Effects of Tobacco Control Policies and Cigarette Pricing on Smoking Initiation Among Youth in Bosnia and Herzegovina

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ABSTRACT

Background

Tobacco smoking remains a significant public health concern worldwide. With more than 15 percent of youth being current smokers according to the 2018 and 2019 Global Youth Tobacco Surveys, Bosnia and Herzegovina stands out with one of the highest youth smoking rates in Europe. This high youth smoking rate necessitates an in-depth investigation into the factors influencing smoking initiation among youth.

Data and Methods

This study utilizes data extracted from the World Health Organization's Global Youth Tobacco Survey conducted in Bosnia and Herzegovina in 2018 and 2019. With a comprehensive sample size of 9,702 participants, the study deployed a split-population duration model to assess the relationship between tobacco price increases—realized through augmented excise taxes—and youth smoking initiation rates.

Results

The findings from the analysis highlight a pronounced negative association between tobacco price and youth smoking initiation, evidenced by a price elasticity of smoking initiation at -0.491. Additionally, exposure to anti-tobacco media campaigns showed a significant deterrent effect on youth smoking initiation. On the contrary, several factors were found to positively influence smoking initiation. These include parental smoking habits, peer influence, the prevalence of smoking within school environments, and the amount of disposable pocket money available to youth.

Conclusion

The results of this research underscore the potential of price strategies in reducing youth smoking initiation in Bosnia and Herzegovina. Price increases have a considerable impact on smoking initiation and contribute both directly and indirectly by decreasing peer and parental smoking prevalence. The negative correlation with anti-tobacco media campaigns further

supports utilizing such strategies as a tobacco control measure. However, the positive influence of parental and peer habits, school environment, and economic factors signifies the need for a multifaceted approach to comprehensively address the issue of tobacco use among youth. Policy makers are urged to consider these findings in formulating effective strategies to curb youth smoking rates in the region.

Keywords: Tobacco taxation, youth smoking initiation, tobacco control policies, youth smoking onset, Bosnia and Herzegovina

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LIST OF ABBREVIATIONS

GYTS – Global Youth Tobacco Survey

WHO – World Health Organization

CDC – Centers for Disease Control and Prevention

RS – Republic of Srpska

FB&H – Federation of Bosnia and Herzegovina

SPD – Split-population duration model

ITA – Indirect Taxation Authority

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INTRODUCTION

Smoking prevalence in Bosnia and Herzegovina (B&H)[1] is among the highest in the world. More than 41 percent of adults smoked in B&H in 2019 (Gligorić et al., 2023), significantly higher than the world average of 22.3 percent in 2020 (World Health Organization, 2021). The country also faces a worrying situation regarding youth smoking. According to the 2018 and 2019 Global Youth Tobacco Surveys (GYTS) conducted by the World Health Organization (WHO), 10.9 percent of students aged 13–15 in the Republic of Srpska (RS) and 24.2 percent in the Federation of Bosnia and Herzegovina (FB&H) were current tobacco smokers at the time of the survey (World Health Organization, 2018, 2019).

Preventing youth smoking is one of the focal points of tobacco control policies as it can create long-term positive effects for public health, particularly by decreasing the probability of individuals being smokers at later stages of life (Chaloupka & Wechsler, 1997; Lewit & Coate, 1982). According to Chen & Unger (1999), more than 80 percent of those who ever experiment with cigarette smoking do so before the age of 18. This was later confirmed in other studies, stating that adolescence is probably the key period of life for determining ones future smoking behavior outcomes (Chaim et al., 2019; Zhang et. al 2018; Green et al., 2014). Furthermore, those who start smoking early are at a much greater risk of becoming smokers as adults than those who first use cigarettes after the age of 18.

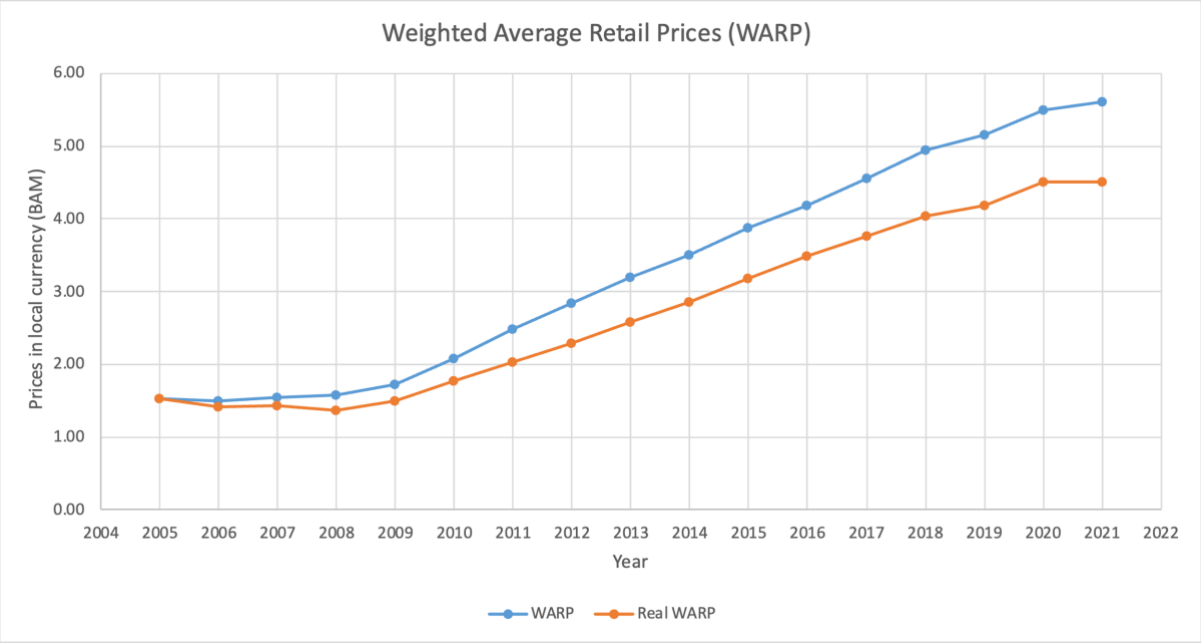
There is compelling evidence indicating an inverse relationship between the initiation of smoking among young people and the price of tobacco. Despite its addictive effect, tobacco is not immune to the basic economic law of demand, and price increases above inflation and economic growth—mainly achieved by increasing excise taxes—will produce slow, yet significant results (Chaloupka & Pacula, 1999; Chaloupka & Wechsler, 1997). Chaloupka and Pacula (1997) further argue that price increases will have more significant effects on youth than on adults, as youth tend to put more emphasis on the immediate effects of smoking (mainly financial) than on long-term negative health effects which are less heavily discounted by adults. A similar finding is also reported by Chaloupka & Wechsler (1997), who explain that—of the drop in cigarette consumption due to higher cigarette prices from tax increases—half would be

[1] B&H is divided into two main entities, Republic of Srpska (RS) and Federation of Bosnia and Herzegovina (FBiH), in addition to the municipality, Brčko District.

accounted for by reduced smoking participation overall, while the other half of the effect comes from reducing the amount smoked by those who continue smoking.

Revenue generated by the government in B&H from cigarette taxation comes from three separate charges: a specific excise tax, a percentage-based ad valorem tax, and a value-added tax. Since its implementation in the latter part of 2009, the specific excise tax has experienced an annual increase of approximately €0.077, which has driven the tax from €0.077 per pack in 2009 to €0.84 per pack in 2019 (Zubović et al., 2019). In contrast, the ad valorem excise tax has remained steady, accounting for 42 percent of the retail price. The resulting price increase is observed in Figure 1, below. The price increase trend slowed down in 2019 and the subsequent years due to the decision by B&H's Indirect Taxation Authority (ITA) to halt increases in the specific excise tax in 2019 once the European Union's required minimum was reached. This decision is concerning from both health and tax revenue perspectives.

Figure 1. Weighted average retail price of a 20-cigarette pack in Bosnia and Herzegovina



Source: Authors' calculations based on data from Bosnia and Herzegovina's ITA

While earlier studies have explored smoking in B&H and youth smoking in low- and middle-income countries, there is a gap in research specific to youth smoking in B&H. Even with GYTS, this area remains under-researched. Our work builds on the GYTS and combines it with socioeconomic elements, especially focusing on the nation's initiatives to tax tobacco and

enforce other tobacco control measures. Our study utilizes a survival analysis to estimate the effects of price increases on smoking initiation, as well as the effects of other factors, using the split-population duration model. This model has become common in the recent literature, as it overcomes some of the limitations of traditional probit and logit models.

The paper is structured as follows: section two reviews the literature; section three describes the methodological approach; and section four provides the results of the study, which is followed by a section discussing the results. The final section summarizes the main conclusions and recommendations.

LITERATURE REVIEW

There is a substantial body of research documenting the impacts of cigarette taxation on different aspects of smoking behavior. Forster and Jones (2001) examine tax elasticity in relation to the age of smoking onset and quitting. Their research, employing the split-population duration model (SPD), reveals a tax elasticity of 0.16 for men and 0.08 for women, regarding the age of initiating smoking, suggesting that higher prices delay initiation. With respect to quitting smoking, tax elasticity stands at -0.60 for men and -0.46 for women, suggesting that higher prices encourage quitting. Importantly, Forster and Jones (2001) also examine the effects of ethnicity and parental smoking status, both of which exhibit negative elasticities for initiating smoking and positive elasticities for quitting.

Nicolás (2002) explores the Spanish context, revealing that price increases exert a significant influence on smoking patterns. Interestingly, the effect of higher prices is more pronounced in decreasing the duration of smoking rather than deterring initiation. Nicolas (2002) utilizes the split-population duration model and advocates for national tax policies aimed at reducing disparities among cigarette varieties, as smokers who choose pricier categories often switch to lower-priced alternatives in response to tax and price increases. However, the impact on quitting is relatively modest, with price hikes in lower-priced categories primarily affecting duration of time up to quitting, while increasing the prices of higher tier cigarettes only directs consumption to lower tier ones.

Powell et al. (2005) utilize the probit model to explore multiple factors affecting smoking initiation in young individuals in the United States of America. Their research underscores the

significant negative effects of cigarette prices and youth access measures on the likelihood of starting smoking. Madden (2007) also investigates the impact of taxation on smoking initiation in Ireland using the split-population duration model. Interestingly, this study finds that taxation lacks significant effects when observing the total population. However, when focusing on smokers exclusively, a log-logistic duration model reveals a significant impact, with a coefficient of 0.532 for the natural logarithm of tax.

Carpenter and Cook (2008) contribute to this discourse by reporting noteworthy effects of price increments on youth smoking. Their research suggests that heightened prices not only reduce smoking prevalence, but also curtail the frequency of smoking, though with variations across age groups. An important finding is that price hikes induce so-called "light" smokers to quit and lead continuing smokers to reduce their consumption. Their study highlights a tax elasticity of teen smoking at -0.106.

Guindon (2014) uses a split-population duration model in Vietnam. He finds a substantial influence of wealth and peer smoking on both duration and participation. An increase in tobacco prices, both measured with an index or with prices of the most popular brands, delays smoking initiation.

Kostova et al. (2015) employ the split-population duration model across six low to lower-middle-income countries and eight upper-middle income countries to examine the role of price elasticity and find a price elasticity of -0.74 for initiation and 0.51 for cessation. However, in upper middle-income countries, including B&H, the price elasticity of initiation is considerably lower at -0.05 and lacks statistical significance. In terms of socioeconomic factors, being male holds statistical significance for hazard of initiation with a coefficient of 0.00970.

Gonzalez-Rozada and Montamat (2019) investigate the effects of price elasticity in Argentina, utilizing the split-population duration model. Their findings indicate a price elasticity of initiation ranging from -0.19 to -0.51, with a 10-percent price increase delaying smoking initiation by approximately two and a half years, based on a mean starting age of 15. Raising prices proves more effective in deterring or delaying smoking initiation compared to aiding cessation. Moreover, their study emphasizes gender differences, as the onset delay due to price increases is more pronounced among women than men.

Guindon et al. (2019) study the effects of tobacco control policies on Chile's school population. Their research, which includes a substantial sample of survey participants, shows that elevated

tobacco prices and the implementation of tobacco control measures are linked to reduced risks of starting to smoke. Price elasticity is estimated at -0.40, indicating that a one-percent increase in cigarette prices is linked to a 0.4-percent lower hazard of smoking onset. Notably, teenage boys exhibit greater responsiveness to price changes than teenage girls.

Dauchy and Ross (2019) employ a split-population duration analysis to study smoking initiation and cessation in Kenya. Their study indicates an inverse relationship between rising tobacco prices and the onset of smoking, with the impact being significantly more pronounced among young males compared to the general sample. The price elasticity of smoking initiation varies between -0.03 and -0.14, exhibiting a two- to three-fold greater effect on younger male adults. Furthermore, price increases correlate with increased cessation for younger males.

Merkaj et al. (2022) conduct a similar study in Albania using GYTS data and find that cigarette price increases reduce the likelihood of young individuals starting to smoke. Other significant factors that influence youth smoking initiation include peer smoking, as well as the presence of smokers in their households. Those whose close friends smoke, as well as those with one or both parents who smoke, have higher chances of becoming smokers themselves. Similar findings can be found in Madarasova Geckova et al. (2005) who show how peer smoking status in one of key predictors of ones future smoking behavior, as well as in Flay et al. (1994). Since price likely significantly affects both peer and parental smoking, the indirect effects of price are also likely to be strong when prices affect youth smoking behavior (Norton et al., 1998). Powell et al. (2005) call this effect a social multiplier, whereby increase in cigarette prices and taxes do not only directly affect the consumer, but also their parents and peers, whose consumption then decreases, affecting the consumption of the direct consumer.

These studies collectively contribute to our understanding of how cigarette taxation, pricing, and associated policies can shape smoking behaviors across diverse contexts.

DATA AND METHODOLOGY

The present study is based on GYTS individual-level survey conducted in 2018 in the Republic of Srpska (RS) (RS 2018 GYTS) and 2019 in the Federation of Bosnia and Herzegovina (FB&H) (FB&H 2019 GYTS). The GYTS is a cross-sectional database with data at a fixed moment in time for every respondent, the majority of whom are aged 13–15. The survey consists of information regarding tobacco use prevalence, cigarette access, and media impacts

on tobacco consumption. The RS 2018 GYTS covered 5,346 eligible students in grades 7–9 of primary school and the first year of secondary school. The overall response rate was 80.5 percent, with 78.9 percent of students aged 13–15. The FB&H 2019 GYTS covered 5,483 eligible students in grades 7–9 of primary school and the first year of secondary school. The overall response rate was 83.3 percent, with 74.32 percent of students aged 13–15.

To determine the impact of cigarette price increases on youth smoking initiation in B&H, we apply the split-population duration model (Douglas & Hariharan, 1994; Forster & Jones, 2001; Kidd & Hopkins, 2004; Göhlmann et al., 2010; Guindon, 2014; Kostova et al., 2015; Vellios & van Walbeek, 2016; Gonzalez-Rozada & Montamat, 2019; Stoklosa et al., 2022). The standard duration/survival models assume that all individuals eventually fail (that is, initiate smoking). In contrast, the SPD model assumes that a proportion of individuals will never experience failure. Basically, the SPD splits the population into two subgroups: one that never fails (that is, never experiences the event of interest) and one that will eventually fail, or will experience the event of interest.

The estimation of the SPD models results in two sets of coefficients. The first set refers to the probability of failure—that is, the probability that the event of interest will ever happen. The second is conditional on the probability of failure, and it refers to the estimation of the time when failure will occur. Next to these two sets of coefficients, the SPD model estimates the split parameter. This parameter reflects the mean probability of subjects experiencing the event of interest. The SPD model applied by Schmidt and Witte (1984, 1989) suffers from one serious drawback: it could include only time-invariant control variables. Forster and Jones (2001) deal with this drawback in their investigation of the impact of tax changes on the timing of people initiating smoking. For this purpose, they develop a version of the SPD that can include time-variant control variables.

The SPD model is a common tool, used by many researchers to investigate the impact of cigarette price increases on smoking initiation. To estimate the maximum likelihood with weights (w_i), we apply the following procedure (Asare et al., 2019; Stoklosa et al., 2022; Guindon, 2014; Gonzalez-Rozada & Montamat, 2019; Franco-Churruarin & Gonzalez-Rozada, 2021; Merkaj et al., 2022):

$$\ln(L) = \sum w_i \{ c_i ln\left[kz_i * f\left(t \middle| s_i = 1, x_i(t)\right)\right] + (1 - c_i) ln\left[1 - kz_i + kz_i * S\left(t \middle| s_i = 1, x_i\,(t)\right)\right]\}$$

where c_i=1 if individual *i* ever smoked; s_i=1 if individual *i* will eventually start smoking and 0 if they never do; z_i: time-invariant covariates; $x_i(t)$: time-varying covariates; k is the probability of smoking; $f\ (t|s_i=1, x_i(t))$ is the conditional density function of starting smoking at the observed starting age; $k*S(t|s_i=1, x_i(t))$ is the probability of starting after the age observed in the survey.

In SPD models, time runs differently for every subject. Therefore, time is defined as a number of years, starting with the year in which subjects start being at risk of experiencing the event of interest (i.e., start smoking) up until they eventually fail (i.e., start smoking), or up until the year in which the GYTS study is conducted, for those subjects that never fail (i.e., never start smoking) (Kostova, 2013). For this study, we set the risk age at eight.

We estimate the hazard of smoking initiation as a function of the real prices and a vector containing control variables: gender, parents' and friends' smoking status, income, anti-tobacco media presence, and smoking behavior inside or outside the school.

The variable "friends' smoking status" is a binary variable designed such that a value of 1 accounts for students with some, most, or all friends who smoke. It is used to capture the peer effect on smoking initiation. We conduct a sensitivity analysis to evaluate the effects in each specified scenario, essentially testing different versions of the peer variable (see Appendix). The "friends smoke – some" variable in Table A2 displays results for students with some friends who smoke; the "friends smoke – most" variable in Table A3, for students with most friends who smoke; and "friends smoke – all" variable in Table A4, for those where all friends smoke.

The variable that reflects individual-level affordability of cigarettes is represented by pocket money. This question has seven possible answers on which the continuous variable is created as described in Table 1. The variable on the anti-tobacco media presence is also a binary variable and captures the effect of any anti-tobacco media messages. It takes a value of 1 if the student hears any anti-tobacco media messages or 0 if they do not. Since smoking behavior within a school or in a school courtyard is among the most important variables among young people, it is also included in the model as a binary variable (0 denotes absence and 1 presence of smoking).

Variables and their description are presented in Table 1.

Table 1. Variables and their description

Variables	Source	Notes
Smoking status	GYTS database, 2018 and 2019	Derived from the question: Have you ever tried or experimented with cigarette smoking, even one or two puffs? Binary variable: smokes=1, 0 if otherwise.
Year when the survey was conducted	GYTS database, 2018 and 2019	Fixed value, 2018 and 2019
Age at the year when the survey was conducted	GYTS database, 2018 and 2019	
Age when first tried a cigarette	GYTS database, 2018 and 2019	
Gender	GYTS database, 2018 and 2019	Binary variable: female=1, male=0
Prices	ITA	Weighted average real prices for the 2009–2019 period
Parental smoking status	GYTS database, 2018 and 2019	Derived from the question: Do your parents smoke tobacco? Binary variable: 1 if one or both smoke, 0 if otherwise.
Friends' smoking status	GYTS database, 2018 and 2019	Derived from the question: Do any of your closest friends smoke tobacco? Binary variable: 1 if any friends smoke, 0 if otherwise. In the sensitivity analysis (Appendix), it takes a value of 1 if some (Table A2), most (Table A3), or all friends smoke (Table A4).
Pocket money	GYTS database, 2018 and 2019	Derived from the question: During an average week, how much money do you have that you can spend on yourself, however you want?

		This question has six possible answers, where one of them is (1) I usually don't have any spending money, and the rest of them are presented as an interval: (2) Less than 5 BAM, (3) 6–10 BAM, (4) 11–15 BAM, (5) 16–20 BAM, and (6) More than 20 BAM. We create a continuous variable by taking average values for points 2–5. Point six is taken as a fixed value of 25 BAM.
Anti-tobacco media messages	GYTS database, 2018 and 2019	Derived from the question: During the past 30 days, did you see or hear any anti-tobacco media messages on television, radio, internet, billboards, posters, newspapers, magazines, or movies? 1 if subject has seen or heard any anti-tobacco media messages on television, radio, internet, billboards, posters, newspapers, magazines, or movies; 0 if otherwise.
School smoking	GYTS database, 2018 and 2019	Derived from the question: During the past 30 days, did you see anyone smoke inside the school building or outside on school property? 1 if subject has seen anyone smoke inside the school building or outside on school property, 0 if otherwise.
Country-specific time trend		Expressed in three different measures: as a simple time trend, squared, and cubic.

RESULTS

Descriptive statistics

After organizing the database, a total of 9,702 students are observed in the samples taken in two stages (2018 RS GYTS and 2019 FB&H GYTS). The descriptive statistics presented are based on weighted data as provided in the GYTS study.

The insights show that among the smoking population a higher proportion are men than women, with 54.02 percent of smokers being male and 45.98 percent female (Table A1). Furthermore, a higher share of men are smokers compared to women: 42.87 percent of men smoke, while 36.01 percent of women do (Table 2).

Table 2. Descriptive statistics with weights: Smoking prevalence by gender

Sex		The individual has ever smoked		
		Non-smoker	Smoker	Total
Male	Freq.	21,354	16,026	37,380
	Percent	57.13	42.87	100
Female	Freq.	24,246	13,643	37,889
	Percent	63.99	36.01	100
Total	Freq.	45,600	29,668	75,268
	Percent	60.58	39.42	100

Source: Authors' calculations

Understanding the smoking prevalence within different age groups offers insights into the patterns of youth smoking behavior. As presented in Table 3, the youngest age group, 12-year-olds, has the highest percentage of non-smokers at 86.74 percent. This percentage gradually decreases as the age increases, suggesting that the smoking prevalence tends to be greater as the individual ages. By age 16, more than half (55.91 percent) of the individuals have tried smoking at least once. The 17-year-olds represent the highest percentage of teenagers who have tried smoking, at 64.41 percent. The data demonstrate that the proportion of teenagers in a given year who have smoked increases with their age. As individuals advance through their teenage years, there is an accelerated increase in the percentage of them who have tried

smoking at least once. This increase is especially evident after 14, when the portion of those who have tried smoking becomes more pronounced.

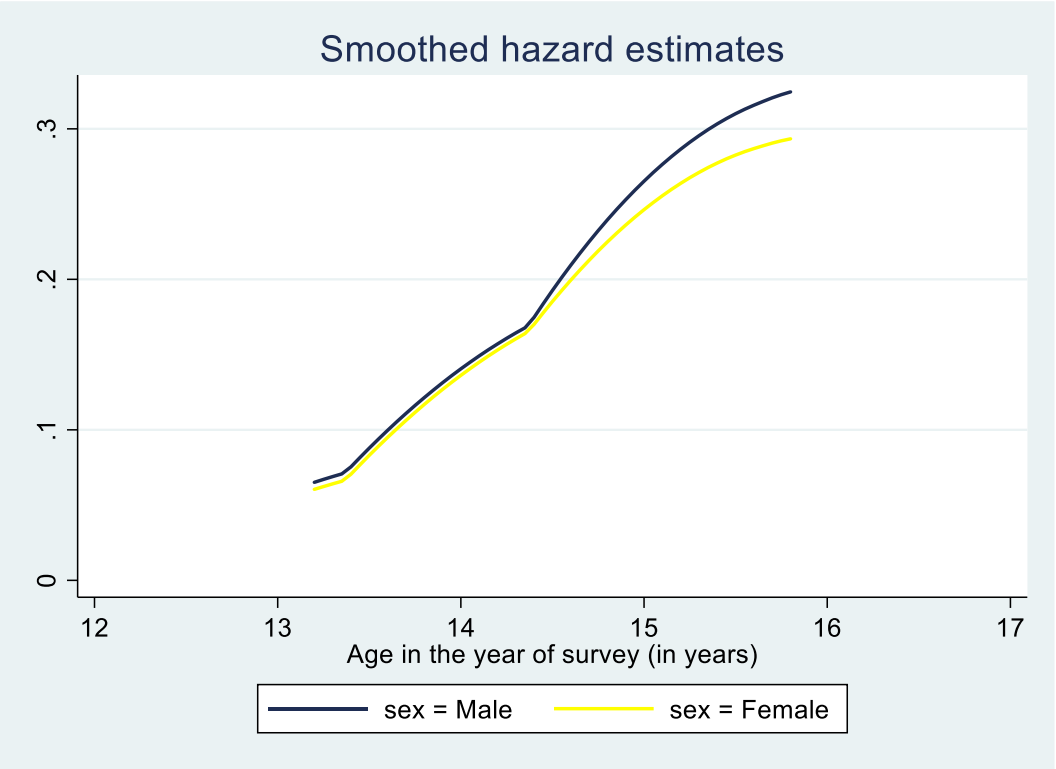
Table 3. Descriptive statistics with weights: Smoking prevalence by age in the survey year

The individual ever smoked		Age in the year of the survey						
		12	**13**	**14**	**15**	**16**	**17**	**Total**
No	Freq.	229	9252	16631	13186	6151	284	45733
	Percent	86.74	77.01	68.17	54.88	44.09	35.59	60.61
Yes	Freq.	35	2762	7767	10840	7801	513	29718
	Percent	13.26	22.99	31.83	45.12	55.91	64.41	39.39
Total	Freq.	265	12014	24398	24026	13953	797	75451
	Percent	100	100	100	100	100	100	100

Source: Authors' calculations

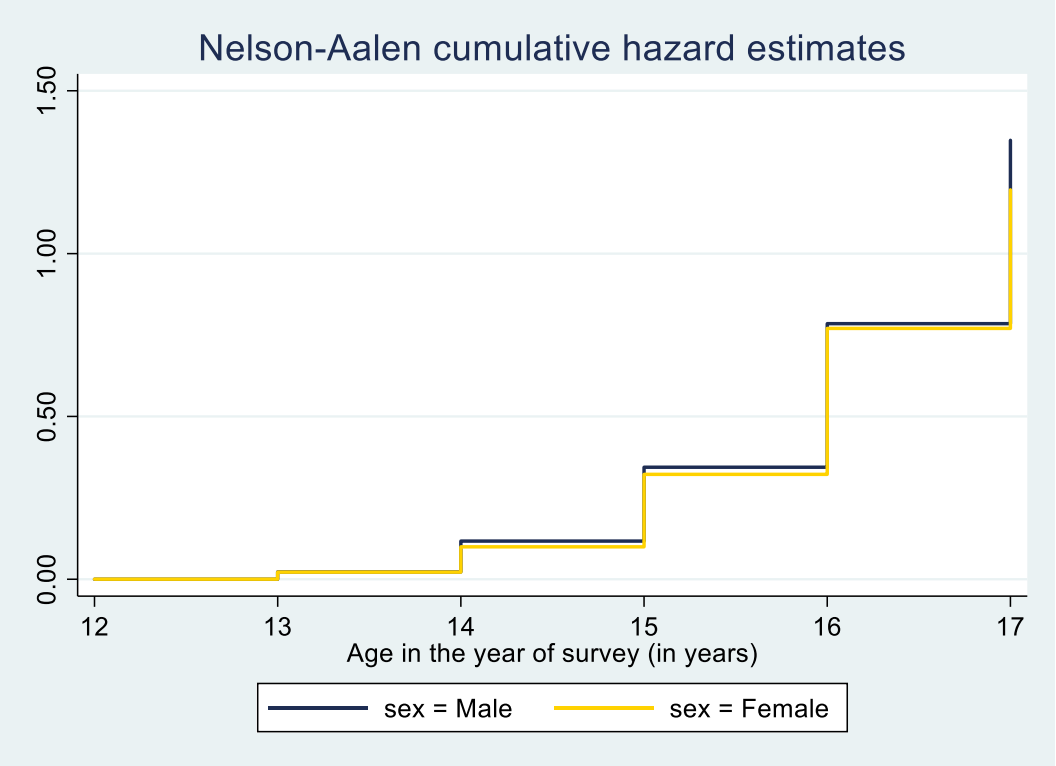
Figure 2 shows the risk of smoking initiation of adolescents in B&H. The graph shows that up until the age of 14.5 both curves have the same steep slope, with the same risk for males and females. We observe that from the age of 14.5, the risk of smoking initiation becomes higher for males. Figure 3 shows the cumulative risk of smoking initiation among adolescents. Up to the age of 14, the cumulative risk of smoking initiation is basically the same for both genders. Between the ages of 14 and 16, there is a slightly higher cumulative risk of smoking initiation for males. The highest cumulative risk of smoking initiation is at the ages of 16 and 17, for both genders, which is in line with the analysis from Table 3.

Figure 2. Smoothed hazard estimates



Source: Authors' calculations

Figure 3. Nelson-Aalen cumulative hazard estimates



Source: Authors' calculations

Results of the split-population model

The results of the split-population duration model are presented in Table 4. A total of six models were utilized, with the addition of one variable in each model. Based on Akaike's information criterion, Bayesian information criterion, and log-likelihood, we conclude that Model 6 is the most efficient estimator. Therefore, our analysis, conclusion, and recommendation are based on the SPD estimation of Model 6.

According to the results, the price of cigarettes demonstrates a statistically significant and negative impact on smoking initiation in all tested models. The estimated price elasticity of smoking initiation ranges between -1.487 in Model 1 and -0.491 in Model 6, which indicates that a 10-percent increase in tobacco prices would reduce the probability of smoking initiation by between 4.9 percent and 14.9 percent. The average estimated elasticity stands at -0.963, suggesting that a 10-percent increase in tobacco prices would reduce the probability of smoking initiation on average by around 9.6 percent. Sex is a statistically significant variable in all models, with results suggesting that males are more likely to initiate smoking than females.

Table 4. Results of split-population duration model

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
	Hazard ratio					
Prices	0.535*** (0.036)	0.534*** (0.353)	0.691*** (0.046)	0.789*** (0.052)	0.801*** (0.053)	0.837** (0.057)
Parental smoking status		1.551*** (0.06)	1.380*** (0.053)	1.367*** (0.051)	1.377*** (0.052)	1.387** (0.053)
Friends' smoking status			2.742*** (0.126)	2.579*** (0.117)	2.598*** (0.119)	2.533*** (0.119)
Gender	0.828*** (0.032)	0.830*** (0.313)	0.846*** (0.032)	0.881*** (0.032)	0.890** (0.033)	0.888** (0.033)
Country-specific time trend	0.761*** (0.079)	0.751** (0.078)	0.680*** (0.071)	0.654*** (0.068)	0.656*** (0.070)	0.638*** (0.068)

Country-specific time trend (t^2)	1.191*** (0.027)	1.195*** (0.027)	1.203*** (0.028)	1.204*** (0.028)	1.202*** (0.028)	1.205*** (0.028)
Country-specific time trend (t^3)	0.989*** (0.001)	0.989*** (0.001)	0.988*** (0.001)	0.988*** (0.001)	0.988*** (0.002)	0.988** (0.002)
Pocket money				1.179*** (0.153)	1.181*** (0.015)	1.178*** (0.016)
Anti-tobacco media messages					0.893** (0.033)	0.892** (0.033)
School smoking						1.214*** (0.051)
cons	0.021*** (0.004)	0.015*** (0.003)	0.004*** (0.000)	0.002*** (0.000)	0.002*** (0.000)	0.002*** (0.000)
Price elasticity	-1.487 (0.302)	-1.551 (0.315)	-0.982 (0.200)	-0.652 (0.133)	-0.612 (0.125)	-0.491 (0.100)
AIC	42109.65	41641.24	40641.83	40388.76	39578.16	38797.02
BIC	42187.49	41730.13	40741.76	40499.76	39700.13	38929.90
log-likelihood	-21047.83	-20812.62	-20311.92	-20184.38	-19778.08	-19386.51
Number of observations (N)	498922	494821	490583	488951	482843	476057

Source: Authors' calculations

Parental smoking status has a statistically significant positive impact on smoking initiation, with students with one or both parents who smoke being more at risk to start smoking than students whose parents do not smoke.

The smoking behavior of peers stands out as a very influential predictor for smoking initiation. Individuals whose friends are smokers are more likely to start smoking as well. As the results

of Model 6 imply, the likelihood of young individuals initiating smoking when their closest friends smoke is 2.5 times higher compared to those whose closest friends do not smoke.

We perform a sensitivity analysis by using a different version of peer variable as described in Table 1. In the main models, peer effect is captured by the variable that takes the value of 1 if any friend smokes (models from 3 to 6 in Table 4). In the additional model, performed for the purpose of sensitivity analysis, peer effect is captured by the variable taking the value of 1 if some, most, or all friends smoke (models from 3 to 6 in tables A2, A3, and A4).

When comparing the outcomes of the main and additional models using Akaike's information criterion (AIC), Bayesian information criterion (BIC), and log-likelihood (LL), it is evident that the AIC, BIC, and LL values in the main models are lower than those in any model from the Appendix. This indicates that models 3 to 6 from the main set are more efficient than those in the Appendix.

Furthermore, students with varying degrees of peer influence demonstrate different probabilities of adopting smoking habits. Comparing the coefficient of the "friends' smoking status" variable in the main set against those in the additional models presented in the Appendix, the coefficients in the original models show a significantly greater impact. Specifically, those who have "some" friends who smoke, based on the 1.1 average coefficient of all models in Table A2, have a lower likelihood of smoking initiation.

Meanwhile, as indicated by the same average coefficient of 1.9 in all models in Tables A3 and A4, students with "most" or "all" friends who smoke show a higher likelihood of smoking initiation. However, when these influences are combined, as illustrated in Table 4, students exposed to any level of smoking among their friends are, on average, 2.6 times more likely to smoke. This highlights the significant role that peer environment has in influencing individual behaviors including smoking habits.

As expected, pocket money has a statistically significant positive effect on smoking initiation, meaning a higher amount of pocket money leads to a higher probability of smoking initiation.

Moreover, observing smoking within the school premises, either inside the building or outside on school property, has a significant positive influence on a student's propensity to smoke. The results suggest that exposure to such behaviors in school increases the likelihood of a student initiating smoking. On the other hand, exposure to anti-tobacco messages in the media acts as

a deterrent against smoking initiation. The model indicates a statistically significant negative relationship, suggesting that students who have been exposed to anti-tobacco messages in the 30 days before taking a survey are less likely to start smoking. By adding different variables in each subsequent model, we observe that the results remain robust, demonstrating their resilience to variations of variables in models.

DISCUSSION

The results of all estimated models indicate that an increase in prices is associated with a decreasing likelihood of smoking initiation, meaning higher prices are linked to a lower probability of young individuals initiating smoking. These findings correspond with the study by Merkaj et al. (2022), which utilizes a split-population duration model and concludes that price is a significant predictor of smoking initiation among teenagers. Similarly, the split-population model results of Gonzalez-Rozada & Montamat (2019) imply that an increase in real cigarette prices is expected to delay smoking onset. Our findings are also consistent with Guindon (2014) and Kostova et al. (2015), which similarly demonstrate a statistically significant impact of price on smoking initiation.

The smoking behavior of peers stands out as a very influential predictor for smoking initiation. This is very important for this study because price almost certainly affects the smoking behavior of these peers, so therefore the indirect effects of price are likely very strong.

Individuals whose friends are smokers are more likely to start smoking as well. As the results imply, the likelihood of young individuals initiating smoking when all of their closest friends smoke is nearly 2.6 times higher compared to those whose closest friends do not smoke. These results align with those of a probit model conducted by Powell et al. (2005) which jointly examines the importance of cigarette prices, tobacco control policies, and peer influences on youth smoking behavior, with the key finding that peer effects play a significant role in youth smoking decisions.

The outcomes of our models suggest that parental smoking behavior strongly influences their children's smoking patterns. Adolescents with one or both parents who smoke are more prone to initiate smoking themselves, aligning with existing studies which had similar results (Merkaj et al., 2022; Odukoya et al., 2013; O'Loughlin et al., 2009). Much like with peer smoking, this

finding suggests that price likely has an indirect effect here, too, as parents' smoking behavior will also be sensitive to price.

It is important to stress that, as the results show, prices have both direct and indirect impacts on smoking initiation. The direct effect is represented by the price elasticity, which is very large in absolute value, especially in Model 1. By adding parental and friend smoking status variables in the following models, the impact of price significantly decreases, suggesting that there is a relatively large indirect impact of price through its impact on parental and peer smoking. Still, the direct impact of price remains large. As almost all research has proven, an increase in price decreases smoking prevalence among both adults and youth. Moreover, as this research proves, there is a significant impact of parental and peer smoking prevalence on smoking initiation among youth. Taking both these findings into consideration, it can be concluded that a price increase has a considerable impact on smoking initiation and contributes both directly and indirectly through peer and parental smoking.

Witnessing smoking on school grounds, whether it is inside the building or outside on the property, notably increases a student's inclination to smoke. The findings indicate that being exposed to these actions within the school setting enhances the chances of a student starting to smoke. A study conducted by Holm et al. (n.d.) highlights that the presence of smoker friends and the intention to smoke are strongly associated with smoking behavior among adolescents. This underscores the importance of the school environment, where peer influence is at its peak.

Finally, due to its widespread influence, the media plays a significant role in molding attitudes and actions. In the context of youth smoking, the results of this study show that encountering anti-tobacco messages in the media serves to discourage the onset of the habit, which is consistent with findings from Guindon et al. (2019) and Bafunno et al. (2020). These findings highlight the power of media campaigns in influencing public health behaviors, emphasizing the need for continued and impactful anti-tobacco messaging.

Limitations

Data Collection and Availability Limitations

The process of gathering data for the Global Youth Tobacco Survey in Bosnia and Herzegovina faced certain limitations. Notably, the survey was not consistently conducted in the same year

for both of B&H's entities across all years. This discontinuity in survey timing has implications for making direct comparisons and drawing conclusions across different periods.

Limitations Within the Survey Structure

The GYTS survey itself has inherent limitations that influence the precision of its findings. One key limitation arises from the structure of the questionnaire, which only inquires whether respondents have ever experimented with smoking a cigarette. This binary distinction between trying and active smoking might not accurately capture the full spectrum of smoking behavior and initiation.

The combined number of subjects within GYTS for RS and for FB&H was 10,829. After the necessary rearranging of the database, the number of subjects dropped to 9,702, which is approximately 90 percent of the database.

Another obstacle emerges when attempting to measure the effect of a price increase on smoking behavior using average retail prices. The GYTS questionnaire does not encompass detailed information about the specific type or price of cigarettes. Consequently, the reliance on average retail prices requires a certain level of approximation.

Moreover, the survey's target population does not always initiate smoking through conventional means. The assumption that they purchase full packs of cigarettes might not hold true for all cases. Instead, young individuals might acquire cigarettes individually, such as by buying single sticks, taking them from adult smokers, or obtaining them from peers who smoke.

Regarding the potential endogeneity issue with the peer-effect variable, the duration model does not allow the implementation of two-stage least square (2 SLS), or instrumental variable generalized method of moments (IV GMM). To deal with the potential endogeneity issue, the researcher should first estimate the SPD without the peer-effect variable and without the parental smoking status variable. In the second iteration, the model is estimated with the parental smoking status variable. In the third iteration, the model is expanded with the variable regarding closest friends who smoke. Finally, in the last iteration, the model is estimated by including the parental smoking variable and the variables showing the percentage of peers in the same school whose parents are smokers. In our case, the GYTS does not provide the location identifier. We have estimated the models from the first three iterations, but the lack of

the location identifier prevents us from dealing with the potential endogeneity problem. Therefore, our study has a potential endogeneity problem.

CONCLUSION

In conclusion, this study yields robust results confirming the effectiveness of increasing tobacco prices through excise tax hikes as a potent strategy for discouraging the initiation of smoking among young individuals. Our findings provide valuable insights into the field of tobacco control, particularly in the context of youth smoking in upper middle-income countries and the Western Balkans, where the existing body of literature remains relatively limited.

A notable contribution of our research lies in its examination of a variable that has been somewhat overlooked in similar studies: pocket money. We have observed a clear correlation between higher levels of disposable income and an increased likelihood of young individuals taking up smoking. This variable underscores the need for policy makers and public health advocates to consider not only price-based interventions but also the economic factors that influence the smoking behaviors of young people.

While raising tobacco prices through excise taxes emerges as a commendable strategy, our study underscores the complexities associated with youth smoking initiation. Notably, the influences of peer and parental smoking status emerge as significant contributing factors, emphasizing the need for a multifaceted approach. Though both variables have a strong indirect relationship to price, regulators must complement price-based measures with non-price interventions aimed at addressing the social and familial dimensions of smoking initiation. Furthermore, substantial effects of exposure to anti-tobacco media campaigns and smoking in schools imply the importance of non-price measures, as these campaigns and stricter enforcement of smoking bans in schools could prolong or even prevent youth smoking initiation.

In summary, our research contributes robust empirical evidence to the field of tobacco control by demonstrating the effectiveness of price-based measures in deterring youth smoking initiation through direct and indirect channels, particularly in regions that have been underrepresented in existing literature. However, we emphasize the need for a comprehensive approach that considers economic, social, and familial influences to achieve more substantial

and enduring reductions in youth smoking rates. By combining price increases with targeted non-price interventions, policy makers can better address the multifaceted challenge of youth smoking initiation and safeguard the health of future generations.

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APPENDIX

Table A1. Descriptive statistics with weights: Distribution of smoking prevalence by gender

Sex		The individual has ever smoked		
		Non-smoker	Smoker	Total
Male	Freq.	21,354	16,026	37,380
	Percent	46.83	54.02	49.66
Female	Freq.	24,246	13,643	37,889
	Percent	53.17	45.98	50.34
Total	Freq.	45,600	29,668	75,268
	Percent	100	100	100

Source: Authors' calculations

Table A2. Sensitivity analysis – some friends smoke

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Hazard ratio						
Prices (Real WARP)	0.535*** (0.036)	0.534*** (0.353)	0.543*** (0.036)	0.644*** (0.043)	0.651*** (0.044)	0.710*** (0.049)
One or both parents smoke		1.551*** (0.06)	1.544*** (0.060)	1.514*** (0.058)	1.524*** (0.059)	1.526*** (0.059)
Friends smoke some			1.145*** (0.044)	1.139*** (0.043)	1.139*** (0.043)	1.114** (0.042)
Sex	0.828*** (0.032)	0.830*** (0.313)	0.826*** (0.032)	0.863*** (0.032)	0.872*** (0.033)	0.867*** (0.033)
t	0.761*** (0.079)	0 .751** (0.078)	0.747*** (0.078)	0 .707*** (0.075)	0.709*** (0.076)	0.680*** (0.073)
t_sq	1.191*** (0.027)	1.195*** (0.027)	1.195*** (0.027)	1.197*** (0.028)	1.196*** (0.028)	1.200*** (0.028)
t_cube	0.989*** (0.001)	0.989*** (0.001)	0.989** (0.001)	0.988*** (0.002)	0.989*** (0.002)	0.989*** (0.002)
Pocket money				1.212*** (0.016)	1.215*** (0.016)	1.205*** (0.016)
Media presence					0.919** (0.035)	0.908* (0.035)
School smoking						1.383*** (0.059)
cons	0.021*** (0.004)	0.015*** (0.003)	0.014*** (0.003)	0.005*** (0.001)	0.005*** (0.001)	0.003*** (0.001)
Price elasticity	-1.487 (0.302)	-1.551 (0.315)	-1.500 (0.305)	-1.140 (0.232)	-1.114 (0.227)	-0.898 (0.183)
AIC	42109.65	41641.24	41162.56	40857.87	40047.64	39226.83
BIC	42187.49	41730.13	41262.49	40968.87	40169.6	39359.71
log likelihood	-21047.83	-20812.62	-20572.28	-20418.94	-20012.82	-19601.41
Number of observations	498922	494821	490583	488951	482843	476057

*Significance at 10%, **significance at 5%, ***significance at 1%
Note: Standard errors in brackets.
Source: Authors' calculations

Table A3. Sensitivity analysis - most friends smoke

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Hazard ratio						
Prices (Real WARP)	0.535*** (0.036)	0.534*** (0.353)	0.614*** (0.040)	0.711*** (0.047)	0 .721*** (0.047)	0.771*** (0.052)
One or both parents smoke		1.551*** (0.06)	1.448*** (0.055)	1.423*** (0.053)	1.431*** (0.054)	1.437*** (0.054)
Friends smoke most			1.984*** (0.084)	1.894*** (0.079)	1.907*** (0.080)	1.863*** (0.079)
Sex	0.828*** (0.032)	0.830*** (0.313)	0.828*** (0.030)	0.859*** (0.031)	0.866*** (0.032)	0.860*** (0.032)
t	0.761*** (0.079)	0 .751** (0.078)	0.704*** (0.074)	0.676*** (0.071)	0.679*** (0.072)	0.655*** (0.070)
t_sq	1.191*** (0.027)	1.195*** (0.027)	1.202*** (0.027)	1.202*** (0.028)	1.199*** (0.028)	1.204*** (0.028)
t_cube	0.989*** (0.001)	0.989*** (0.001)	0.988*** (0.002)	0.988*** (0.002)	0.988*** (0.002)	0.988*** (0.002)
Pocket money				1.192*** (0.016)	1.194*** (0.015)	1.187*** (0.016)
Media presence					0.922* (0.034)	0.911* (0.034)
School smoking						1.313*** (0.055)
cons	0.021*** (0.004)	0.015*** (0.003)	0.010*** (0.002)	0.004*** (0.001)	0.004*** (0.001)	0.003*** (0.001)
Price elasticity	-1.487 (0.302)	-1.551 (0.315)	-1.310 (0.267)	-0.948 (0.194)	-0.916 (0.187)	-0.733 (0.149)
AIC	42109.65	41641.24	40941.39	40657.14	39846.76	39040.3
BIC	42187.49	41730.13	41041.32	40768.14	39968.72	39173.18

log likelihood	-21047.83	-20812.62	-20461.7	-20318.57	-19912.38	-19508.15
Number of observations	498922	494821	490583	488951	482843	476057

*Significance at 10%, **significance at 5%, ***significance at 1%
Notes: Standard errors in brackets.
Source: Authors' calculations

Table A4. Sensitivity analysis - all friends smoke

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Hazard ratio						
Prices (Real WARP)	0.535*** (0.036)	0.534*** (0.353)	0.565*** (0.037)	0.660*** (0.042)	0.667*** (0.044)	0.730*** (0.049)
One or both parents smoke		1.551*** (0.06)	1.509*** (0.057)	1.485*** (0.055)	1.493*** (0.056)	1.492*** (0.056)
Friends smoke all			1.955*** (0.142)	1.840*** (0.132)	1.891*** (0.137)	1.912*** (0.139)
Sex	0.828*** (0.032)	0.830*** (0.313)	0.848*** (0.032)	0.884*** (0.032)	0.895** (0.033)	0.890** (0.033)
t	0.761*** (0.079)	0 .751** (0.078)	0.716*** (0.075)	0.686*** (0.072)	0.687*** (0.073)	0.657*** (0.070)
t_sq	1.191*** (0.027)	1.195*** (0.027)	1.205*** (0.027)	1.205*** (0.028)	1.202*** (0.027)	1.208*** (0.028)
t_cube	0.989*** (0.001)	0.989*** (0.001)	0.987*** (0.002)	0.988*** (0.002)	0.988*** (0.002)	0.988*** (0.002)
Pocket money				1.199*** (0.016)	1.201*** (0.016)	1.191*** (0.016)
Media presence					0.920* (0.034)	0.908** (0.034)
School smoking						1.382*** (0.057)
cons	0.021*** (0.004)	0.015*** (0.003)	0.013*** (0.003)	0.005*** (0.001)	0.005*** (0.001)	0.003*** (0.001)
Price elasticity	-1.487 (0.302)	-1.551 (0.315)	-1.500 (0.306)	-1.136 (0.232)	-1.109 (0.226)	-0.875 (0.178)
AIC	42,109.65	41,641.24	41,098.88	40,804.96	39,990.72	39,164.63
BIC	42,187.49	41,730.13	41,198.81	40,915.96	40,112.68	39,297.51

log likelihood	-21,047.83	-20,812.62	-20,540.44	-20,392.48	-19,984.36	-19,570.32
Number of observations	498,922	494,821	490,583	488,951	482,843	476,057

*Significance at 10%, **significance at 5%, ***significance at 1%
Notes: Standard errors in brackets.
Source: Authors' calculations