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Impact of Cigarette Prices on Youth Smoking Onset in Montenegro

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Ana Mugoša,* Mirjana Čizmović, Milica Kovačević,****

Milica Vukčević,* Violeta Vulović***

* Faculty of Economics, University of Montenegro, and Institute for Socio-Economic Analysis, Podgorica, Montenegro

** Faculty of Business and Economics, Mediterranean University, and Institute for Socio-Economic Analysis, Podgorica, Montenegro

**Institute for Health Research and Policy, University of Illinois Chicago, United States of America

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Correspondence to: Ana Mugoša, ana.mugosa@ucg.ac.me

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Abstract

Background

The main objective of this study is to assess the effect of price and non-price tobacco control policies, regulatory changes, and other relevant factors on youth smoking onset in Montenegro. This research is especially important considering that one in five current smokers tried their first cigarette before the age of 15. Evidence shows that smoking initiation at an early age leads to a higher probability that individuals will become regular smokers.

Methodology

To estimate the hazard rate, or the probability of initiation over the observed period, a duration/survival analysis is applied. The discrete split-population model is the most appropriate method of modeling smoking decisions because it splits the sample into never smokers and potential smokers, rather than assuming that everyone will initiate at some point. The analysis uses relevant data from the Global Youth Tobacco Survey (GYTS) from three waves: 2008, 2014, and 2018. Note that the GYTS questionnaire does not distinguish between broad experimentation and the initiation of regular smoking. Thus, initiators of regular smoking are a subset of those identified in the survey results as experimenting. However, consistent with most of the extant literature utilizing similar data and studying this phenomenon, this study uses the word “initiation” to describe the main dependent variable.

Results

The results show that price negatively affects smoking initiation among young people, with initiation elasticities ranging between -0.223 and -0.365, suggesting an inelastic response of youth smoking onset to price changes. However, as discussed above, these data also include those who are only experimenting, and the estimated effect of cigarette prices would likely be even higher if it were possible to isolate only initiation of regular

smoking. Being a male; having parents, peers, and peers' parents who smoke; considering smoking as a factor of better social inclusion and acceptance; and being exposed to tobacco advertising are factors which are associated with a higher risk of starting to smoke. This study confirms that the indirect effect of price on smoking initiation, through various demographic factors, is much stronger compared to the direct impact of price likely because price has a significant effect on these variables.

Conclusion

The research shows that price and non-price tobacco control measures are significant indicators of youth initiation. These results can serve as an evidence base for the creation of effective targeted social and economic policies. Since the research shows the significant effect of price on smoking onset, an effective policy to combat high initiation among the youth population is the acceleration of excise tax policy.

JEL Codes: C41, I12, I18, L66

Keywords: Youth smoking initiation, cigarette prices, split-population duration model, Montenegro, tobacco taxation

Introduction

Youth tobacco initiation remains a significant public health concern, and understanding the risk factors of smoking initiation is critical to reducing tobacco use among youth. Relevant data show an increase in youth smoking prevalence in Montenegro from 2008 to 2018. Surveys indicate that not only is high adult prevalence (40.7 percent) a significant problem in Montenegro (Mugoša et al., 2020), but the high rate of initiation at an early age is even more concerning. According to Institute for Socio-Economic Analysis (ISEA) research (Mugoša et al., 2020), one in five current smokers tried their first cigarette before the age of 15.

Evidence shows that initiating smoking at an early age leads to a higher probability that individuals will become regular smokers (Lewit et al., 1981). Relevant data from the Global Youth Tobacco Survey (GYTS) point to the significance of this issue for Montenegro, as they show an increasing trend in youth smoking prevalence in the country. For example, boys' prevalence increased from 4.3 percent in 2008 to 11.6 percent in 2018, while girls followed a similar pattern increasing from 3.3 percent to 8.1 percent, respectively (GYTS 2008, 2018). According to the European School Survey Project on Alcohol and other Drugs (ESPAD Survey), the total smoking prevalence for boys increased from 34 percent in 2008 to 37 percent in 2019, while girls' prevalence showed the opposite trend, with a decrease from 34 percent to 32 percent in the same period.

Despite the high importance of this topic, there is a lack of research focused on this issue in Montenegro. Most surveys such as Institute for Public Health and GYTS, provide information on youth prevalence and ages when young people start smoking. Yet there is no study for Montenegro estimating the importance of risk factors (such as price, peer influence, exposure to advertising, and parent and family smoking behavior) on youth smoking onset, which represents a significant gap in the literature. Hence, the main objective of this study is to assess the effect of price and non-price tobacco control

policies, regulatory changes, and other relevant factors on youth smoking onset in Montenegro.

Estimating the effects of these factors will significantly contribute to the development of effective prevention strategies including increasing tobacco taxes, implementing comprehensive tobacco control policies, and developing mass media campaigns aimed at reducing the probability of smoking initiation. As early-age smoking is a central challenge for tobacco control efforts, this evidence can serve as a base for programs that will educate young adults about the health risks of tobacco use and discourage them from smoking initiation. Also, the results of this research will provide evidence for policy makers to develop targeted interventions in response to identified risk factors of youth smoking initiation in Montenegro.

The body of this paper consists of five sections. An overview of previous research on this topic is given in section 2. The description of the data used in the estimations is shown in section 3, while section 4 presents the methodology. Section 5 contains the results of the paper, ending with a discussion and conclusions.

Literature review

Many studies have investigated the factors influencing youth smoking initiation, including tobacco price changes and demographic, social, and policy factors. Initiation represents one of the most important issues when analyzing youth tobacco use, which has increased globally in recent years (CDCTobaccoFree, 2022) as well as in Montenegro (GYTS 2008, 2014, 2018). Price represents one of the most efficient tools in combatting high levels of tobacco use among adults and youth. Higher tobacco prices decrease affordability and consequently the probability of potential initiation among youth (CDCTobaccoFree, 2022). A substantial body of research shows that with the increase of excise taxes, retail prices increase, thereby inducing cessation and lowering initiation, driving down prevalence (Vellios & van Walbeek, 2016).

Depending on the methodology and data used, empirical research has derived different conclusions regarding the impact of price on youth initiation. For example, a meta-analysis of 27 studies concluded that the impact of tax and price increases is mixed, depending on the specific country data and methods applied (Guindon, 2014a). Even though different empirical evidence provides conflicting conclusions over the effect of price on youth initiation probability, this can be due to empirical and methodological limitations (Kostova, 2013). Numerous studies show a significant impact of excise tax increase on smoking onset (Asare et al., 2019; DeCicca et al., 2008; Guindon, 2014b; Guindon et al., 2019; Kidd & Hopkins, 2004; Kostova, 2013; Kostova et al., 2015; López Nicolás, 2002; Marti, 2014; Nonnemaker & Farrelly, 2011; Stoklosa et al., 2022; Tauras et al., 2001; Vellios & van Walbeek, 2016; Zhang et al., 2006).

Asare et al. (2019) found that higher cigarette prices had an impact on reduction of smoking onset in youth as well as cigarette consumption in both Ghana and Nigeria. The estimates of price elasticity for tobacco use youth initiation ranged from −1.04 and −3.66 for Nigeria and Ghana, respectively, which are higher compared to estimates from similar studies from other low- and middle-income countries (LMICs). Similar results of price impacts were obtained in several other studies conducted in LMICs, such as South-Africa, Vietnam, China, and Latin America (Argentina) (Gonzalez-Rozada & Montamat, 2019; Guindon, 2014a; Kenkel et al., 2009; Kostova, 2013; Kostova et al., 2015; Laxminarayan & Deolalikar, 2004; Vellios & van Walbeek, 2016; Merkaj et al., 2022). Most studies on this topic have focused on higher-income countries, which is why there is still a lack of research specific to LMICs, especially in Southeastern Europe.

The most common factors other than price that impact tobacco use are non-price tobacco control policies, tobacco advertisement, and peer and family behavior. For instance, regulatory changes or smoke-free laws have direct effects on tobacco use, due to restrictions and difficulty of smoking in public and open spaces (Guindon et al., 2019). Moreover, parents' behavior is an important indicator for smoking initiation, as regular tobacco use of parents is positively correlated with smoking onset in children (Asare et

al., 2019; Kostova, 2013; Vellios & van Walbeek, 2016). Importantly, price is likely to have a significant effect on parents' smoking as well, so increasing prices can impact reductions in youth smoking both directly and indirectly. Media and advertisements of tobacco have strong impacts on tobacco use in both adult and youth populations. This is why advertising bans have shown to be a very important indicator, contributing to a lower hazard of smoking initiation. The same impact is attributed to the introduction of pictorial warnings on packs (Asare et al., 2019; Guindon et al., 2019; Marti, 2014; Stoklosa et al., 2022).

The methodology applied in this type of analysis can be broadly divided into two groups: 1) those modeling initiation and quitting, or a binary approach (probit and logit models), and 2) those using duration models. The advantage of duration analysis, when applied to estimation of the probability of smoking initiation, is that it contains a dynamic component, and therefore accounts for each individual behavior over multiple points of time. One of the duration models, the split-population model, is used in various research studies on youth smoking onset (Asare et al., 2019; Douglas, 1998; Douglas & Hariharan, 1994; Forster & Jones, 2001; Gonzalez-Rozada & Montamat, 2019; Grignon, 2007; Kidd & Hopkins, 2004; Kostova et al., 2015; López Nicolás, 2002; Madden, 2007; Stoklosa et al., 2022).

Methodology

Data

Survey description

The GYTS is a nationally representative school-based survey of students in grades associated with ages 13 to 15 and is designed to produce cross-sectional estimates for each country. The focus of the survey is students of the abovementioned ages, although the sample could be larger. The Montenegro GYTS employs a two-stage cluster sample design to produce a nationally representative sample of students. The first-stage sampling frame consists of all regular elementary schools containing the last two grades and the first year of all secondary schools. Schools are selected with probability proportional to school enrolment size. The second sampling stage consists of systematic equal-probability sampling (with a random start) of classes from each school that participate in the survey. All classes in the selected school are included in the sampling frame. All students in the selected classes are eligible to participate in the survey. The procedure is designed to protect the students through voluntary and anonymous participation.

The GYTS questionnaire covers common topics such as tobacco use, cessation, second-hand smoke, anti-tobacco media and advertising, availability of tobacco products, and knowledge and attitudes regarding tobacco use. The sample sizes are:

- 2018: 4,216 eligible students, of which 3,896 (92.4 percent) were ages 13–15;
- 2014: 4,027 eligible students, of which 3,692 (91.7 percent) were ages 13–15; and
- 2008: 5,723 eligible students, of which 3,299 (57.6 percent) were ages 13–15.

Since students aged 13 to 15 represent the majority in the 2014 and 2018 samples, the sample in 2008 was constrained to the same age interval. The total sample includes 10,887 observations.

Variables

The GYTS is a static cross-sectional survey that provides information for individuals at fixed points in time. To apply duration analysis, it is necessary to reorganize the data set into a pseudo-longitudinal format. In this case, the data set is expanded so the number of data rows for each individual is the same as the number of time intervals in which a person is at risk that an event (smoking initiation) might occur. Construction of this data set could be done by retroactively inferring a smoker's year of initiation from the survey question: "How old were you when you first tried a cigarette?" If a person smoked at some point of time in their life, the number of years at risk is calculated as the difference between the age of initiation and the age of first exposure to smoking. In the case of never smokers, age at the time of interview is used instead of age of initiation. This will allow us to create duration dependence variable.

It is important to note that the GYTS lacks data related to the age when a student started smoking consistently (even less than daily, since that is how most students start). Since the GYTS does not provide such information, the second-best way is to assess experimentation by focusing on the question about when they first tried a cigarette. Since experimentation may not necessarily lead to initiation of regular smoking, this is a limitation of the research. Nevertheless, it is still a good indication of the potential impact of price and other measures on initiation. Furthermore, this is likely to be a conservative estimate of impact since price should have a stronger effect on the initiation of more regular smoking than on experimentation, particularly because of the financial requirements of purchasing tobacco products more often.

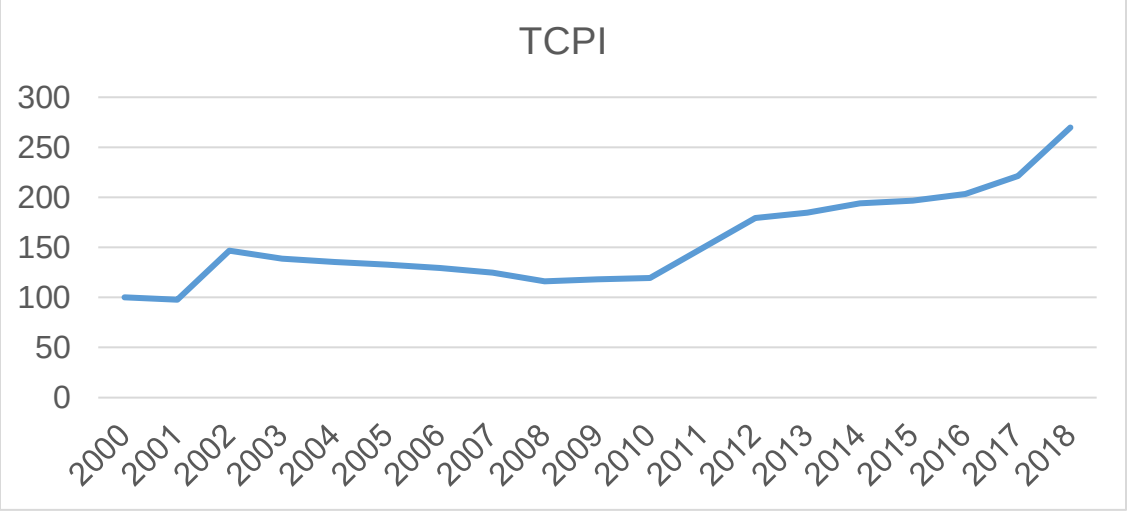
The age of first exposure to smoking was chosen to encompass an early enough chance of initiation while retaining a sample size as large as possible, according to the availability of price data (the risk of starting to smoke at the age of seven and robustness analysis of results conducted using the age of eight) (Asare et al., 2019; Guindon et al., 2019; Kostova, 2013). The analysis will use information regarding students aged 13 to 15 from

three[1] GYTS surveys (2008, 2014, 2018) and the maximum survival time of nine years, so the GYTS data set should be expanded in the pseudo-longitudinal form to cover the period from 2000 to 2018. Considering this stated limitation of the research, in this analysis and following the broad convention in the literature, the term "initiation" will be used instead of first-time smoking experimentation, for the sake of consistency.

The dependent variable used in the study is the event indicator (smoking initiation), and it will be constructed as a dummy, equaling one at the age of smoking initiation if the respondent started to smoke. Zero was assigned for other years, as well as in all years for those who did not initiate up to the age at time of interview. In all rounds of the GYTS data sets, age of initiation is given in two-year intervals, so we randomly draw between age limits of given intervals using a uniform distribution.

The main explanatory variable is cigarette price, measured by the tobacco consumer price index (TCPI). Nominal TCPI (Figure 1) is obtained from the Statistical Office of Montenegro (Monstat) for the period from 2000 to 2018.

Figure 1. Real tobacco consumer price index, 2000–2018 (2000 baseline)



Source: Statistical office of Montenegro - Monstat

[1] The GYTS 2004 was not used in the analysis due to the unavailability of reliable data on tobacco prices until year 2000.

Control variables

The impact of non-price tobacco control policies and other factors (demographic and social environment) will be assessed through a set of control variables: regulatory changes, gender, parental and peer smoking behavior, tobacco advertising, and tobacco use smoking as a factor of social inclusion.

To capture the influence of the tobacco control environment on tobacco youth initiation in Montenegro in the observed period, the analysis encompasses the effect of the Law on Limiting Use of Tobacco adoption and later amendments. Therefore, the following control or regulatory variables are formed:

- Variable *reg1* takes the value of 1 for 2004 to 2010, and zero otherwise, reflecting the period from the adoption of the Law until its first amendments; and
- Variable *reg2* takes the value of 1 for the period 2011–2018, and zero otherwise, to take into account stricter bans on tobacco advertising, sponsorship, marketing, selling, and promotion, as well as on tobacco use in public spaces defined by Law amendments in 2011.

To check the possible differences in price effects on smoking initiation between boys and girls, the estimates are given separately for the subsample of boys and girls. To control for peer influence, the research focuses on the variable constructed from the question "Do any of your closest friends smoke?" In cases in which *some* (as an answer) of the closest friends are tobacco users, the dummy variable takes one, and otherwise, zero. The impact of parental smoking behavior is estimated through the variable, "Do your parents smoke?" which measures the effect of parental smoking status. The dummy variable takes the value of 1 when at least one parent is a smoker at the time of the interview, and zero otherwise.

When assessing the impact of anti-tobacco messages, the variable used is related to the question "During the past 30 days, did you see or hear any anti-tobacco messages at sports events, fairs, concerts, community events, or social gatherings?" Tobacco smoking is often seen as a factor of social inclusion and acceptance, which is why it is used as a control variable. Its impact is defined using the question "Do you think smoking tobacco helps people feel more comfortable or less comfortable at celebrations, parties, or in other social gatherings?" Finally, pro-tobacco messages and promotion effects on youth tobacco use initiation is assessed by the question "Has a person working for a tobacco company ever offered you a free tobacco product?"

Other variables often used in this kind of research such as parent education, pocket money, family wealth, and experience of smoking in enclosed spaces could not be used due to different survey structures in GYTS waves in 2008 compared to 2014 and 2018. Due to the impossibility to reconstruct the variability of indicators in the observed period, all the control variables are fixed. For example, parents may smoke at the time of the interview, but not necessarily in the previous period. Still, these parents could have been less strict toward tobacco use and initiation.

Empirical approach

The first step to estimate the hazard of initiation (H_i) is to model it as a function of cigarette prices (P_t) as a time-variant and other time-invariant control variables (X).

$$H_t = f(\alpha_0 + \alpha_1 P_t + \alpha_2 X) \quad (1)$$

To estimate the hazard rate or the probability of initiation over the observed period, duration/survival analysis is applied (given the condition that the respondent did not start to smoke yet). This analysis allows the inclusion of students or respondents who did not initiate smoking before the year of the interview. The data relating to those individuals is right censored.

The survival analysis assumption states that each observation in the available data will eventually fail. Even though in some cases this assumption could be reasonable, in the case of smoking onset it is restrictive and unreasonable. To relax the restriction of this assumption, we apply a discrete split-population model, which allows the division of the population into two subpopulations. In this manner, the analysis includes the group of students that will fail (that is, start smoking) and the other group that will never initiate smoking. The main advantage of this model is that it uses the probability of ever initiating as a weight in the estimation of hazard of smoking initiation (Kostova, 2013). The log likelihood for ith individual with a survival time of t years is estimated as follows:

$$d_i \times ln\{P(ever\ initiate) \times f(t|t > 0\} + (1 - d_i) \times$$
$$ln\{P(never\ initiate) + P(ever\ initiate) \times f(t|t = 0\} \quad (2)$$

where d_i stands for a binary variable or censoring indicator, which takes the value of zero in cases where the observation is censored and one if failure is observed. Time or t is measured in number of years since the age of the first exposure to the risk of smoking, where positive t means initiation occurring between this age and the interview date and zero means the individual did not start to smoke by the interview date.

The probability density function of different times to initiate or $f(t)$ represents the time defined in the hazard function (Equation 1). The first part of Equation 2 shows the contribution to the likelihood function of a student that started to smoke, estimated through the multiplication of the probability of initiating and density of initiating at time t. On the other side, the second part of the equation is related to the individual who did not fail in the observed period of time t, giving their contribution to the likelihood function as a sum of the probability that they will never initiate and the product of the probability of starting to smoke and density of starting to smoke after the observation period ends. In the analysis, the survival times are intrinsically discrete, meaning that the time is divided into certain intervals, in our case once a year.

In the analysis, the data should be reorganized in pseudo-longitudinal form. This means that for each individual the data set should be extended to capture the time spell at risk of initiation. Dependent and duration dependency variables should be created. If the respondent was a non-smoker until the year of interview, the binary dependent variable is equal to zero for the time spell at risk defined for the respondent. In case the respondent initiated during the time spell at risk, the binary dependent variable equals zero for all years except the last year, in which it equals one.

Variable *duration* represents survival time per person, constructed as an identifier of the number of years elapsed from the age of risk until the age of onset, or age in the time of interview for those who did not fail. The next stage in estimating a discrete-time model is the creation of time-varying covariates. Besides price, the other one is the variable used to characterize the pattern of duration dependence. These will be functions of each person's survival time, which in discrete models is recorded in integer values.

The hazard, using cloglog form, is given by the following equation:

$$h = Hazard(H) = 1 - \exp(-\exp(H)) \quad (3)$$

With its derivative *d*:

$$d = \frac{\partial F(H)}{H} = \exp(-\exp(H))\exp(H) \quad (4)$$

To estimate initiation elasticity, meaning the percentage change in probability of initiation due to the percentage change of price increase, *p*, the following equation is applied:

$$eyex = \beta \times \frac{d(p\beta)}{h(p\beta)} \times p \times (1 - c) \quad (5)$$

where $1 - c$ stands for the probability that the individual will eventually initiate smoking.

In our model, there is a challenge regarding the estimation of peer influence on students' or individual behavior (endogeneity). Specifically, the endogenous effect is found in the fact that individual behavior is related to the peer's smoking habit (Nikaj, 2017a; Manski, 1993; Powell et al., 2005). Therefore, the study needs to address those issues to avoid potential biased estimates of friends'/peers' influence on a student/individual. To address this issue, the analysis incorporates instrumental variables methodology.

Following previous literature (Bifulco et al., 2011; Fletcher, 2010; Nikaj, 2017) and according to the available data, the research controls for simultaneity between individuals and peers, including peers' parental smoking, as an instrumental variable (no direct effect on an individual's smoking choices). The instrument is considered efficient, as the peers are not narrowed on a small group of friends, being instead defined at the class or school level. Taking all peers in the school would lead to assessing non-influential behaviour and impact. However, narrowing down the impact only to the few best friends of the student, being the most influential, introduces the problem of selection, as individuals choose their own friends. In the Results section, we will provide estimates replacing the peer variable with the instrumental variable peers' parental smoking as one more sensitivity test of our results. To check the sensitivity of estimates, due to the endogeneity issue, a two-stage generalized least squares model was applied, even though this approach is more applicable in linear models.

Results

Descriptive statistics

The total sample consists of approximately equal shares of boys (48.57 percent) and girls (51.43 percent). This structure of respondents can be considered adequate due to approximately equal representation of both sexes in the research, which is important for

drawing general conclusions related to the topic. Throughout all three rounds of the survey, respondents on average were 14 years old at the time of the interview, with 11 years being the average age of initiation (Table 1).

To the question “Do your parents smoke” for all three observed years, more than 53 percent of respondents answered that at least one parent smokes, while the results related to peers showed that 37 percent of respondents in the entire sample answered that some of their peers consume cigarettes. Through survey waves from 2008–2018, the percentage of peers (some of them) who consume cigarettes gradually decreased.

Regarding the question related to the opinion that “smoking helps feel comfortable socially,” approximately 35 percent of the respondents in the total sample answered that in general people do feel “more socially comfortable” when consuming cigarettes. If we look at the analyzed years, this percentage was the highest in 2014 (41.46 percent). Contrary to this conclusion, 26.82 percent of respondents from the entire sample stated that people feel “less socially comfortable” when smoking, showing a decreasing trend from 2008–2018 with a decline of almost 31 percentage points.

According to the survey results, 71.72 percent of respondents were ever smokers, while the percentage of current smokers was 5.78 percent. The data show that the older the respondents, the more of them are current smokers (Table A1, Appendix), with prevalence ranging from 2.4 percent (13 years old) to 9.3 percent (15 years old). However, the main question in this paper is when young people initiate the use of cigarettes. Therefore, Figure 2 shows the risks of initiating the use of tobacco products in Montenegro, by gender.

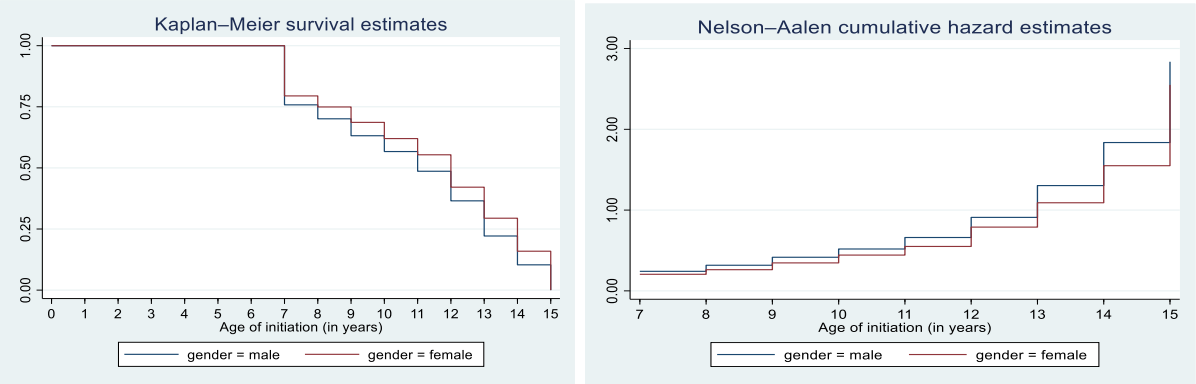
Table 1. Descriptive statistics

	2008		2014		2018		Whole sample	
VARIABLES								
Male (%)	46.36	(44.51 - 48.21)	50.04	(48.35 - 51.73)	48.92	(47.25 - 50.58)	48.57	(47.57 - 49.57)
Female (%)	53.64	(51.79 - 55.49)	49.96	(48.27 - 51.65)	51.08	(49.42 - 52.75)	51.43	(50.43 - 52.43)
At least one parent smokes (%)	59.98	(58.16 - 61.80)	56.25	(54.58 - 57.93)	53.85	(52.19 - 55.51)	56.47	(55.48 - 57.46)
Some of peers smoke (%)	40.49	(38.67 - 42.31)	37.99	(36.35 - 39.63)	33.46	(31.89 - 35.03)	37.08	(36.12 - 38.05)
All peers smoke (%)	1.65	(1.18 - 2.12)	2.17	(1.68 - 2.66)	1.53	(1.12 - 1.94)	1.79	(1.52 - 2.05)
Peer prevalence by grade (%)	51.82	(51.14 - 52.49)	52.60	(51.99 - 53.21)	43.95	(43.46 - 44.44)	49.26	(48.91 - 49.60)
More socially comfortable (%)	21.18	(19.66 - 22.69)	41.46	(39.80 - 43.13)	39.69	(38.06 - 41.32)	34.94	(33.99 - 35.89)
Less socially comfortable (%)	47.83	(45.98 - 49.69)	19.90	(18.55 - 21.25)	16.61	(15.37 - 17.85)	26.82	(25.93 - 27.70)
Ever smoker (%)	69.62	(67.91 - 71.33)	69.96	(68.41 - 71.51)	75.12	(73.68 - 76.57)	71.72	(70.81 - 72.62)
Current smoker (%)	4.46	(3.68 - 5.23)	6.71	(5.85 - 7.56)	5.93	(5.14 - 6.73)	5.78	(5.30 - 6.25)
Age at survey	13.94	(13.91 - 13.97)	14.20	(14.17 - 14.23)	14.15	(14.12 - 14.18)	14.11	(14.09 - 14.12)

Initiation age	10.48	(10.28 - 10.68)	11.18	(11.00 - 11.36)	11.46	(11.26 - 11.65)	11.05	(10.94 - 11.16)
Observations	2,791		3,367		3,467		9,625	

Source: Authors' calculations

Figure 2. Risk of initiating smoking, by gender



Source: Authors' calculations

Note: The hypothesis that survival functions are the same is rejected ($chi^2(1) = 20.83$, $pr > chi^2 = 0.000$).

Figure 2 shows that the risk of initiation increased more than proportionally after age 11 for both groups. The Nelson-Aalen model shows cumulative risk from initiation. Young females face a lower cumulative risk compared to young males. The 50 percent of respondents initiated approximately at the same age males at the age of 11, and females at the age of 12. This gender difference in cumulative initiation risk increases over time.

The descriptive analysis presented in Table 2 indicates that a higher share of male respondents start smoking cigarettes at the age of seven compared to females. This relationship shifts as girls get older: at 15 years the age of initiation is 59.2 percent for females compared to 40.8 percent for males.

Table 2. Initiation age by gender

Initiation age	Male %	CI	Female %	CI	Wald F	P value
7	55.6	(51.5 - 59.7)	44.4	(40.3 - 48.5)	7.25	0.007
8	57.3	(48.8 - 65.7)	42.7	(34.3 - 51.2)	2.81	0.093
9	53.8	(46.3 - 61.4)	46.2	(38.6 - 53.7)	1.01	0.316

10	50.9	(43.3 - 58.5)	49.1	(41.5 - 56.7)	0.05	0.816
11	56.4	(49.3 - 63.5)	43.6	(36.5 - 50.7)	3.11	0.077
12	49.2	(43.8 - 54.7)	50.8	(45.3 - 56.2)	0.08	0.781
13	54.6	(49.4 - 59.9)	45.4	(40.1 - 50.6)	2.99	0.084
14	48.1	(42.7 - 53.6)	51.9	(46.4 - 57.3)	0.45	0.503
15	40.8	(35.6 - 46.1)	59.2	(53.9 - 64.4)	11.56	0.001

Source: Authors' calculations[2]

Table A2 (Appendix) shows that 83.3 percent of respondents at age seven were non-smokers, while the percentage of current smokers was 16.7 percent. If we look at respondents who initiated at age 15, this relationship is significantly different, with an increase in the percentage of current smokers to 30.1 percent.

Results of the Split-Population Duration Model

Table 3 presents the results using a split-population duration model of the impact of price, demographic, social, and regulatory variables on smoking initiation of young people in Montenegro. All estimates are given in the form of hazard ratios. To check parameter consistency, three models were used: the most restrictive baseline Model 1, where explanatory variables consist of price and gender, and Models 2 and 3, which are augmented with other control variables discussed above. Due to the problem of the peer variable's potential endogeneity, to perform additional sensitivity checks we used Model 4, where the peer variable is replaced with the instrumental variable, peers' parental smoking.

[2] There is only a statistically significant difference between males and females in cases of age of initiation at seven years and 15 years.

Table 3. Determinants of youth smoking initiation

VARIABLES	Model 1	Model 2	Model 3	Model 4
Price	0.998***	0.997***	0.997***	0.997***
	(0.001)	(0.001)	(0.001)	(0.001)
Gender (female)	0.806***	0.857***	0.873***	0.857***
	(0.038)	(0.038)	(0.039)	(0.038)
Parents (at least one smoking)		1.483***	1.462***	1.475***
		(0.068)	(0.066)	(0.068)
More comfortable		1.520***	1.504***	1.521***
		(0.077)	(0.075)	(0.077)
Less comfortable		0.877**	0.877**	0.878**
		(0.053)	(0.052)	(0.053)
Promotion of tobacco - yes		1.520***	1.499***	1.517***
		(0.106)	(0.104)	(0.105)
Regulatory variable 1		0.727***	0.734***	0.732***
		(0.043)	(0.043)	(0.043)
Regulatory variable 2		0.867*	0.883	0.878
		(0.069)	(0.070)	(0.070)
Time (third-order polynomial)	1.003***	1.003***	1.002***	1.003***
	(0.000)	(0.000)	(0.000)	(0.000)
Peers' parents prevalence (mean)				1.440*
				(0.318)
Peers (some smoking)			1.390***	
			(0.061)	
Initiation elasticity	-0.223	-0.365	-0.350	-0.351
	(-0.224 - -0.223)	(-0.366 - -0.365)	(-0.351 - -0.350)	(-0.351 - -0.350)
Observations	430,175	421,326	419,457	421,326

Note: In these models, it is assumed that young adults are first exposed to the risk of smoking at the age of seven. The analysis uses weights. The time variable is in cubic form. To check the consistency of results due to the potential problem of endogeneity of variables representing peers' influence, the effect of price on smoking initiation was estimated using two-stage least squares (Table A5 in

Appendix).

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

All four models confirmed the significant negative impact of price on cigarette use initiation, meaning that a price increase would reduce the probability of starting to smoke. Depending on specifications, initiation elasticity ranges between -0.223 and -0.365, suggesting an inelastic response of youth smoking onset to price changes. For instance, Model 1 estimates indicated that a 10 percent price increase corresponds to a 2.23 percent decrease in initiation among young people.

The demographic and other control variables are statistically significant and have the expected signs. Being a male; having parents, peers and peers' parents who smoke; considering smoking as a factor of better social inclusion and acceptance; and being exposed to tobacco advertising are associated with a higher risk of starting to smoke. The obtained results indicate the importance of social factors on youth smoking initiation.

Parents' smoking behavior, used as a proxy for fixed family characteristics, may impact the decision of youth to initiate at any point in time. Results showing that young people are more likely to start consuming cigarettes if their parents were/are smokers are expected, considering that parents in that case have more tolerant attitudes towards smoking.

Also, young adults who consider smoking as socially acceptable behavior and have friends or friends' parents who smoke are more prone to initiate smoking, being constantly exposed to surroundings where smoking is an acceptable habit. The same can be concluded when considering peer's parents prevalence (used as an instrumental variable to address the potential problem of endogeneity).

The indirect effects of price through demographic characteristics prove to be very strong in these analyses, which is understandable, as youth smoking initiation is triggered by cumulative effect, taking into account all possible factors.

Negative effects on the probability of starting to smoke are found in some non-price tobacco control regulatory changes. Results in models 2 and 3 showed that stricter bans on tobacco advertising, sponsorship, marketing, selling, and promotion, as well as on tobacco use in public spaces, decrease the chance of initiation.

Table A3 in the Appendix presents a more in-depth analysis of initiation behavior by gender, using the same set of variables. Estimates showed that girls' smoking initiation is more price-responsive than boys', with a higher initiation elasticity. The signs and magnitude of all other coefficients are similar to those presented in models in Table 4, confirming the robustness of the results.

To check the sensitivity of the results, we estimated an additional split-population model changing the assumption of the age of the first exposure to the risk of smoking from the age of seven to eight. Similar conclusions were obtained, with only slight changes in the magnitude of some coefficients (Table A4 in Appendix).

Discussion and Conclusion

Addressing the initiation of tobacco use among young individuals is a crucial public health priority. Data from Montenegro between 2008 and 2018 reveal an upward trend in the prevalence of smoking among youth, which is concerning. Alongside the high prevalence among adults, there is a disturbingly high rate of early smoking initiation. Research shows that one in five smokers in Montenegro consumes their first cigarette before the age of 15 (Mugoša et al., 2020). Data from the GYTS survey further underscores the significance of this issue by highlighting an increase in smoking prevalence among young individuals in Montenegro. For instance, the prevalence among boys rose from 4.3 percent in 2008 to 11.6 percent in 2018, and a similar pattern was observed among girls, with an increase from 3.3 percent to 8.1 percent, respectively (GYTS 2008, 2018). Consequently, it is crucial to address the issue of youth smoking initiation to tackle the overall high prevalence of smoking effectively.

The analysis of data showed that a high percentage of youth experimented with cigarettes at early age, with the majority of them being males. This shifts to girls when considering 15 years as the age when they are more likely to initiate than boys. The number of current smokers who initiated at the age of seven is relatively high at approximately 17 percent. If we look at respondents who initiated at age 15, this percentage is even higher (30.1 percent).

The research results show that price negatively affects smoking initiation among young people: as price increases, initiation decreases. Depending on specifications, initiation elasticity ranges between -0.223 and -0.365, suggesting an inelastic response of youth smoking onset to price changes. Moreover, the indirect effect of price on smoking initiation is likely very strong through the influence of parents and peers. Both groups' smoking behavior will be influenced by price. This research shows that price has a significant effect on the initiation of tobacco use, with elasticity being higher among females. Thus, an increase in the price of cigarettes indicates a decrease in the probability that females will start smoking, and by a higher percentage than men.

Additionally, this study confirmed that consumption of cigarettes makes a high share of young people feel more comfortable and "accepted" in society, and those boys and girls have a higher risk of smoking initiation. The results in this study are consistent with the findings in most of the related literature.

Other factors that can influence the initiation of youth are advertising and non-price tobacco control regulations. The presence of tobacco product advertising increases the probability of initiation among young people, while non-price tobacco control measures such as stricter restrictions on tobacco advertising, sponsorship, and promotion lead to the reduction of smoking onset.

Limitations of this study, due to the lack of data, can be found in the inability to observe actual initiation; consider some within-country variability since the time series on price are national weighted averages; and include other data points often used in this kind of research such as parent education, pocket money, family wealth, and experience of smoking in indoor spaces (this was due to different survey structures in GYTS waves in 2008 compared to 2014 and 2018). Additionally, it was not possible to completely address the issue of endogeneity with peer effect. However, these limitations do not impact the consistency of obtained results, as the study captures the most important tobacco onset predictors.

Despite these reasonable limitations, this research makes important practical, empirical, and theoretical contributions, especially for LMICs. The theoretical contribution is reflected in the addition of literature in this area in a LMIC, being the first research dealing with this issue in Montenegro. The practical contribution of the work is reflected in the fact that the research provides insight into the factors that determine smoking initiation among young people, giving information to policy makers on what indicators to target to overcome this problem in the future. Given that the research showed that price and non-price tobacco control measures are significant indicators of youth initiation, these results can serve as an evidence base for the creation of effective targeted social and economic policies. As research shows the significant effect of price on smoking onset, an effective policy to combat high initiation among youth population is the acceleration of excise tax policy. Additionally, anti-smoking campaigns raising parent awareness of the influence of their smoking habits

on boys' and girls' smoking onset, and enforcement of stricter bans on tobacco advertisement, marketing, and use in public spaces would be highly beneficial in preventing the smoking initiation of young adults.

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Appendix

Part A

Table A1. Current and non-smokers at the age of interview

Age at time of interview	% non-smoker	CI	% current smoker	CI
13	97.6	(97.0 – 98.2)	2.4	(1.8 – 3.0)
14	95.6	(94.9 – 96.3)	4.4	(3.7 – 5.1)
15	90.7	(89.7 – 91.6)	9.3	(8.4 – 10.3)

Source: Authors' calculations

Table A2. Current and non-smokers – initiation age

Age first tried cigarette	% non-smoker	CI	% current smoker	CI
7	83.3	(80.1 – 86.5)	16.7	(13.5 – 19.9)
8	82.7	(76.1 – 89.3)	17.3	(10.7 – 23.9)
9	90.4	(85.8 – 95.0)	9.6	(5.0 – 14.2)
10	77.5	(70.8 – 84.1)	22.5	(15.9 – 29.2)
11	85.4	(80.2 – 90.6)	14.6	(9.4 – 19.8)
12	74.2	(69.2 – 79.3)	25.8	(20.7 – 30.8)
13	71.5	(66.5 – 76.4)	28.5	(23.6 – 33.5)
14	67.9	(62.6 – 73.1)	32.1	(26.9 – 37.4)
15	69.9	(64.8 – 75.0)	30.1	(25.0 – 35.2)

Source: Authors' calculations

Table A3. Determinants of young adult smoking initiation, by gender

VARIABLES	Male	Female
Price	0.997**	0.993***
	(0.001)	(0.001)
Parents (at least one smoking)	1.544***	1.497***
	(0.104)	(0.100)
More comfortable	1.481***	1.523***
	(0.110)	(0.114)
Less comfortable	0.867*	0.939
	(0.074)	(0.082)
Promotion of tobacco – yes	1.803***	1.602***
	(0.209)	(0.155)
Regulatory variable 1	0.627***	0.661***
	(0.055)	(0.054)
Regulatory variable 2	0.587***	0.898
	(0.070)	(0.100)
Time (third-order polynomial)	1.003***	1.002***
	(0.000)	(0.000)
Peers (some smoking)	1.524***	1.207***
Initiation elasticity	-0.313	-0.428
	(-0.316 to -0.313)	(-0.431 to -0.420)
Observations	36,357	33,309

Source: Authors' calculations

Note: Estimates expressed in exponents

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

Table A4. Determinants of young adult smoking initiation – risk of exposure at age 8

VARIABLES	Model 1	Model 2	Model 3
Price	0.999***	0.999*	0.999***
	(0.000)	(0.001)	(0.000)
Gender	0.790***	0.904**	0.904**
	(0.052)	(0.045)	(0.045)
Parents (at least one smoking)		1.550***	1.551***
		(0.089)	(0.088)
More comfortable		1.514***	1.514***
		(0.095)	(0.094)
Less comfortable		0.897*	0.897*
		(0.058)	(0.058)
Promotion of tobacco – yes		1.682***	1.687***
		(0.165)	(0.161)
Regulatory variable 1		0.985	
		(0.077)	
Regulatory variable 2		0.981	
		(0.100)	
Time (third-order polynomial)	1.006***	1.004***	1.004***
	(0.000)	(0.000)	(0.000)
Initiation elasticity	-0.126***	-0.199***	-0.203***
	(0.000)	(0.000)	(0.000)
Observations	63,909	60,618	60,618

Source: Authors' calculations

Notes: Estimates expressed in exponents; in these models, it is assumed that young adults are first exposed to the risk of smoking at the age of eight. The analysis is done without weights, as the model with weights failed to converge.

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

Table A5. Determinants of young adult smoking initiation – 2SLS

VARIABLES	Model 2sls
Peer impact (mean)	0.1296***
	(0.0412)
Gender	-0.0050***
	(0.0014)
Price	-0.0001***
	(0.0001)
Parents (at least one smoking)	0.0126***
	(0.0014)
More comfortable	0.0130***
	(0.0017)
Less comfortable	-0.0012
	(0.0020)
Promotion of tobacco – yes	0.0201***
	(0.0027)
Time	0.0001***
	(0.0000)
Regulatory variable 1	-0.0120***
	(0.0023)
Regulatory variable 2	-0.0057**
	(0.0026)
Initiation elasticity	-0.2094***
	(0.000)
Constant	-0.0349
	(0.0309)
Observations	69,666
R-squared	0.0073

Source: Authors' calculations

Note: Standard errors in parentheses

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

Part B

The real tobacco consumer price index used here is obtained from statistical indexes calculated and recorded by MONSTAT within the regular project of measuring the consumer price index (CPI). This measurement is mainly based on EUROSTAT methodology. According to that methodology, CPI is calculated as the average weighted arithmetic index of indexes calculated for prices of different products and services ($CPI = {\sum_k w_k \, I_k}/{\sum_k w_k}$, where w_k presents weight while I_k presents the monthly index of product *k*).

Weights are supposed to measure the share of respective products or services in household consumption as estimated in the year 2011, meaning that weights are fixed. One of these products is cigarettes. Tobacco price indexes as well as other product price indexes are calculated as chain indexes for different successive periods ($I_k = p_{kt}/p_{k0}$, where p_{kt} and p_{k0} stands for price of respective product at the end and at the beginning of month).

On the other hand, cigarette (as well as other products) prices in certain periods are calculated as a geometric weighted average price for five cities in Montenegro, where weights refer to the share of respective cities in tobacco (or other products) consumption ($p_{kt} = \prod_g p_{kgt}^{\frac{w_g}{\sum w_g}}$, where p_{kgt} represents the price of the respective product at period *t* in city *g*, while w_g stands for weight for the respective city).

Average prices of cigarettes (and other products) in respective cities, on the other hand, are calculated as unweighted geometric averages of different brands in respective cities in that period recorded at different stores, *i* ($p_{kgt} = \prod_n p_{it}^{\frac{1}{n}}$).

In MONSTAT methodology, it is explained that the number of brands for every single product cannot be smaller than three and higher than 10. The same applies for cigarettes, where the most commonly used brands are included.