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Economic Research Informing
Tobacco Taxation Policy

How Do Prices of Manufactured Cigarettes and Roll-Your-Own Tobacco Affect Demand for these Products?

Tobacco Price Elasticity in Southeastern Europe

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COGNOSCERE EST MUTARE

Institute of Economic Sciences

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Contents

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Executive summary

The Southeastern Europe (SEE) region is characterised by a high level of tobacco consumption and low prices of cigarettes (Zubović and Vladisavljević, 2019). The average price per pack of manufactured cigarettes in the region is about €2.1, more than half than European Union (EU) average of €4.9[1]. High tobacco consumption represents a significant economic burden on households in the region, especially given poverty rates in all of the countries studied. At the same time, the negative effects of tobacco consumption have long-lasting effects on health and well-being in general. Tobacco consumption has serious health consequences as approximately half of smokers die from tobacco-related diseases.[2]

Numerous studies indicate that tobacco taxation is one of the most important policies to reduce tobacco consumption (Chaloupka et al., 2012; NCI and WHO, 2016). The effectiveness of this policy depends on consumer responses to price increases. This report analyses the impact that tobacco prices have on prevalence and intensity of tobacco use (that is, tobacco price elasticity of demand) in six SEE countries: Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, and Serbia. A unique dataset from the Survey on Tobacco Consumption in SEE countries (STC-SEE) is used to investigate the impact that tobacco prices have on smoking prevalence and intensity.

STC-SEE data provides a nationally representative sample of the adult (18-85 years old) population for each country. In total, 7,000 respondents were interviewed. The data contain detailed information on tobacco consumption, cessation, expenditures, and prices as well as attitudes towards tobacco consumption, prices and control measures, access restrictions, exposure to tobacco advertising, and socio-demographic characteristics of the respondents. For the purpose of this research, STC-SEE data is divided into 23 statistical regions (s-regions).

According to STC-SEE data, smoking prevalence in the SEE region is very high – 37.6 percent, which is about nine percentage points higher than in the European average of about 29 percent.[3] Smoking prevalence in the SEE region differs significantly between the countries ranging from 24.7 percent in Albania to 48.9 percent in North Macedonia. Smokers typically smoke manufactured cigarettes (MC), as 32.8 percent of the adult population (between the ages of 18 and 85) uses MC. On the other hand, prevalence of roll-your-own tobacco (RYO) among the same population is much lower and it amounts to 6.3 percent on average. Other tobacco products have a negligible prevalence (less than 0.5 percent). On average, MC users smoke 16.5 cigarettes per day, while RYO users smoke 14.6 RYO cigarettes per day.

The main results of the research are as follows:

1) S-regions with higher prices of MC have lower MC use prevalence. Estimated elasticities suggest that s-regions that have 10 percent higher prices of MC have about 5 percent lower prevalence of MC use.

2) The results further suggest that higher MC prices push smokers towards using RYO over MC. S-regions with 10 percent higher MC prices have a 12 percent higher likelihood of

[1] https://ec.europa.eu/taxation_customs/sites/taxation/files/resources/documents/taxation/excise_duties/tobacco_products/rates/excise_duties-part_iii_tobacco_en.pdf
[2] https://cancercontrol.cancer.gov/brp/tcrb/monographs/21/docs/m21_complete.pdf
[3] http://www.euro.who.int/__data/assets/pdf_file/0009/422838/Tobacco-8-B-002.pdf?ua=1

using RYO over MC. Furthermore, according to STC-SEE data, 92.8 percent of RYO users cite lower prices as a reason for smoking RYO rather than MC. These findings suggest that RYO represents a cheaper option when MC are not affordable. Therefore, higher prices of RYO could reduce smoking prevalence, as it would discourage smokers from choosing RYO as a cheaper option.

3) Increasing RYO prices lowers RYO smoking intensity. In s-regions with 10 percent higher prices, RYO users smoke about 3.5-4 percent less RYO cigarettes per day.

4) Lower prevalence and intensity of tobacco use are associated with more smoking restrictions and support for tobacco price increases. These non-price factors have an independent and additional effect on reducing tobacco use prevalence and intensity.

Based on the research results, the policy recommendations are as follows:

- In order to reduce prevalence of MC use, governments should increase excises on these products. An increase in excises should lead to higher prices, which would then lead to lower MC prevalence. As MC represent the largest share of the tobacco market by far, this measure is the most important for reducing smoking prevalence in the SEE region.

- Since RYO are typically used as a cheaper alternative to MC, in order to reduce overall smoking prevalence, governments should increase the excises on RYO to a much higher level, so that RYO prices correspond to those of MC. In this way, MC smokers will stop using tobacco products altogether instead of switching to RYO as a cheaper alternative. Increasing excises (and consequently the prices) of RYO, would lower the intensity of RYO use.

- In order to reduce tobacco consumption, governments should combine price measures, such as increasing taxes on tobacco products, with non-price measures, such as introducing stricter smoking restrictions and enforcing penalties for not obeying to the to smoke free regulation, raising public awareness of the health harms of tobacco use, and strengthening positive attitudes toward tobacco control measures.

1. Introduction

Compared to the EU, SEE countries are characterised by high levels of tobacco consumption and low prices of cigarettes (Zubović and Vladisavljević, 2019). High tobacco consumption imposes a significant economic burden on households in the region, while at the same time, the negative effects of tobacco consumption have long-lasting effects on health and well-being in general. Numerous studies indicate that tobacco taxation is one of the most important policies to reduce tobacco consumption. The effectiveness of this policy depends on consumer responses to price increases, that is, price elasticities of demand for tobacco products.

Previous studies find negative tobacco price elasticities, typically ranging from -0.25 to -0.5 for high-income countries (Chaloupka et al., 2012), and clustering around -0.5 for low- and middle-income countries, although the estimates for the former are more variable (NCI and

WHO, 2016). Previous research by the SEE network,[4] focusing on within-country price elasticities of SEE countries, find negative elasticities ranging from -0.387 in Kosovo to -1.065 in Montenegro, with an average elasticity of about -0.712 (Zubović and Vladisavljević, 2019). The same study finds that in most of the countries studied, consumers respond to changes in the price of MC, both in terms of their decision to smoke and in terms of how many cigarettes they smoke. In scientific terms, both smoking prevalence and smoking intensity elasticities are statistically significant, with smoking intensity elasticity slightly more pronounced: average smoking intensity elasticity was estimated at -0.362, while average prevalence elasticity was -0.307. In other words, as prices of cigarettes increase by 10 percent, the number of cigarettes consumed decreases by 3.62 percent and smoking prevalence decreases by 3.07 percent.

In this research, price elasticities of two tobacco products MC and RYO are analysed by examining cross-country variation in prices and tobacco consumption and controlling for other relevant characteristics. Therefore, estimated elasticities are cross-country and more specifically, across s-regions within the countries studied. These elasticities indicate if differences in smoking prevalence and/or intensity depend on the differences in prices of MC and RYO.

The methodological framework of the two-part model, developed by Mullahy and Manning (Mullahy, 1998; Manning and Mullahy, 2001) is used. This model estimates the overall demand elasticity as a sum of two parts: prevalence elasticity and conditional demand (intensity) elasticity. Additionally, given that the consumption of the two tobacco products can be interlinked, this research: 1) estimates the cross-price elasticities of the products; and 2) uses the correlation of error terms across equations to improve the efficiency of the estimators.

This research utilizes a unique dataset from STC-SEE, conducted in September and October of 2019 on a sample of adults (18-85 years old) as a part of the project "*Accelerating Progress on Effective Tobacco Tax Policies in Low- and Middle-Income Countries*", and is largely based on the Global Adult Tobacco Survey (GATS) questionnaire. Additionally, the questionnaire includes questions from ITC (International Tobacco Control) and PPACTE (Pricing Policies and Control of Tobacco in Europe) questionnaires.

The main results of the research are the following: (1) higher prices of MC are associated with lower prevalence of MC use; (2) RYO is used as a cheaper alternative to MC; and (3) increasing prices of RYO tobacco lowers its use. The findings from the research suggest that in order to decrease smoking prevalence and intensity, governments should increase the excises, and consequently the prices of tobacco products, which would then lead to lower smoking prevalence. Since RYO are a cheaper alternative to MC, the increase of excises on RYO should be much 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.

[4] The Institute of Economic Sciences from Belgrade, Serbia is coordinating a regional network of researchers in Southeastern Europe on tobacco taxation. These countries include: Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, and Serbia. The project is funded by the University of Illinois at Chicago's (UIC) Institute for Health Research and Policy to conduct economic research on tobacco taxation in Serbia. UIC is a partner of the Bloomberg Initiative to Reduce Tobacco Use. The views expressed in this document cannot be attributed to, nor do they represent, the views of UIC, the Institute for Health Research and Policy, or Bloomberg Philanthropies.

The remaining part of the report is structured as follows. Section 2 describes the data used in the analysis, while Section 3 presents descriptive statistics and variables used. Section 4 describes the methodology, while Section 5 presents the results of the analysis. The report concludes with Section 6.

2. STC-SEE Data

STC-SEE used the same questionnaire in all countries surveyed through face-to-face interviews at respondents' homes using the Computer Assisted Personal Interviews (CAPI) methodology. The length of interview was approximately 30 minutes. The sample size was 1,000 respondents per country, apart from Serbia where 2,000 respondents were interviewed.[5] Along with detailed information on tobacco consumption, cessation, expenditures, and prices, STC-SEE provides information on attitudes towards tobacco prices and consumption, access restrictions, attitudes towards tobacco control measures, exposure to tobacco advertising, and socio-demographic characteristics of the respondents.

The sampling frame was based on countries' latest census and the sample was stratified within 3-stage probability samples. In the first stage, primary sampling units (PSUs) were selected randomly by probability proportional to the size of the region. In the second stage, 10 housing units in each PSU were randomly selected by a random route technique starting from the randomly selected address with a fixed, periodic interval (the sampling interval).

In the third stage, household members were randomly selected using a next birthday method. Post stratification of the data was performed by using the following variables for post-calibration: regions, type of residence (urban vs. rural), age, gender, and level of education. The data provide nationally representative samples of the adult (18-85 years old) population with representativity in terms of region, type of residence, age, gender, and level of education.

3. Variable definitions and descriptive statistics

3.1. Tobacco use prevalence and intensity

Prevalence for each of tobacco products is based on self-assessed smoking status.[6] Two tobacco products have a sufficient sample size of consumers to be analysed in a demand model: MC (2,527 people) and RYO (352 people). The prevalence of other products is very low, thus they are not included in the analysis.[7]

Table 1 presents the (weighted) prevalence of MC and RYO use by country. On average about 32.8 percent of the adult population in the SEE region smokes MC with significantly varying prevalences: from 19.8 percent in Albania to 44.5 percent in Macedonia. On the other hand, the prevalence of RYO use is 6.3 percent on average, ranging from 1.4 percent in Kosovo to 9.7 percent in Bosnia and Herzegovina. The overall prevalence of using either MC

[5] Data collection was coordinated by Deep Dive - a private, independent full-service social and market research consultancy. Deep Dive is an ESOMAR (European Society for Opinion and Marketing Research) member.

[6] The survey question asks: "For each of classic tobacco smoking products please indicate whether you are current smoker, former smoker, have tried once or more times but have never consumed it continually for 2-3 months or longer or you have never tried it".

[7] Electronic cigarettes 0.4 percent, Heated tobacco 0.4 percent, Smokeless tobacco 0.01 percent, Waterpipe with tobacco 0.6 percent.

or RYO is 37.6 percent - only slightly lower than the sum of prevalences of the two products, indicating a relatively small overlap in the 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%**

Note: In column "Total," the sum of MC and RYO prevalence does not add up to total prevalence, as smokers can smoke both products. Source: Author's calculation based on the STC-SEE data.

Smoking intensity is recorded in weekly use by MC and RYO. For easier presentation, intensity variables are transformed to daily levels (Table 2). On average, current MC users in the SEE region smoke 16.5 cigarettes per day, while RYO users smoke 14.4 cigarettes per day. Country differences in smoking intensity are less pronounced than differences in prevalence. Current MC users smoke from about 14.5 MC 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.[8]

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**

Note: Column "Total" represents the average of cigarettes (MC or RYO) smoked by an individual.
Source: Author's calculation based on the STC-SEE data.

3.2. Prices of tobacco products

Prices of tobacco products are calculated as s-regional averages (median) 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.[9] The s-regional averages are used for two

[8] Initial analysis suggests only one value in MC and RYO distibutions outside of of mean +- 5 standard deviations interval (outlier): 100 RYO cigarettes – replaced to 80 (tests are applied to check if some cases have a signfiicant influence on changing the regression coefficients).

[9] Although the data also contains information on prices of the last pack purchased, this study uses unit values of cigarettes as they correspond to the dependent variable: number of cigarettes smoked in one week. Additionally, although there is a question on the price of the last RYO pack purchased, the unit in grams for RYO is unknown, which makes this information unusable.

reasons. First, in order to estimate prevalence model, prices are needed for both smokers and non-smokers. Second, prices at the average (median) s-regional level give further argument to their exogeneity (which will be further discussed in the methods section). Mean and median prices are used to ensure utilization of the whole s-regional distribution of the unit (mean prices), but also to check the robustness of the results to the presence of extreme values (median prices).

Since the data on regions in STC-SEE are available at different levels of aggregation (NUTS 2, or other regions which are at country-specific levels), for the purpose of this research they are reorganized into 23 s-regions approximately equal in sample size.[10] In cases where the s-regional mean (median) is based on less than 10 observations, it is replaced with the national mean (median). According to STC-SEE data, the average price of the MC pack of 20 cigarettes in 2019 was about €2.2 (Table 3). The prices vary significantly: from €1.6 in Macedonia to €2.7 in Bosnia and Herzegovina (column MC mean, similar for s-regional median values of prices). On the other hand, the average estimated price of 20 RYO cigarettes[11] was about €1.50 with relatively smaller variation in mean or median prices. Detailed prices by s-region are presented in Table A1 in the Appendix.

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

Country	MC Mean	MC Median	RYO Mean	RYO Median
Albania	2.2	2.1	1.3	0.8
Bosnia and Herzegovina	2.7	2.6	1.2	0.9
Kosovo	2.2	2.0	1.6	0.9
Montenegro	1.9	1.7	1.6	1.0
North Macedonia	1.6	1.4	1.5	1.0
Serbia	2.4	2.3	1.5	1.2
SEE region	**2.3**	**2.1**	**1.4**	**1.0**

Source: Author's calculation based on the STC-SEE data.

Although in some previous research, authors estimating cross-country price elasticities have corrected the prices by purchasing power parity (e.g., Kostova et al., 2010), this study accounts for country differences in purchasing power by controlling for income level.[12]

3.3. First look at the link between the prices and tobacco consumption in SEE countries

Figure 1 presents the s-regional level correlation between tobacco prices and demand indicators. In general, all panels indicate a negative correlation between the prevalence and intensity of MC and RYO use and the prices of these products. Cross-s-regional correlations (based on 23 observations, one per s-region) suggest a negative correlation between product

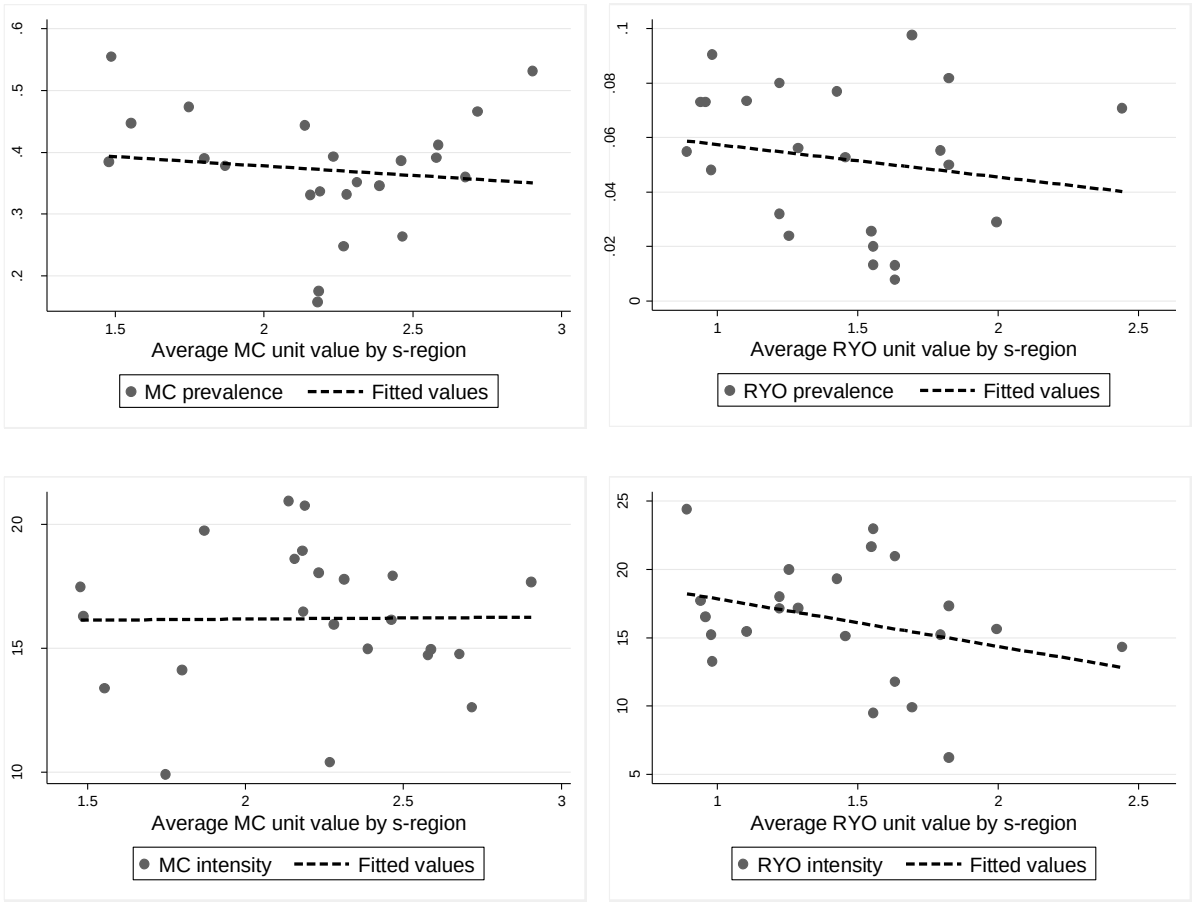
[10] Albania (North Albania, Center Albania, South Albania); BiH (Brcko, North-East RS, West RS, North FBIH, South FBIH); Kosovo (East Kosovo, West Kosovo); Montenegro (North MNE, Center MNE, South MNE); North Macedonia (West NM, East NM, Skopje, Vardar); Serbia (West Vojvodina, East Vojvodina, Belgrade, West Serbia, Central Serbia and South-East Serbia).

[11] Although RYO is not sold in 20-cigarette packs, in order to have the comparable level of prices for both products the study uses this unit for the RYO prices.

[12] An alternative strategy expresses both prices and income in purchasing power parity, however, the income variable in this survey is collected as interval, rather than ratio variable and therefore it cannot be adjusted in a meaningful way.

prices and prevalence: -0.12 for MC and -0.17 for RYO. The correlation between the prices and smoking intensity for MC is 0.02, while for RYO is negative, at -0.36. However, only the last correlation is statically significant, although this could be due to the small sample size.

Figure 1: Correlation between prices and smoking prevalence (top panel) and intensity (bottom panel)



Source: Author's calculation based on the STC-SEE data.

Evidence presented in Figure 1 is only a first step in the investigation of the link between tobacco prices and demand among the s-regions. In order to investigate this link in a more rigorous manner, econometric techniques will: 1) control for other factors that might affect tobacco demand aside from the prices; and 2) provide stronger evidence that tobacco prices have a causal impact on the demand of tobacco products.

4. Methodology: Estimation of price elasticity in the SEE region

4.1. Model of the price elasticity in SEE region

Tobacco consumption is characterized by a large proportion of non-smokers, 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 j = mc, ryo. (1)

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 their own budget constraints, and 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 so-called two-part model (Belotti et al., 2015). This particularly applies in the cases where y=0 is observed frequently, which is the case with cigarette use, as global smoking prevalence is around 21 percent (WHO, 2017), while the smoking prevalence in this sample is about 34 percent for cigarettes and about 5 percent for RYO (see Table 1).

Therefore, for both products two models are estimated:

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

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

where equations (2) represent prevalence, and equations (3) intensity models. Both of these equations are a system of two equations representing demand for two products: MC and RYO (notated by index j = mc, ryo). Both MC and RYO prices appear in models for both products, since they can be used as substitutes, and 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- and cross-price elasticities. Own-price elasticities are expected to be negative as higher prices are expected to decrease the prevalence and intensity of smoking. On the other hand, 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 (Karki et al., 2003; Kyaing, 2003; NCI, 2016; Kostova & Dave, 2015) even if coming from the same level of aggregation (Huang et al., 2018). 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 (Bishop et al., 2007; Mao et al., 2008; cf. NCI and WHO, 2016). The higher aggregation level is also one of the cornerstones in arguing the exogeneity of prices in Deaton's demand model (Deaton 1997). Finally, prices are not fully determined by market mechanisms for at least two reasons. Firstly, excise taxes have a large share in the price and are determined by the state. Secondly, prices in the SEE region are heavily influenced by the harmonization of prices with EU and therefore the demand decrease would not lead to a change in cigarette prices.

Equations (2) and (3) additionally control for the set of personal (X_{ri}), and household (H_{ri}) characteristics[13] as well as the set of local environment (LE_r) variables. Personal

[13] As only one individual per household is interviewed, household variables are effectively also on the individual (i) level.

characteristics include age, age squared, gender, level of education (three categories)[14], labour market status (three categories)[15], and marital status (single or married). On the other hand, the set of household characteristics includes household income group, 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.[16] Descriptive statistics of personal and household characteristics are presented in Table A2 in the Appendix.

The purpose of local environment (LE_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 (Kostova et al., 2010).[17] Given that STC-SEE data extensively measures attitudes on tobacco consumption there are several indicators available as controls for country heterogeneity. Starting from individual survey responses, s-regional-level indicators are constructed as s-regional averages.[18] The indicators are divided into three groups:[19]

1) *Attitudes towards tobacco control measures*: support for tobacco price increases (s-regional average (RA) for non-smokers (NS) and all participants (all))[20], usefulness of tobacco control measures (RA for NS and all), complaints to smokers about smoking behaviour (RA for smokers)[21];

2) *Smoking restrictions – permissions*: restrictions at home (RA for NS and all), frequency of people smoking in public places (university, public offices, etc.) and cafes/restaurants (RA for NS and all), restrictions for smoking (RA for smokers); and

3) *Tobacco advertising*: sponsored events (RA for NS and all) and tobacco promotion activities (RA for NS and all). Descriptive statistics of local environment indicators are presented in table A2 in Appendix.

[14] Three categories are: primary education (which includes ISCED groups 0 to 2), secondary education (ISCED groups 3 and 4), and tertiary (ISCED groups 5 to 8).

[15] Three categories are: employed (including agriculture, part-time, and occasional workers), unemployed, and inactive (including students, pensioners, and homemakers).

[16] 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 currensy 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.

[17] Although country-fixed effects can additionally be applied to account for the remaining unobserved country 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. Furthermore, introduction of the country-fixed effects increases the standard errors and distorts the signs of the coefficients. Therefore, the results with the country-fixed effects are omitted from the results section and are available upon request.

[18] S-regions are defined in Section 3.2.

[19] Initial estimates also included the effects of the s-regional proportions of the MC and RYO bought illegally, i.e. without stamps. The results show that these effects are not significant in any of the estimates and are therefore excluded from of the analysis

[20] In line with Kostova et al. (2010) this study uses the averages for non-smokers to avoid endogeneity issues. However, the impact of the overall average indicator was tested as it can be argued that smokers also contribute to the sentiment of the s-region.

[21] Only smokers are asked the question of whether they have received complaints about their smoking from other people.

4.2. Estimation strategy

S-regional-level cluster corrected standard errors 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 standard errors to control for potential heteroscedasticity in both parts of the model.

As the decisions to smoke MC and RYO are potentially connected, correlation of errors across equations can be used to improve the precision (that is, efficiency) of the estimators (although individual equations also yield consistent estimates). In other words, in addition to correlation across individuals and statistical regions (controlled by cluster and heteroscedasticity-robust standard errors) there is a possibility to exploit the cross-correlation of the error terms for the same individual (*i*) in two equations in order to reduce the standard errors of the estimates. In order to account for the correlation across the individuals, this study uses a bivariate probit model (Cameron and Trivedi, 2010; p. 530), rather than individual logit models to estimate prevalence elasticities. Furthermore, the specification of the simple logit regressions for MC and RYO ignores that when these two products are considered, individuals face the decision between four outcomes: 1) not smoking; 2) smoking MC only; 3) smoking RYO only; and 4) smoking both products.[22] The bivariate probit model estimates the associated probabilities of these four outcomes based on two probit equations and the correlation between their residuals.

The dependent variable in intensity models (Equation 3) is typically represented in log form as it helps to stabilize non-constant error variance. A standard practice in health economics in this case is to use the Generalized Linear Model (GLM) with gamma family and a log link function. This method has been proposed as a more robust alternative to a log regression specification (Manning et al., 2005). In this situation, GLM is the preferred model as the Ordinary Least Squares (OLS) estimator requires retransformation which can cause a prediction bias.

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 percent of MC users use RYO at the same time (72 out of 2,527). Therefore, estimation within a seemingly unrelated equations framework could be biased due to misspecification of the RYO model, whose distribution would then include a high share of zero values. The stability of the coefficients for the MC intensity equation will be tested by dropping individuals who consume both MC and RYO from the sample and re-estimating the equation. A similar approach is applied to the RYO intensity equation as 22 percent of RYO users use MC at the same time (72 out of 352).

5. Results

5.1. Prevalence models

The results of estimated effects of MC and RYO prices on smoking MC (outcome 2), and smoking RYO (outcome 3)[23] are presented in Table 4 (full estimates in Table A3 in the

[22] When described in this way the estimation sample consists of 4,226 non-smokers, 2,455 users of manufactured cigarettes, 253 users of RYO, and 72 people using both products.

[23] 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.

Appendix). The model is estimated by using both mean and median price. Model 1, next to prices and socio-demographic 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.[24] The correlation between the residuals in two equations is significant (in all the specifications), confirming a strong link between the prevalences of the two products.

MC prevalence

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 percent higher prices of MC have about 5 percent lower prevalence of MC use. The effect of RYO prices on MC use, in other words, cross-price elasticity, is insignificant, indicating that price of RYO does not affect MC use 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 (Table A3 in the Appendix).

Table 4: Own- 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)
Correlation		-0.202***	(0.047)	-0.204***	(0.046)	-0.200***	(0.047)	-0.202***	(0.046)
Socio-demogr. covariates		x		x		x		x	
Anti-smoking sentiment		x		x		x		x	
Restrictions				x				x	

Source: Author's calculation based on the STC-SEE data.

[24] After introducing each local environment variable succsesively, only two can at the same time: 1) lower the standard errors of the model; and 2) have the expected signs within the model. Additionally, variables that have increased the price elasticity to a significant proportion (by 50 percent or more) were not consiedered, as the idea of the use of the local enviorement vairables is to control for the overestimated impact of prices on demand.

RYO prevalence

RYO prices have no effect on RYO prevalence; that is, own-price elasticity for RYO is not significant. On the other hand, the effects of MC price on RYO prevalence (that is, cross-price elasticities) are inconclusive. Three out of four specifications' cross-price elasticities are significant, but only one at the 0.05 level (Table 6). In the significant specifications, the effect averages at approximately 1.1, indicating that countries with a 10 percent higher price of MC have about 11 percent higher likelihood of smoking RYO (compared to all other outcomes).

The interpretation of the effect of MC prices on RYO prevalence from the bivariate probit model is not straightforward and requires additional explanation. In this model, the dependent variable – RYO prevalence takes the value 1 if a person uses RYO and takes the value 0 if person does not use RYO. The latter group, besides those who do not smoke either MC or RYO, also includes MC users. Given that a significant number of MC users (37 percent) do not use RYO it is likely that the observed effect of MC prices on RYO prevalence is actually indicating the preference for RYO over MC in s-regions with relatively higher prices of MC.

To verify the validity of this assumption two separate logit models are estimated. The first model investigates the probability that the person will smoke only RYO (outcome 3 from the above categories) rather than only MC (outcome 2). In this model the determinants of the choice between two tobacco products are estimated. In the second model, the probability of choosing outcome 3 (smokes only RYO) rather than outcome 1 (does not smoke either) is estimated. This model effectively investigates the prevalence of RYO, conditional on non-smoking MC. Results of these two models are presented in Table 5.

Table 5: Own- and cross-price elasticity of a choice model and conditional RYO prevalence model

		Model 1				Model 2			
		Mean prices model		Median prices model		Mean prices model		Median prices 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)
Socio-demogr. covariates		x		x		x		x	
Anti-smoking sentiment		x		x		x		x	
Restrictions				x				x	

Source: Author's calculation based on the STC-SEE data.

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. This suggests that the effect of the MC price on the RYO prevalence stems from a choice between MC and RYO, rather than choosing to smoke RYO over not smoking either product. Therefore, smokers in s-regions

where MC prices are 10 percent higher relative to other s-regions have about 13 percent 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 to MC, all things equal, is higher for men, low-educated, unemployed, persons living in smaller households, and persons with lower income. Additionally, local environment variables are not significant in any of the specifications. Similar characteristics also separate RYO smokers from persons who do not smoke either tobacco products (Table A4 in the Appendix).

5.2. Intensity models

Intensity of MC use

The estimation of the MC intensity model via GLM[25] (Table 8, see detailed estimates in Table A5 in the Appendix) follows a similar estimation strategy as the one applied for the MC prevalence model. Results suggest that own-price elasticity for MC smoking intensity is insignificant, indicating that the differences in s-regional MC 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 to MC prevalence), which could prevent the effects of the prices from being demonstrated. The coefficient for RYO prices is also insignificant indicating that s-regional differences in RYO prices also have no impact on the intensity of MC use.[26]

Table 8: Own- 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)
Socio-demog. covariates	x		x		x		x	
Anti-smoking sentiment	x		x		x		x	
Smoking restrictions			x				x	

Source: Author's calculation based on the STC-SEE data.

On the other hand, all the models indicate that smoking intensity is lower for women as well as for younger and older smokers. Unlike MC prevalence, where personal income had a significant effect on prevalence (while household income had no impact), household income (per capita) plays a significant role in the intensity model (persons living in households with higher income per capita smoke more MC). Although the effect of the support for tobacco

[25] The Box-Cox test suggested that the adequate specification of the dependent variable is log. Although standard practice in health economics is to use GLM with gamma family and a log link function, the Modified Park test suggested that Poisson distribution should be used instead of gamma distribution as an approximation of the dependent variable variance. Results which use gamma family variance distribution suggest similar results and are available upon request. Furthermore, the linktest confirmed the correct specification of independent variables, while all the specifications also passed multicolinearity and Modified Hosmer-Lemeshow goodness of fit tests.

[26] The robustness test on the sample of smokers who use only MC (excluding those who smoke both MC and RYO) yields similar results (available upon request).

price increases is not significant, it is kept in the model for consistency. On the other hand, the average number of public places where people are seen smoking – which represents the compliance to smoking restrictions,[27] significantly decreases MC smoking intensity (Table A5 in the Appendix).

The intensity of RYO smoking

Similar to MC, the estimation of the price elasticities for RYO smoking intensity is estimated via GLM,[28] and the results are presented in Table 9 (detailed estimates in Table A5 in the Appendix). 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 (except Model 2 with country-fixed effects). This indicates that s-regions with 10 percent higher RYO prices have about 3.5-4 percent lower intensity of RYO smoking. On the other hand, in all specifications, the effect of MC prices, that is, the cross-price elasticity is insignificant, indicating that s-regional differences in MC prices do not have an effect on the intensity of RYO use.

Table 9: Own- 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)
Socio-demo. covariates	x		x		x		x	
Anti-smoking sentiment	x		x		x		x	
Smoking restrictions			x				x	

Source: Author's calculation based on the STC-SEE data.

Among other characteristics, female RYO smokers smoke less than men as well as younger users. Other socio-demographic characteristics seem to have little influence on the intensity of RYO use. Average s-regional support for tobacco price increases significantly decreases RYO smoking intensity, while the share of homes which do not allow smoking, representing smoking restrictions, has a negative, albeit insignificant effect (Table A5 in the Appendix).

6. Discussion and conclusions

In this research a unique database STC-SEE was used to investigate the impact that tobacco prices have on smoking prevalence and intensity. The research analyses the effect that prices of MC and RYO cigarettes have on their demand. According to STC-SEE data, smoking prevalence in the SEE region is very high, at 37.6 percent, which is about nine percentage

[27] As in all the countries smoking is prohibited in public places such as: government building or offices, health care facilities, public transportation, and universities and schools; this variable presents compliance to those restrictions.
[28] The Box-Cox test suggested that the adequate specification of the dependent variable is log. The Modified Park test suggested that gamma distribution as an approximation of the dependent variable variance. Furthermore, the linktest confirmed the correct specification of independent variables, while all the specifications also passed multicolinearity and Modified Hosmer-Lemeshow goodness of fit tests.

points higher than in the European average of about 29 percent.[29] At the same time, the average price per pack of manufactured cigarettes in the region is about €2.1, less than half the EU average of €4.9.[30] The prevalence in the SEE region varies significantly between the countries: from 24.7 percent in Albania to 48.9 percent in North Macedonia. Tobacco users typically smoke MC with adult prevalence of around 32.8 percent, while about 6.3 percent of the adult population uses RYO. Other tobacco products have a negligible prevalence (less than 0.5 percent).

Estimated elasticities suggest that s-regions that have 10 percent higher prices of MC have about 5 percent lower prevalence of MC use. Therefore, higher prices of MC reduce MC use prevalence. However, the 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 the previous research suggested that the prices do have an impact on the smoking intensity in all countries in the SEE region. On the other hand, MC prevalence varies significantly (from 19.8 percent in Albania to 44.5 percent in North Macedonia), therefore enabling effect of the prices to be visible. 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 percent higher MC prices have a 12 percent higher likelihood of using RYO over MC. S-regional differences in RYO prices have no effect on the choice, as prices of RYO are significantly lower than of MC in all s-regions. The interpretation of these results are as follows. 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 manufactured cigarettes, RYO presents a cheaper option. This interpretation is further supported by the STC-SEE data suggesting that 92.8 percent of RYO users state lower prices as a reason for smoking RYO.

The intensity of RYO smoking depends on the price of this product. In the s-regions with 10 percent higher prices, RYO users smoke about 3.5-4 percent less, while s-regional differences in MC prices do not have an effect on the intensity of RYO use.

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. This finding does not diminish the importance of price measures for smoking prevention. On the contrary, the research shows that price and non-price measures have an independent effect on reducing smoking prevalence and intensity.

7. Policy recommendations

Three policy recommendations result from the main research findings:

1. Increase prices (through higher excise) of MC to reduce its use prevalence. Governments should ensure the increase of prices of MC by increasing the excises on these products.

[29] http://www.euro.who.int/__data/assets/pdf_file/0009/422838/Tobacco-8-B-002.pdf?ua=1
[30] https://ec.europa.eu/taxation_customs/sites/taxation/files/resources/documents/taxation/excise_duties/tobacco_products/rates/excise_duties-part_iii_tobacco_en.pdf

As MC represent the largest share of the tobacco market by far, this measure is the most important for reducing smoking prevalence.

2. Increase prices (through higher excise) of RYO to eliminate the price discrepancy between MC and RYO, as RYO are typically used as a cheaper alternative to MC. The increase of the excise for RYO should be much higher than for MCs (from recommendation 1), so that after the increase RYO prices correspond to those of MC. 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. Combine price with non-price measures. Non-price factors have an independent and additional effect on reducing tobacco use prevalence and intensity. Therefore, in order to reduce tobacco consumption 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.

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Appendix

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

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