0.896***	(0.223)
Federacija BiH	-0.104	(0.097)	-0.119	(0.210)
Republika Srpska	-0.520***	(0.109)	-1.199***	(0.235)
Br?ko Distrikt	-0.016	(0.257)	-0.263	(0.557)
Urosevac	-0.801***	(0.162)	-1.839***	(0.347)
Djakovica	-0.432**	(0.169)	-1.257***	(0.365)
Gnjilane	-0.364*	(0.192)	-0.840**	(0.415)
Mitrovica	-0.781***	(0.120)	-1.426***	(0.257)
Pec	-1.396***	(0.129)	-2.883***	(0.273)
Pristina	-0.711***	(0.108)	-1.605***	(0.232)
Prizren	-0.349***	(0.113)	-0.894***	(0.243)
Household size	0.051***	(0.016)	0.088**	(0.034)
Number of adult (15+)	0.214***	(0.020)	0.439***	(0.043)

Table B2 (: Own- and cross-price elasticity of MC and RYO prevalence (biprobit model)

With imputed income (n = 6,910), results presented in the paper in table 4

		Model 1				Model 2			
		Mean price model		Median price model		Mean price model		Median price model	
Probability of smoking MC (outcome 2)	MC price	-0.492**	(0.243)	-0.437**	(0.182)	-0.605**	(0.254)	-0.504**	(0.215)
	RYO price	0.237	(0.210)	0.052	(0.129)	0.190	(0.176)	0.024	(0.116)
Probability of smoking RYO (outcome 3)	MC price	1.102*	(0.598)	0.850	(0.602)	1.365**	(0.540)	1.034*	(0.541)
	RYO price	-0.260	(0.509)	0.098	(0.399)	-0.150	(0.496)	0.159	(0.367)

Without imputed income (n=4,929)

		Model 1				Model 2			
		Mean price model		Median price model		Mean price model		Median price model	
Probability of smoking MC (outcome 2)	MC price	-0.520**	(0.251)	-0.470**	(0.192)	-0.640**	(0.257)	-0.532**	(0.227)
	RYO price	0.332	(0.227)	0.056	(0.153)	0.265	(0.183)	0.018	(0.130)
Probability of smoking RYO (outcome 3)	MC price	1.147**	(0.578)	0.672	(0.597)	1.508***	(0.502)	0.883*	(0.533)
	RYO price	-0.015	(0.558)	0.311	(0.409)	0.164	(0.526)	0.397	(0.378)