Impact of Cigarette Prices and Tobacco Control Policies on Smoking Initiation among Adolescents: Evidence from North Macedonia

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Abstract

Background

In North Macedonia, almost half of the adult population currently uses tobacco products which places the country among the top 10 countries in the world for tobacco use. The increase of smoking rates among teenagers is also concerning given that around 12.4 percent of students used tobacco products in 2016. Since smoking onset among youth is a significant public health concern, empirical evidence on the determinants that explain smoking initiation is very important. The objective of this study is to provide more understanding on this issue—particularly around the effect of price—and, in that way, to provide valuable recommendations for policy makers.

Methodology

This study uses micro-level data from the Global Youth Tobacco Survey (GYTS), which is a cross-sectional, school-based survey supported by the World Health Organization (WHO) and the US Centers for Disease Control and Prevention (CDC). The model on determinants of smoking initiation among young people is estimated by using the split-population method.

Results

The results suggest that the price of cigarettes does impact adolescents in North Macedonia in their decision to start smoking, but mostly through indirect channels, such as their peers and parents. Smoking initiation among adolescents in North Macedonia is, to a substantial degree, also determined by personal characteristics and general trends in society. Gender, age, education, and knowledge about harmful side effects of tobacco use are all estimated as relevant factors. The research also shows that the tobacco control policies already in place also play an important role in discouraging smoking onset among youth.

Conclusions

The findings suggest that raising cigarette prices could serve as an effective measure to combat youth smoking. As current non-price tobacco control policies seem to be effective in discouraging smoking initiation among adolescents in North Macedonia, future policies should be enhanced with softer, student-based regulations and educational campaigns aimed at increasing young people's understanding of the harmful side effects of smoking. These changes—combined with stricter regulation, better policy implementation control, and higher fines—could further discourage smoking initiation among adolescents and also increase the overall initiation age in the country. In addition, the relatively low prices of cigarettes in the country show that there is still room for future price increases, which

could contribute further to reducing smoking prevalence and discouraging smoking initiation among youth.

JEL Codes: D62, I12, K32, L66

Keywords: Youth smoking initiation, cigarette price, tobacco control policies, split population model

Introduction

Research Background

Tobacco consumption is a leading cause of preventable death, with 100 million deaths attributed to it during the 20th century and nearly one billion deaths projected for the 21st century. Although tobacco smoking has declined worldwide, much of this decline has occurred in high-income countries (HICs), and most current smokers are in low- and middle-income countries (LMICs) (World Health Organization, 2017). LMICs face significantly higher levels of tobacco-related mortality compared to the world average, and approximately 80 percent of global tobacco-related deaths are predicted to occur in LMICs by 2030.

Youth smoking is a significant public health concern due to its potential long-term health consequences, including a range of cancers, heart disease, and respiratory illnesses. Moreover, early-age smoking can lead to a lifelong addiction to nicotine, making it a critical public health issue that must be addressed. Research suggests that the earlier an individual initiates smoking, the greater the probability of developing a habit of regular or frequent smoking (Lewit et al., 1981). According to the most recent European School Survey Project on Alcohol and Other Drugs (ESPAD) in 2015, 23 percent of students in Europe have smoked cigarettes by the age of 13 or younger. Both on average and in most individual countries, more boys than girls have smoked cigarettes by the age of 13. On average, four percent of students began smoking cigarettes on a daily basis by the age of 13 (EMCDDA/ESPAD, 2015). The vast majority of smokers begin smoking prior to their 21st birthday (Pierce et al., 1994). Almost all first use of cigarettes occurs during the high school years. At that age, consumers typically underestimate the health consequences of smoking and the risk of nicotine addiction (Warner et al., 1995), thus underestimating the costs of smoking.

Youth smoking is of particular interest to public policy makers and economists who study smoking behavior. Alarmed by the rising youth cigarette consumption in the early to mid-1990s, policy makers designed and adopted numerous antismoking policies and state tobacco control programs. Nowadays, cigarette market interventions cover a wide range of areas. The most significant among them are tobacco excise taxes, smoke-free indoor air laws, laws restricting minors' access to tobacco (including retail tobacco licensing), advertising and promotion restrictions of tobacco products, requirements for warning labels on tobacco products, and requirements for product ingredient disclosure.

In North Macedonia, almost half of the adult population (48.4 percent) currently uses tobacco products (Hristovska Mijovic et al., 2020), which places the country among the top 10 countries in the world for tobacco use. Smoking is more prevalent in males (57.9 percent) than in females (39 percent). Almost 81.4 percent of smokers started smoking before 25 years of age. The World Health Organization (WHO) has projected that if North

Macedonia continues to maintain its present rates of tobacco consumption, approximately 39,000 deaths related to tobacco use will occur in the country over the next four decades. Moreover, the increase in smoking rates among teenagers is concerning. According to the Global Youth Tobacco Survey (GYTS) conducted in 2016, around 12.4 percent of students (14.6 percent of boys and 9.8 percent of girls) use tobacco products.

Increasing tobacco taxes, restricting access to tobacco products, and implementing comprehensive tobacco control policies are all integral parts of the policy toolkit for preventing smoking and reducing youth smoking rates. The empirical literature provides some evidence that increasing prices and implementing different forms of non-price tobacco policies discourage smoking initiation among young people (Merkaj et al., 2022; Tauras et al., 2001). However, other studies did not find any conclusive evidence of the impact of prices and taxes on smoking initiation among youth, or found only weak evidence (DeCicca et al., 2008; DeCicca et al., 2002; Douglas, 1998; Douglas & Hariharan, 1994). In addition, young people are more likely to start smoking if they are exposed to social influences, such as peer pressure, and if they have positive attitudes towards smoking. Other factors that can increase the likelihood of smoking onset among youth include low socioeconomic status, parental smoking, and exposure to pro-smoking advertising.

Though very important, this topic has never been investigated for North Macedonia. Therefore, this study aims to fill this gap and provide valuable recommendations for policy makers. The study tries to identify the determinants of smoking initiation among adolescents in North Macedonia, with a particular focus on estimating the effects of cigarette prices and non-pricing tobacco control policies. To achieve this, a smoking initiation model is estimated using the split-population method. The study uses micro-level data from the Global Youth Tobacco Survey (GYTS), a cross-sectional, school-based survey supported by the World Health Organization (WHO) and the US Centers for Disease Control and Prevention (CDC).

The study is organized as follows. The next section reviews the most important empirical studies on this topic. Methodology, variables, and the results of the empirical analysis are presented in sections three and four. Section five discusses the results and provides policy recommendations. The concluding remarks are given in the last section of the study.

Literature Review

The literature that investigates the factors behind smoking initiation among young people is vast and plentiful. Studies usually consider economic factors and policies such as cigarette prices, taxes, and/or non-price tobacco control policies. Sociodemographic characteristics—gender, age, friends' and parents' smoking status, level of education, family income, and other relevant characteristics—are included as well.

There is overwhelming evidence that prices and taxes reduce overall tobacco demand. However, when it comes to initiation of smoking among youths the current evidence on the effectiveness of price and tax increases is mixed. Tauras et al. (2001) found that an increase in the price of cigarettes would significantly reduce the number of adolescents who start smoking. Nonnemaker and Farrelly (2011) investigated the effects of excise tax rates and prices and concluded that the effect of cigarette excise taxes is small and mixed, whereas cigarette prices are a more consistently significant determinant of youth smoking initiation. A significant negative relationship between cigarette prices and the hazard of smoking was found in Stoklosa et al. (2021), Merkaj et al. (2022), Asare et al. (2019), and Cawley et al. (2004). On the other hand, DeCicca et al. (2008), DeCicca et al. (2002), Douglas (1998), and Douglas and Hariharan (1994) did not find any conclusive evidence of the impact of prices and taxes on smoking initiation, or found only weak evidence. Kidd and Hopkins (2004) concluded that the robustness of the price variable is questionable in many studies and, therefore, governments cannot rely solely on prices to curb tobacco consumption. Guindon (2014) in his critical survey of the literature on this topic argues that the evidence is too limited to make any definitive statements about the impact of tobacco prices or taxes on smoking onset. Teenagers that start to experiment with smoking consume very few cigarettes and not in a regular time interval, so it is not surprising that price of cigarettes is not an important factor for smoking initiation (Emery et al., 2001).

In addition, certain empirical studies analyze young adults' decisions about smoking initiation and cessation altogether. Results from these studies show that it might be important to differentiate between the initiation and cessation of smoking. The findings suggest that while higher taxes may not serve as a constraint for smoking initiation, they may contribute to a rise in smoking cessation rates (DeCicca et al., 2008).

The literature that investigates effects of tobacco control policies on smoking initiation among youth is more limited, but the empirical evidence remains inconclusive. Tobacco control policies significantly reduced initiation of smoking among youth in Albania (Merkaj et al., 2022). Stoklosa et al. (2021) investigated smoking initiation among youth in Poland and concluded that a comprehensive advertising ban and introduction of pictorial warnings lowered youths' probability of starting to smoke. Lopez (2002) and Tauras et al. (2001) also confirmed the existence of a negative relationship between non-price tobacco policies and smoking initiation. On the other hand, there are studies that did not find any significant impact of non-price tobacco policies on the decision of young people to experiment with tobacco. One of the most recent and comprehensive studies on this topic is by Palali and van Ours (2019), who investigated the policy effects on smoking initiation using a sample of eleven European countries. In their research, the policy effects were analyzed individually, for each policy separately, and in an aggregate form by using the policy index. They conclude that the effects of the tobacco control policies were

insignificant. Similar results are found by Voorhees et al. (2011), Trotter et al. (2002), and Douglas and Hariharan (1994).

Tobacco advertisements have also been shown to influence youth smoking onset (Palali & van Ours, 2019). One of the key channels in which tobacco advertisements influence youth smoking is through their ability to shape perceptions and attitudes towards smoking. Studies have found that exposure to tobacco advertising and promotion is associated with an increased likelihood of youth smoking initiation, as well as greater tobacco use among young people who already smoke (Blecher, 2008; Henriksen et al., 2010). Recognizing the harmful effects of tobacco advertising on youth, many countries have implemented restrictions or bans on tobacco advertising, promotion, and sponsorship.

A growing body of literature suggests that, besides prices and policies, smoking onset among youth depends on social interactions. According to Becker (1974) social interactions influence individual behavior as the satisfaction of a person from some action, such as smoking for example, depends upon the actions of others in the reference or peer group. Thus, individual preferences are not solely determined by prices, income, and personal characteristics but also by the behavior of peers. In the context of smoking, this means that individuals are more likely to smoke if more of their peers smoke. Powell et al. (2005) showed that moving a student from a school where no children smoke to a school where one quarter of the students smoke would increase the probability of smoking initiation by almost 15 percentage points. The importance of peer effect has been demonstrated in Merkaj et al. (2022), Powell and Chaloupka (2005), O'Loughlin et al. (2009), and Oh et al. (2010). Methodologically, it might be challenging to estimate the precise peer influence on one's smoking initiation because of possible simultaneity between these variables (Nikaj, 2017; Gaviria & Raphael, 2001). Peer smoking and individual smoking are jointly determined within a group; it is difficult to separate whether the group affects the individual or the other way around. If this problem is present, then the estimated peer effect might be biased.

Parent characteristics, such as parents' smoking status and education levels, are additional factors that might have important influence over youth smoking behavior. Studies usually found positive association between family smoking and adolescent smoking initiation (Merkaj et al., 2022; Asare et al., 2019; Foster & Jones, 2001; Hammar & Martinsson, 2001). As discussed by Dare et al. (2022), this could be because children exposed to smoking at home perceive smoking as a normal behavior. Also, if a family member smokes at home, access to cigarettes is much easier.

As parental education is concerned, empirical research has shown that higher levels of education are associated with lower levels of smoking initiation. Adolescents whose parents have higher levels of education are less likely to initiate smoking (Kestila et al., 2006). A possible explanation for this relationship is that higher levels of parental education are associated with better health literacy, which can lead to a greater

awareness of the health risks associated with smoking. A more supportive home environment that discourages smoking may also play a role in reducing adolescent smoking initiation among those whose parents have higher levels of education (Kestila et al., 2006).

Empirical studies on smoking initiation also control for gender, age, race, rural residence, habitation with a single parent, non-habitation with parents, degree of religiousness, employment, weekly disposable income, and household income. Very often studies include some psychosocial variables (school performance, depression, rebelliousness, sports participation, parental bond, and belief that it is easy to get cigarettes) as well. The importance of these variables for smoking onset has been confirmed in the medical and psychology literature (Emery et al., 2001).

Most research studies on smoking onset have been conducted in the United States or European countries. There is comparatively less literature available that focuses on smoking onset in low- and middle-income countries.[1] However, as awareness of the health risks associated with smoking is increasing, there have been more studies on this topic in recent years. Vellios and van Walbeek (2016) investigated the determinants of smoking initiation in South Africa, and Dare et al. (2022) researched the effect of price on the decision to experiment with cigarette smoking among Gambian children. Similar studies are conducted for Ghana and Nigeria (Asare et al., 2019), Vietnam (Guindon, 2014), and India (Shang et al., 2018). There has also been some research on smoking onset in other high-income countries: Guindon et al. (2019) analyzed the effects of tobacco control policies on youth smoking in Chile, and Stoklosa et al. (2021) analyzed the effects of price on the decision to experiment with cigarette smoking among children in Poland.

The research on determinants of smoking initiation among the young population in the Southeast European (SEE) region specifically is scarce. Merkaj et al. (2022) investigated the impact of cigarette prices and tobacco control policies on smoking onset among young people in Albania. Lotrean et al. (2013) analyzed the reasons behind smoking initiation among Romanian high school students; however, they focused only on sociodemographic and psychosocial variables and did not include any economic variable. To the best of the authors' knowledge, no research has been conducted on this topic in North Macedonia. Given the importance of this question for both the tobacco regulation framework and the general health of the country, this study aims to fill a major research gap in this area.

[1] According to the IMF - World Economic Outlook classification of countries, which divides the world into two major groups: advanced economies and emerging and developing economies.

Methodology

Data

This research uses GYTS data sets for North Macedonia. GYTS is supported by the WHO and the CDC. It is a cross-sectional, school-based survey, and it is used as a global standard for monitoring smoking among youth populations. The survey does not follow the same respondents over time, but provides a snapshot of their smoking patterns. The survey methodology has a two-stage design. First, schools are selected based on their enrollment size, and then classes are selected randomly. All students in the randomly selected class are eligible to participate in the survey.

For North Macedonia, there are three waves of GYTS publicly available, covering the years 2003, 2008, and 2016. In this research, we use only GYTS 2008 and GYTS 2016 because of the availability of the tobacco price series.

Conceptually, the survey uses a standard core questionnaire, but countries are allowed to adapt some questions and to add extra country-specific questions to track key tobacco control indicators more efficiently. The core questionnaire has several key topics. In the 2008 survey for North Macedonia these topics are: access/availability and price, second-hand smoke exposure, cessation, media and advertising, and school curriculum. The 2008 survey includes students in class 7 and 8 in primary school and 1st and 2nd year in high school. The 2016 questionnaire is slightly modified to reflect new trends and products in the tobacco market, such as e-cigarettes or other types of smokeless tobacco. The 2016 survey includes students in classes 8 and 9 of primary school and 1st year in high school.

These changes between surveys affect the choice of covariates that we use in the econometric analysis. For example, in GYTS 2008 there is no question on parents' education level. This question is included in GYTS 2016. Another example is the parents' smoking status. In GYTS 2008 this is covered by the question "*Do your parents (caregivers) smoke?"*. In GYTS 2016, there are two similar, but slightly different, questions to cover this topic: "*How often do you see your father (stepfather or mother's partner) smoking in your home?"* and *"How often do you see your mother (stepmother or father's partner) smoking in your home?".*

The GYTS survey in 2008 covered 5,824 respondents (response rate of 90.1 percent) and 5,141 students in 2016 (response rate of 86.2 percent).

Data analysis and estimation strategy

Following Guindon (2014), Asare et al. (2019), Stoklosa et al. (2021), Dare et al. (2022), and Merkaj et al. (2022), we model the determinants of smoking initiation by using duration (or survival) analysis. Survival analysis assumes that all individuals eventually

experience the event of interest (e.g., death). In this way, the method uses sample information optimally, including information from the respondents that still have not experienced the event. Excluding these observations from the analysis might disturb the duration of the event.

Sometimes, depending on the nature of the event being modelled, this assumption that the individual eventually experiences the event might not be realistic. For example, if the outcome under study is mortality, then it is reasonable enough to assume that all individuals will eventually die. However, if one studies smoking onset, like in our case, it is too restrictive to assume that all respondents will start to smoke. Our sample also confirms that a significant proportion of the respondents never tried to smoke. Therefore, as in Merkaj et al. (2022), Nonnemaker and Farrelly (2011), Kostova et al. (2015), and Vellios and van Walbeek (2016), we employ the split-population (or cure) model.

The split-population model allows for the possibility that some of the respondents will never experience the event. This method considers only those individuals that are predicted to eventually start smoking. It weights the likelihood of each observation by using the estimated probability that the individual will eventually start to smoke. Lopez (2002) and Kidd and Hopkins (2004) analyzed smoking onset and found that results were significantly different when using the split-population model versus the standard survival model. Formal presentation of the split-population duration model can be found in Guindon (2014).

To estimate the split-population model, the data must be organized in pseudo-longitudinal format. In other words, we had to transform the two cross-sectional GYTS surveys into pseudo-panel format. This transformation allows for the analysis of time-to-event data. The first step is to identify the year of smoking initiation. GYTS includes a question on the age of smoking initiation "*How old were you when you first tried a cigarette?*".[2] This information, combined with the respondent's current age at the year of the interview, enables us to derive the exact year of smoking initiation. Another important assumption in the construction of the pseudo-panel data set is the assumption regarding the initial state. In our case the initial state refers to the initial age at which the individual is at risk of smoking. In line with Merkaj et al. (2022), we assume that individuals are at risk to start experimenting with cigarettes from age 9. A similar at-risk exposed age was assumed for Ghana and Nigeria (Asare et al., 2019), Gambia (Dare et al., 2022), and Argentina (Guindon et al., 2018). In each year, all at-risk students receive a value of 1 if they initiated and 0 otherwise. Once the student initiates the observation is dropped from the sample.

The pseudo-longitudinal data set is then merged with the data on annual cigarette prices and excise rates, which allows us to investigate the importance of the price effect. The

[2] The age of initiation within the GYTS is given in two-year intervals (7 years old or younger, 8-9 years old, 10-11 years old, 12-13 years old, 14-15 years old, and 16 years or older). As in Merkaj et al., we randomly selected between the upper and the lower age of the interval.

source and the construction of the price data and the other independent variables is explained in the next section.

Variables

The pseudo-longitudinal sample covers the period from 2001 to 2016. This period is chosen because data on prices and excises are available to us starting from 2001. The dependent variable is cigarette smoking experimentation/initiation. Following Asare et al. (2019), Merkaj et al. (2022), and Dare et al. (2022), this is a dummy variable equal to 1 if the respondent has ever tried a cigarette and 0 otherwise.

Smoking initiation is modeled as a function of the following variables: cigarette prices, excise tax rate, non-price tobacco control policy variables, gender, age, friends' and parents' smoking behavior, education regarding the dangers of smoking, and respondent's own perceptions on the harmful side effects of smoking.

For the cigarette prices we use two measures: per-pack cigarette price of Boss cigarettes and the tobacco price index. Data for cigarette prices are available from official institutions starting from 2001. The per-pack price of Boss cigarettes, one of the most popular brands of cigarettes, is published from 2001 in the SSO Annual Yearbooks. The tobacco price index is one of the sub-indices of the CPI by Classification of Individual Consumption according to Purpose (COICOP) calculated and published by the State Statistical Office (SSO).[3] The index in this format is available from 2003. SSO published a more aggregated version of the CPI index in the period before 2003. Therefore, for the period 2001–2002 we adjust the tobacco index series by using the yearly changes of the tobacco and beverages index as reported by the SSO.[4] To get the real effects, both prices are inflation-adjusted with the official CPI index.

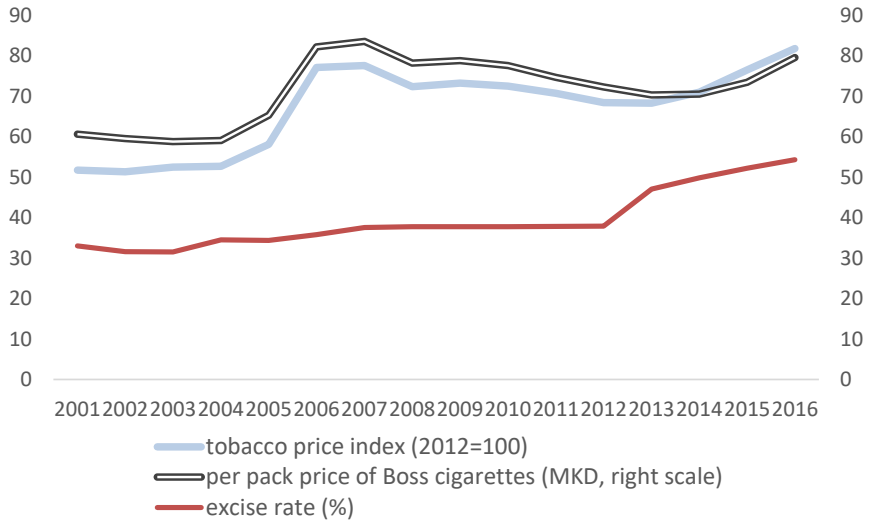
In addition to cigarette prices, we also estimate the model with the total excise rate as a proxy for the price effect. In North Macedonia, there are two types of excise taxes for cigarettes: specific excise (expressed in MKD, or denar, per cigarette stick) and ad valorem excise (rate of increase depending on the per-pack price of cigarettes). In order to obtain a measure of the total excise burden we combine both excises. More precisely, we express the specific excise as a share of the price of Boss cigarettes (in percent) and then we add this constructed measure to the ad valorem rate.

In the empirical analysis, given that it is a consistent and general measure of cigarette prices, we use the tobacco price index as a proxy for the price effect in the core model.

[3] The indices are constructed from the monitored retail prices across the country (eight cities) by taking into consideration the structure of personal consumption. The tobacco price index is calculated on the basis of monitored prices of several of the most-consumed brands of cigarettes. More information on the methodology can be found in the Annual Yearbook of the SSO, available on their website.
[4] The correlation between tobacco price index and tobacco and beverages price index is close to 1.

The price of Boss cigarettes and the excise rate are used in the robustness check exercise.

Figure 1. Inflation-adjusted cigarette prices and excise rate



Source: Authors' own calculations based on SSO data and Customs Administration[5]

To capture the effect of the non-price tobacco control policies on smoking initiation among young people in North Macedonia, we construct four policy dummy variables (policy variables for years 2008, 2009, 2010, and 2011). All these variables are dichotomous and are equal to 0 for the period from 2001 to the moment the policy change was introduced and 1 in the period after the policy change was introduced. Similar to Ross and Al-Sadat (2007), we also construct a pseudo–tobacco policy index. The index is calculated as a sum of all policy variables in the period under analysis (policy in 2008, 2009, 2010 and 2011). By including the index in the empirical model, we save degrees of freedom, and, at the same time, we control for the effects of all policy changes all together.

Besides cigarette prices and non-price tobacco control policy variables, the study also controls for sociodemographic and non-economic variables such as gender, age, friends' smoking behavior, parents' smoking status, education regarding dangers of smoking at school, and respondents' own perception of the harmful side effects of smoking. Gender is a dichotomous variable equal to 1 if the respondent is female. Age refers to the current age of respondents in the pseudo-longitudinal format. Parents' smoking status is a dummy variable equal to 1 if at least one of the parents is smoking. This variable is constructed from the questions *"Do your parents (caregivers) smoke?"* (in GYTS 2008) and "*How often do you see your father (stepfather or mother's partner) smoking in your*

[5] Customs Administration, Excise Law, available at: https://www.customs.gov.mk/mk-MK/pocetna/za-nas/publikacii-i-izveshtai/zakon-za-akcizi.nspx

home?" and *"How often do you see your mother (stepmother or father's partner) smoking in your home?"* (in GYTS 2016).

Friends' smoking behavior is derived from the question *"Do any of your closest friends smoke tobacco?".* The variable is equal to 1 if at least some of the respondent's friends smoke; if none of the friends smoke it is equal to 0. As argued in the literature review section, the friends' smoking variable could be endogenous. To address this problem researchers usually use some form of the instrumental variable method (Powel et al., 2005; Norton et al., 1998; Nikaj, 2017). Friends' personal information (classmates' race, marital status, and education level of classmates' parents, smoking behavior of classmates' parents), census measures (population density and median household income), school characteristics (student-teacher ratio), and socioeconomic variables (safety and drug availability) are some of the most commonly used instruments.

Unfortunately, we do not have this information available. Instead, using the data available to us we construct a slightly augmented version of the instruments. We define an instrument similar to the variable—that is, the proportion of class peers whose parents smoke in one class in a specific school. The intuition behind the instrument is that—although classmates whose parents smoke are themselves more likely to smoke—the proportion of a student's classmates whose parents smoke should have no direct effect on an individual student's smoking decisions. Nikaj (2017) defined this variable within schools and grades. However, our data set does not include information on schools. Instead, we define our variable within PSUs (primary sampling units)[6] and grades. Next, by using this instrument, we estimate a probit model with endogenous covariates.

Finally, in order to investigate the effects of knowledge regarding side effects of smoking, we include a variable based on the question *"During the past 12 months, were you taught in any of your classes about the dangers of tobacco use?".* The variable is equal to 1 if the respondent answered yes and 0 otherwise. In addition, we also construct a variable that describes the respondent's own perceptions regarding the dangers of tobacco use (*"Do you think smoking tobacco is harmful to your health?"*). These two variables are very important for the design of future policy measures and regulation because they might indicate the importance of and need for educational campaigns and lectures via the school system that could help in smoking initiation among young people. All described variables are summarized in Appendix 2.

[6] In GYTS survey the assignment of strata and PSUs is as follows. If the school was selected with certainty (probability =1), then the school forms its own stratum and the classes within the schools are identified as the PSUs. The non-certainty strata are sorted from largest to smallest. The schools are then paired together to form strata for variance estimation during analysis. The schools within each stratum are identified as the PSUs.

Results

Descriptive statistics

In this section, we present the descriptive statistics of our pseudo-panel data set. The data set is constructed by using data from the two waves of the GYTS survey (2008 and 2016). Before proceeding further, it is important to emphasize that, due to data cleaning and study assumptions, there are some differences between the official data and our sample. The key indicators are presented in Table 1.

The average age of respondents in the sample is 14.2 years. Adolescents in North Macedonia usually initiate smoking at 13.5 years. There is only a small difference in the initiation age between genders (males first try cigarettes at 13.6 years, whereas females initiate at 13.4 years). Around 74 percent of the "initiators" began smoking before 13 years of age.

Table 1. Descriptive statistics

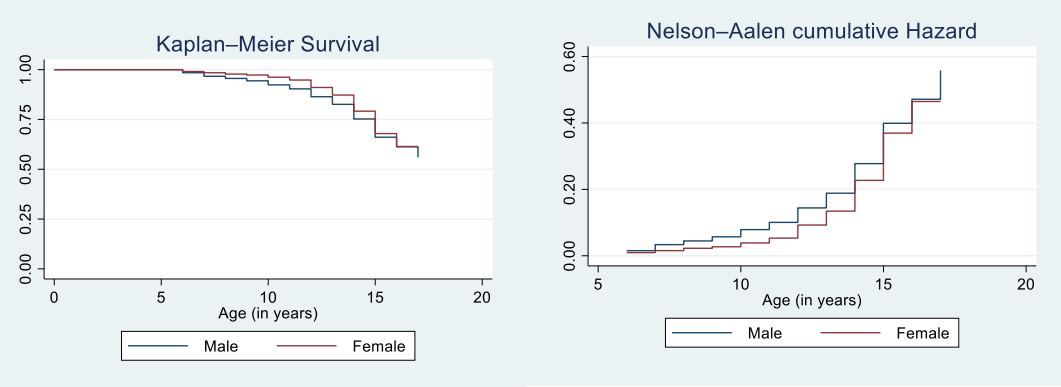
		Average for the whole sample
Age	Average age of respondents at the time of the interview (years)	14.2
Smoking initiation age	Average age of the respondents when starting smoking (years)	13.6
Male		13.5
Female		13.6
Smokers (initiators)	Respondents that tried cigarettes (% of the total number of respondents)	19.2
Male		50.1
Female		49.9
Average age of smokers (initiators)	Average age of the respondents that tried cigarettes (years)	14.7
Male		14.7
Female		14.7

Source: Authors' own calculations based on GYTS data

In the literature, it is emphasized that the risk of initiation is expected to be gender-specific (Palali & van Ours, 2019). Figure 2 illustrates the hazard of smoking separately for males and females. The first graph is the Kaplan-Meier survival function, and it illustrates that the risk to initiate smoking increases after 12 years for both groups. Males have slightly higher risk compared to females, up until 15 years. After that the risk of initiation is more

or less the same. The value of the survival function at "the end of time" (age 17) estimates the proportion of the population that will survive past this last observed period. In our case, both survival functions (for males and for females) remain at a limit of about 0.5, meaning that around 50 percent of the respondents are estimated to survive (not start smoking). This result is in line with our choice of a split-population model as the framework for the empirical analysis. The second graph shows the Nelson-Aalen cumulative hazard. The cumulative risk for becoming a smoker is less pronounced for females as opposed to males. For example, the cumulated risk of initiation at 15 years is around 40 percent for males, almost double the accumulated risk of females at the same age.

Figure 2. Hazard to initiate smoking by gender in the period 2001–2016



Source: Authors' own calculations based on GYTS data

Results of the split-population model

Results of the split-population model are reported in Table 2. In Model 1, we include only the price variable, age, and gender. Model 2 and Model 3 are the same as Model 1, but they are gender-specific—estimated separately for females and males. In Model 4, alongside the price variable, we include two variables that capture the effect of education and knowledge about the negative side effects of smoking (education regarding dangers of smoking at school and own perception about the dangers of smoking) and the policy variable, represented by the aggregate policy index. The individual effects of each newly introduced policy are also estimated separately, and the results are presented in Appendix 3.[7] Model 5 additionally controls for friends' smoking behavior and parental smoking status. In all models, we include the duration dependency, which is a log form of time. Duration dependency controls for the hazards of outcomes change over time, or how likely smoking onset is to occur over time (Shang et al., 2019).

[7] Initially, we introduced all policy dummy variables in one model. However, we had problems with model convergence, and some variables were omitted due to collinearity issues.

The models are estimated by using Stata's *spsurv* command (Dare et al., 2022). The s*psurv* command uses a complementary log-log specification, which reports hazard ratios, and the response curve is asymmetric. The coefficients in Table 2 are presented in exponentiated form. Estimates below 1 are interpreted to reduce the average hazard of smoking initiation by the distance to 1, while those above 1 increase the hazard of smoking initiation by the amount over 1.

Table 2. Split-population survival model (hazard ratios)

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Price index (logs)	0.532***	0.312***	0.829	0.676	1.385
	(0.129)	(0.112)	(0.273)	(0.176)	(0.354)
Current age	2.390***	2.507***	2.192***	2.345***	1.831***
	(0.153)	(0.239)	(0.201)	(0.154)	(0.118)
Gender (female = 1)	0.846***			0.876**	0.884**
	(0.049)			(0.051)	(0.049)
Friends smoking					3.639***
					(0.238)
Parent smoking					1.792***
					(0.106)
I have been taught in class about tobacco dangers				0.938	0.918
				(0.057)	(0.052)
Smoking is harmful				0.811**	0.804**
				(0.087)	(0.079)
Policy				0.935***	0.951***
				(0.015)	(0.014)
Log_t	0.441***	0.486**	0.466***	0.451***	0.784
	(0.089)	(0.150)	(0.128)	(0.092)	(0.160)
Cure probability (never fail probability)	0.592***	0.573***	0.601***	0.582***	0.429***
	(0.016)	(0.024)	(0.023)	(0.017)	(0.027)
Observations	55,411	27,885	27,526	53,059	52,707

Standard errors are shown in parentheses.
* p < 0.10, ** p < 0.05, *** p < 0.01

The price variable is significant in Model 1, but statistically insignificant in models 4 and 5. There are two possible explanations for this result. First, evidently Model 1 does not

include the policy variable and the other important sociodemographic and psychosocial variables, hence it might be the case that the model suffers from omitted-variable bias. Therefore, the estimated price coefficient might be biased. In line with this, the results from Model 4 and Model 5 show insignificant price effects, meaning that adolescents in North Macedonia do not form their smoking decisions based on cigarette prices. On the other hand, the significant price effect in Model 1—and then the disappearance of this effect once all other control variables are included in the models—likely indicates that the effect of prices on smoking initiation is indirect. In other words, prices operate through other control variables. The indirect price effect has been also confirmed in Powell et al. (2005). They found evidence that, besides the direct impact of prices, prices additionally influence smoking initiation indirectly via the impact on the peer group. In the next section we elaborate more on this result.

In Model 1, the hazard ratio for the price variable is estimated as 0.532, meaning that a one-unit increase in the price index will decrease the average hazard of smoking by around 0.47 percent. The calculated marginal effect[8] is 0.3 percent, meaning that a one-percent increase in the price index will result in a 0.3 percent decline in the probability that an individual will initiate smoking, all other things being equal.

As far as non-price tobacco control policies are concerned, our results suggest that their role in discouraging smoking initiation was important in this time period. The coefficient on the aggregate variable that captures all the policy changes introduced in 2008, 2009, 2010, and 2011 is estimated at lower than one and statistically significant (hazard ratio of 0.94 in Model 4).

The majority of the sociodemographic and psychosocial variables prove to be statistically important determinants of smoking initiation among youth in North Macedonia. During the period of observation, girls were less likely to initiate cigarette smoking than boys (hazard ratios ranging from 0.8 to 0.9 in Model 1, Model 4, and Model 5). We also find some evidence that prices might influence smoking initiation in females more than males (Model 2 versus Model 3). As Model 2 and Model 3 are estimated with a significantly reduced sample, and therefore the results are less reliable i.e. we regard these results as more indicative in nature.

Youth smoking initiation is negatively affected by the respondent's own perceptions regarding the dangers of smoking (hazard ratio of 0.8 in Model 4 and Model 5). With respect to age, the older the respondent, the higher the hazard of initiating (hazard ratios ranging from 1.8 to 2.5 across the models). Having parents that smoke is also significantly

[8] The *spsurv* command in Stata did not have the option to compute the marginal effects. Therefore, we calculate the marginal effects (that is, percent change in probability for a one-percent change in price) manually by calculating the derivative from the *cloglog* hazard ratio and then adjusting it with the cure probability.

and positively associated with the likelihood of smoking initiation (hazard ratio of 1.8 in Model 5).

The coefficient of the peer effect is positive, relatively large, and statistically significant. In line with our discussion in the previous section, there is a possibility that this effect is overestimated because of the existence of simultaneity between the individual and the peer group. To address this problem, we estimate a probit model with endogenous covariates using the variable for the proportion of class peers whose parents smoke as an instrument. The probit model uses all the variables that are used in Model 5 in Table 2. The results are presented in Table 3.

Table 3. Controlling for endogeneity – probit model (odds ratios)

	Model 5	**Probit model***
Price index (logs)	1.385	0.637
	(0.354)	(0.933)
Current age	1.831***	0.025
	(0.118)	(0.051)
Gender (if female = 1)	0.884**	-0.048***
	(0.049)	(0.019)
Friends smoking	3.639***	1.620***
	(0.238)	(0.231)
Parent smoking	1.792***	0.074
	(0.106)	(0.053)
I have been taught in class about tobacco dangers	0.918	-0.039**
	(0.052)	(0.019)
Smoking is harmful	0.804**	-0.096***
	(0.079)	(0.032)
Policy	0.951***	1.096
	(0.014)	(44.519)
Log_t	0.784	
	(0.160)	
Cure probability (never fail probability)	0.429***	
	(0.027)	
Wald test of exogeneity (H0: No endogeneity)		chi2(1) = 10.86 Prob > chi2 = 0.001

Observations	52,707	52707

Standard errors are shown in parentheses.
* p < 0.10, ** p < 0.05, *** p < 0.01
* Probit model includes year dummies.

The results in Table 3 indicate that the coefficient of the peer effect in our base split-population model might be upwardly biased. The Wald test of exogeneity shows that the null hypothesis of no endogeneity is rejected at the conventional level of statistical significance. The peer effect in the probit model is positive and smaller, but the coefficients between the split-population model and the probit model are not directly comparable. To conclude, our analysis shows that the peer variable is definitely an important predictor of smoking initiation; however, because of endogeneity issues, the magnitude of the effect should be interpreted with some caution.

Robustness checks

We perform two robustness checks. First, we re-estimate the simplest model, Model 1, and the most complex model, Model 5, with alternative measures for cigarette prices: price per pack of Boss cigarettes and the excise rates. Second, in Model 5 we replace the aggregate policy index with policy dummy variables to estimate the individual effect of each policy change. All models are presented in Appendix 3.

As the price effect is concerned, the results from the robustness exercise are to some extent similar to our baseline results. In the simple version of the model we found a significant effect of the excise rate, but the estimated coefficient is much smaller. The price of Boss cigarettes is not significant. In the more complex versions of the model, both the price of Boss cigarettes and the excise rate are not significant. As with our baseline results, these results might indicate either an insignificant price effect or an indirect price effect.

Models 10 to 13 present the individual effects of different policy changes. The policy variables are dummy variables equal to 0 in the period before the policy change and 1 in the period after the change was implemented. The coefficients on all policy variables are estimated as statically significant and lower than 1, meaning that policies did negatively affect smoking initiation among youth in the period under analysis.

All other socioeconomic characteristics and psychosocial variables that are significant in our base results remain significant. The size of the coefficients is very similar across the models.

Discussion

Our research shows that, while adolescents in North Macedonia do not consider the price of cigarettes as a direct factor when they decide to start smoking, price does impact their smoking behavior through peer influence and parental smoking behavior. Typically, adolescents who experiment with smoking acquire cigarettes through social channels, such as friends, rather than purchasing them themselves. Therefore, the direct impact of price on smoking initiation may be limited (Emery et al., 1999). However, if friends are already established smokers, higher cigarette prices could influence their smoking behavior, resulting in a decrease in the number of cigarettes consumed and potentially even leading to smoking cessation. This change in smokers' behavior may, in turn, discourage potential smoking initiation among their non-smoking friends. Considering these findings, increasing cigarette prices is likely to be an effective strategy to reduce smoking in North Macedonia.

The majority of the non-economic variables are estimated as statistically relevant for smoking initiation. The hazard for smoking initiation is significantly more pronounced for males as opposed to females. This result is typical in the empirical literature. Moreover, as Merkaj et al. (2022) argued, the gender effect may be stronger in countries from the Balkan region, where traditionally, it was socially unacceptable for a female to smoke. Besides gender, our results indicate that smoking is an age-related decision among youth. The older the individual, the higher the potential hazard of smoking initiation.

Peer pressure is also an important factor for smoking initiation among adolescents in North Macedonia. Teenagers whose friends smoke are very likely to start experimenting with smoking. This determinant is highly correlated with smoking onset in the majority of the empirical literature on this topic (Powell & Chaloupka, 2005; O'Loughlin et al., 2009; Oh et al., 2010). However, it must be stressed that this variable, as our analysis shows, is likely endogenous because of the existence of simultaneity between individual smoking behavior and a group's smoking behavior. Hence, the peer effect is likely smaller than the estimates in our core models.

Besides peer pressure, smoking initiation among adolescents is positively related to the smoking status of parents; adolescents with at least one parent smoker are more likely to initiate smoking. This effect, like the peer pressure effect, is one of the most common in empirical literature on this topic (for example, Merkaj et al., 2022; Asare et al., 2019; Foster & Jones, 2001; and Hammar & Martinsson, 2001). Children that are exposed to smoking at home perceive smoking as a normal behavior. Moreover, access to cigarettes is much easier if a family member smokes at home.

The significance of the non-economic factors is a very important result that can help in designing future measures and strategies for tobacco control. For example, our results show that a respondent's perceptions regarding the harmful side effects of tobacco use

discourages initiation. Therefore, educational campaigns on different levels (mass and/or school-level based) that will increase the willingness and ability of teenagers to understand the harmful effects of smoking will further discourage smoking initiation. Media campaigns may even be complemented with carefully designed smoking cessation programs available for young people to further reduce youth smoking.

Stricter and more efficient control over some of the policies that are already in place might also help to mitigate youth smoking. Namely, the GYTS 2016 survey showed that around 78.2 percent of current youth smokers were not prevented from buying cigarettes because of their age. This result might indicate rather poor implementation of some of the policies already in place. For strengthening control over implementation of government policies, Stoklosa et al. (2021) suggest increasing fines for violations, or even loss of the ability to sell cigarettes and tobacco products, by vendors that violate bans as some alternative policy measures that might be effective in this context.

The study has several limitations. First, survey data reflect individuals' own memory regarding past smoking behavior, and hence the dependent variable could be subject to measurement error. However, this bias is more pronounced if the study is conducted on a sample of the adult population (Dare et al., 2022); our sample was composed of adolescents aged 11 to 17 years, with relatively short smoking histories. Second, we do not control for the socioeconomic status of the respondents. This effect is usually emphasized as an important determinant of smoking onset; theoretical and empirical work in this field showed that the probability of starting to smoke is higher for children from wealthier families (Douglas & Harahan, 1994). Finally, we do not control for the use and the price of electronic cigarettes and other types of smokeless tobacco products. But e-cigarettes were not yet prevalent (in GYTS 2016 only four percent of all surveyed adolescents used e-cigarettes) and, therefore, we believe that not including them has little effect on the results. However, e-cigarettes are becoming increasingly popular among the entire smoking population, not only youngsters. With this in mind, future research on smoking initiation should control for the use of these types of tobacco products, and governments should include them in the design of future non-price tobacco control policies.

Conclusions

The study analyzes the determinants of smoking initiation among adolescents in North Macedonia, with a particular focus on the effects of cigarette prices and non-price tobacco control policies. To that end, we use two waves of the GYTS datasets for North Macedonia, for 2008 and 2016. The econometric analysis was conducted by employing the split-population estimation method.

In sum, the paper suggests that youth smoking initiation in North Macedonia is, to a substantial degree, determined by personal characteristics and general trends in society. Smoking decisions depend on a set of sociodemographic and psychosocial variables such as gender, age, friends' smoking behavior, and parents' smoking status. Education and knowledge about harmful side effects of tobacco use are also important factors. Having said that, it is very important to introduce 1.) media campaigns to educate parents about harmful effects of smoking and the importance of being a healthy role model for their children, 2.) educational and health lectures in the curricula of school programs to educate young people about the negative effects of smoking, and 3.) government campaigns that will emphasize the importance of living a healthy and smoke-free life.

In addition, research shows that smoking onset among youth in North Macedonia is influenced by non-price tobacco control policies. Together, all policy changes and measures introduced in the period after 2008 are estimated as statistically relevant. This is consistent with previous research on the effectiveness of tobacco control policies in North Macedonia. From here, strengthening the implementation of tobacco control policies that ban smoking in public places and restrict access to tobacco products for underage students are likely to strengthen the effect of reduction of youth smoking initiation.

We also find some evidence indicating that cigarette prices might be important for smoking initiation, although this effect is likely indirect and operates through peer influence and other variables in the model. Nonetheless, this finding suggests that raising cigarette prices is likely to serve as an effective measure to combat smoking. In addition, the relative cheapness of the cigarettes in the country shows that there is still considerable room for future price increases, which could contribute to discouraging smoking initiation and promoting cessation.

The research has made two significant contributions. First, as the first study on this subject, it sheds light on the determinants of smoking initiation among young people in North Macedonia. Given tobacco's addictive nature, smoking initiation at a young age is a crucial public health issue. Second, the research findings provide valuable information for policy makers. The empirical results can serve as a basis for modifying existing policies and inspire the creation of new policies and regulations in this area. Together, these efforts can effectively discourage smoking initiation among adolescents and possibly increase the overall initiation age in the country.

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Appendix

Appendix 1

Cigarette Price and Tobacco Control Policies in North Macedonia

The Government of North Macedonia considers tobacco to be a strategic crop with an important place in the national economy. Tobacco production has been supported by government subsidies for decades, regardless of the political structure or who holds political power. Most of the tobacco produced (around 90 percent) is exported. Tobacco and tobacco product exports account for one fifth of the total export value of agricultural and food products (20.4 percent), which represents one percent of gross domestic product (GDP). Based on Food and Agriculture Organization (FAO) data, the North Macedonian production of tobacco represented 0.4 percent of world tobacco production and 13.9 percent of European production in 2019. These numbers place North Macedonia among the 30 major tobacco-producing countries in the world, among the 20 major exporters of raw tobacco, and the second-largest producer of oriental tobacco, following Türkiye.

When it comes to smoking behavior in the country, North Macedonia ranks highly globally for both the prevalence of smoking and the average number of cigarettes smoked per day per smoker (Mijovic Hristovska et.al, 2020). The average smoker in North Macedonia smoked 21.3 cigarettes per day in 2017 (Mijovic Spasova & Mijovic Hristovska, 2018). In North Macedonia, the smoking prevalence is 48.4 percent, which ranks the country far above the European Union (EU) average in terms of tobacco consumption (EU average = 18.4% and global average = 22.3%). (Mijovic Hristovska et al., 2020).

The correlation between the high prevalence of smoking and the low cost of manufactured cigarettes has been well established ((Mijovic Spasova & Mijovic Hristovska, 2018). In North Macedonia, a pack of 20 cigarettes can be purchased for EUR 1.73, which is considerably cheaper than in many other countries. According to the State Statistical Office (2023), the price of one pack of cigarettes varies from 105 denars (1.82 dollars) to 160 denars (2.77 dollars), which is relatively low compared to other countires. In contrast,

the average price for pack of cigarettes in the European Union back in 2019 was 5.23 dollars (EUROSTAT, 2020). North Macedonia has both high smoking prevalence and the region's lowest cigarette prices (Zubović et al., 2019). In addition, North Macedonia has the most affordable cigarettes in the region with 2.55 percent of average GDP per capita required to purchase 2000 cigarettes (Djukić, M, et. al., 2021). Consequently, 44% of adult smokers smoke on average more than 20 cigarettes per day. In comparison, in 2019, 5.9 % of the EU population aged 15 years and over consumed at least 20 cigarettes per day, and 12.6 % consumed less than 20 (EUROSTAT, 2022). The low cost of manufactured cigarettes is likely contributing to the high rates of smoking in the country, as it makes smoking a more accessible and affordable habit for many individuals. In addition, tobacco use among youth is a major concern. According to the Global Youth Tobacco Survey (GYTS) conducted in 2016, around 12.4 percent of students (14.6 percent of boys and 9.8 percent of girls) used tobacco products.

In 2019 a significant proportion of daily smokers in North Macedonia reported attempt to quit smoking due to the high cost of cigarettes (31.6 percent), while 36 percent cited increased awareness of the detrimental health effects of smoking as their primary motivation for quitting (Mijovic Hristiovska et al., 2020). This finding suggests that increases in cigarette prices and increasing knowledge of the adverse effects of smoking might have significant impacts on the reduction of smoking in North Macedonia.
The government has taken steps to address this issue through various measures, such as introducing smoking bans in public spaces and increasing taxes on tobacco products, but the country continues to struggle with high rates of smoking and its associated health problems.

Tobacco control policy in North Macedonia has three main objectives: health promotion, protection of citizens against tobacco use, and an integrated systematic and gender-sensitive approach in policy making on a national and local level that will fit the specific needs and rights of the citizens (Kjosevska, 2017).
Over the previous two decades, North Macedonia has introduced several important tobacco control measures. Beginning in 2003, public smoking was partially prohibited by

the Law on Protection from Smoking, which allowed designated smoking areas in public offices, restaurants, and bars. In 2008, the partial public smoking ban was amended to prohibit smoking in most public places, including schools and other public buildings that accommodate children and young people. A general ban on smoking in public places, including restaurants and bars, came into effect in North Macedonia on January 1, 2010. In early 2018, the Law on Protection was amended, and the smoking ban was weakened by allowing smoking in specially designated areas and open-air terraces.[9]

North Macedonia is one of the 168 countries in the world that ratified the Framework Convention on Tobacco Control (FCTC) in 2006. The country closely followed the recommendations of the FCTC, and as of January 2010 it implemented strict anti-smoking and anti-tobacco advertising measures. A smoking ban was introduced in all public places, including bars and restaurants. Color pictorial health warnings on tobacco packages became mandatory in September 2009 following EU directive 2001/37/EC. These initiatives made North Macedonia one of the top countries in the Balkan region in terms of implementation of strict anti-smoking measures. Additionally, North Macedonia ratified the Protocol to Eliminate Illicit Trade in Tobacco Products on January 8, 2014, together with 53 other countries.

In North Macedonia, the excise of tobacco products is regulated with the Excise Law. Tobacco products that are subject to excise are: cigars and cigarillos, cigarettes, and fine chopped tobacco. Electronic cigarettes and e-liquids are not regulated with Excise Law or any other law. The first significant increase in the excise tax on cigarettes, by 10 percent, was implemented in January 2006. The amendments of the Excise Law in 2013 allowed changes to the existing excise tax rates and the methodology used to calculate these rates. On July 1, 2013, the Excise Tax Law was amended and the excise rate on cigarettes was changed to MKD 1.30 per unit and 9 percent of the retail price for cigarettes (in 2012 the excise was MKD 0.1 per unit and 35 percent of the retail price). As of July 1, 2014, and up to July 1, 2015, the rates of the specific and minimum excise tax on

[9] Law on smoking protection, Official Gazette of the Republic of North Macedonia number 36/95, 70/2003, 29/2004, 37/2005, 103/2008, 140/2008, 35/10,100/11, 2018.

cigarettes were increased by MKD 0.15 per piece. As of July 1, 2016, and up to July 1, 2023, the rates of the specific and minimum excise tax on cigarettes are to increase by MKD 0.20 per piece on July 1 of each year. In 2022, the excise tax on cigarettes amounted to MKD 3.053 per piece and 9 percent of the retail price. In case the combined excise tax (specific and ad valorem) is below the amount of MKD 3.253 per piece, the minimum excise tax in this amount shall apply. In addition, tobacco products taxation includes a value-added tax of 18 percent of the retail price.

Importantly, the current specific excise per 1,000 cigarettes is far from the minimum excise amount prescribed by the European Union.[10] The prescribed level by EU for the minimum level of excise per 1000 cigarettes is EUR 90 compared to North Macedonia's EUR 54 per 1,000. In order to meet the specific excise prescribed by the EU, the country will need to increase the current excise rate by 66 percent. All discussed tobacco control policies are summarized in Table A1.

Table A1. Tobacco control policies (variables) from 1995–2017

Law(s)	Specific measures against tobacco use	Implementation year
Law on Protection from Smoking*	Until 1995 there was no smoking ban. The first law restricting smoking in the Republic of Macedonia was adopted in 1995. This law is the first restriction for advertising cigarettes and trademarks of cigarettes and the tobacco industry in public media. It forbids the selling of cigars and tobacco to persons younger than 16 years. Cigarette manufacturers are obliged to print a message on the front of the package with warning information that smoking is harmful to health.	1995

[10] North Macedonia, as a candidate EU country, is obliged to comply with all EU regulations and directives by the time of entering the European Union. The prescribed level by the EU for the minimum level of excise per 100 cigarettes is 90 EUR. Available at: https://ec.europa.eu/taxation_customs/taxation1/excise-duties/excise-duties-tobacco_en

	In 2008 it is forbidden to advertise tobacco products and the tobacco industry in any form and place.	2008
	An amendment to the partial public smoking ban prohibits smoking in most public places (but not all) including educational institutions and public buildings accommodating small children, young people, and students.	2008
	Distribution of tobacco-branded gifts and other promotional activities is prohibited. This includes promotional games, lottery draws, or any other form of communication with customers, including e-mail and SMS. Tobacco-product-related competitions, as well as the distribution of free prizes or gifts related to internet website visits, are also prohibited by law.	2008
Law on Protection from Smoking* Law on Tobacco and Tobacco Products	Color pictorial health warnings on tobacco packages are mandatory as of September 2009. The Law on Tobacco and Tobacco products regulates the sale of tobacco products and prohibits the sale of these products without printing a health warning on the box.	2009
Excise Law†	All tobacco products sold in Macedonia must have a "customs paid" sign or banderole.	2001, 2006, 2009, 2013
Law on Protection from Smoking* Law on Tobacco and Tobacco Products Law on Broadcasting Activity‡	A general ban on smoking in public places, including restaurants and bars, came into effect in Macedonia on January 1, 2010. The Law on Broadcasting Activity and the Law on Audio and Audiovisual Media Services establish a strict ban on tobacco advertising.	2010

Law on Audio and Audiovisual Media Services§	The Law on Broadcasting Activity establishes a ban on advertising and teleshopping of tobacco and tobacco products. There is also a ban on sponsorship by a natural person or organization whose main activity is the production or sale of products or the provision of services whose advertising is prohibited, such as tobacco and tobacco products. It is forbidden to advertise tobacco products and the tobacco industry in any form and place.	
Law on Protection from Smoking* Trade Law¶	Fines are imposed for private entities and the management of restaurant, bars, and cafes for violation of smoking ban. Fines are imposed for any person smoking in a designated non-smoking area. An establishment in which the public smoking ban is violated can now face a fine of between EUR 2,000 and 4,500, while the facility's manager would have to pay between EUR 500 and 1,000. Finally, any person smoking in a designated non-smoking area, in breach of the respective law, will face a fine of between EUR 150 and 300, or its equivalent value in the local currency (MKD). In July 2011, an amendment to the Law on Protection from Smoking further stipulates new fines for business entities or restrictions of their business operations for between 7 to 15 days.	2011

	Selling tobacco products to children under 18 is banned. In the event of a purchase of tobacco products by minors, a fine in the amount of EUR 8,000 in MKD will be imposed against the legal entity—that is, an individual trader—for an offense of selling cigarettes to persons under age 18 (Article 24 paragraph 1). Any parent or guardian of a minor who purchases tobacco products will also be fined between EUR 500 and 1,000.	
Excise Law†	The first significant changes in the Excise Law related to excise rates for tobacco products occur in 2013. The amendments allow changes to the existing excise tax rates imposed on tobacco goods sold in Macedonia as well as changes to the methodology used to calculate these rates. These changes took effect on July 1, 2013, and they are to remain in effect until 2023. The excise rate on cigarettes changes to MKD 1.30 per unit and 9% of the retail price for cigarettes. (In 2012 the excise had been MKD 0.1 per unit and 35% of the retail price.)	2013

*Official Gazette of the Republic of Macedonia no. 36/1995, 70/03, 29/04, 37/05, 6/07, 103/08, 140/08, 35/10, 100/11, 157/13, 51/18
†Official Gazette of the Republic of Macedonia no. 32/2001, 50/2001, 52/2001, 45/2002, 98/2002, 24/2003, 96/2004, 38/2005, 88/2008, 105/2009, 34/2010, 24/2011, 55/2011, 135/2011, 82/2013, 98/2013, 43/2014, 167/2014, 188/2014, 129/2015, 154/2015, 192/2015, 23/2016, 31/2016, 171/2017, and 120/2018
‡ Official Gazette of the Republic of Macedonia no. 100/2005, 19/2007, decision 2007, decision 2008, 103/2008, 152/2008, 6/2010, decision 2010, 145/2010, 97/2011, 13/2012, and 72/2013
§ Official Gazette of the Republic of Macedonia no. 184/13, 13/14, 44/14, 101/14, 132/14, 142/16, 132/17, 168/18, 248/18 and 27/19, 42/20 and 77/21
¶ Official Gazette of the Republic of Macedonia no. 128/06, 63/07, 88/08, 159/08, 20/09, 48/09, 99/09, 105/09, 115/10, 158/10, 36/11, 53/11, 148/13, 164/13, 97/15, 129/15, 53/16, 11/18, and 120/18

Appendix 2

Variables for the Split-population Model

Table A2. Selected variables for the split-population model

Variable name	Definition	Sample average (2001–2016)
Smoking initiation	Dummy variable for ever trying or experimenting with cigarette smoking	0.19
Cigarette price	Tobacco price index (inflation-adjusted) Per-pack price of Boss cigarettes in MKD (inflation-adjusted) Excise (% of inflation-adjusted per-pack price of Boss cigarettes)	67.54 71.49 40.1
Non-price tobacco control policies	Dummy variables equal to zero in the beginning of the period up until the introduction of the policy change; equal to one after the policy change was introduced policy_2008 policy_2009 policy_2010 policy_2011 Tobacco policy index (sum of all policy variables)	
Current age	Current age of the respondent in the pseudo panel data set, average	11.5
Gender	Dummy variable equal to one if the respondent is female	0.50
Friends smoking	Dummy variable equal to one if at least some of the respondent's friends smoke, by ID	0.54
Parents smoking	Dummy variable equal to one if at least one of the parents smokes, by ID	0.58
Parents smoking (PSU- and grade-based variable)	Percentage of respondents who have at least one parent smoking in a specific grade, sorted by PSU and GYTS survey	0.58

Taught dangers of tobacco	Dummy variable equal to one if the respondent answered that he/she has been taught about dangers of tobacco in any of the classes	0.40
Health concerns	Dummy variable equal to one if the respondent answered that he/she thinks that smoking tobacco is harmful	0.90
Number of observations		55524

Source: Authors' own elaboration

Appendix 3

Robustness check

Table A3. Robustness check – different price indicators

	Model 6	Model 7	Model 8	Model 9
Price per pack – Boss cigarettes	0.823		1.274	
	(0.237)		(0.364)	
Current age	2.356***	2.310***	1.842***	1.827***
	(0.153)	(0.141)	(0.119)	(0.120)
Gender (if female = 1)	0.842***	0.859***	0.884**	0.884**
	(0.049)	(0.049)	(0.049)	(0.049)
I have been taught in class about tobacco dangers			0.919	0.918
			(0.052)	(0.052)
Smoking is harmful			0.804**	0.803**
			(0.079)	(0.079)
Friends smoking			3.633***	3.638***
			(0.238)	(0.239)
Parent smoking			1.792***	1.791***
			(0.106)	(0.106)
Policy			0.959***	0.919**
			(0.014)	(0.037)
Log_t	0.428***	0.498***	0.787	0.782
	(0.086)	(0.098)	(0.161)	(0.160)
Excise (% of price)		0.978***		1.012
		(0.004)		(0.011)
Cure probability (never fail probability)	0.598***	0.576***	0.430***	0.429***
	(0.015)	(0.016)	(0.027)	(0.027)
Observations	52707	52707	52707	52707

Standard errors are shown in parentheses.
* p < 0.10, ** p < 0.05, *** p < 0.01

Table A4. Robustness check – policy variables

	Model 10	Model 11	Model 12	Model 13
Price index (logs)	1.443	1.430	1.345	1.286
	(0.374)	(0.370)	(0.342)	(0.320)
Current age	1.839***	1.837***	1.828***	1.824***
	(0.118)	(0.118)	(0.119)	(0.118)
Gender (if female = 1)	0.884**	0.884**	0.884**	0.884**

	(0.049)	(0.049)	(0.049)	(0.049)
I have been taught in class about tobacco dangers	0.917 (0.052)	0.917 (0.052)	0.918 (0.052)	0.919 (0.052)
Smoking is harmful	0.803** (0.079)	0.804** (0.079)	0.807** (0.079)	0.807** (0.079)
Friends smoking	3.644*** (0.238)	3.643*** (0.238)	3.641*** (0.239)	3.637*** (0.238)
Parent smoking	1.792*** (0.106)	1.792*** (0.106)	1.791*** (0.106)	1.792*** (0.106)
policy_2008	0.816*** (0.049)			
Log_t	0.759 (0.154)	0.763 (0.155)	0.792 (0.162)	0.820 (0.169)
policy_2009		0.818*** (0.049)		
policy_2010			0.833*** (0.049)	
policy_2011				0.830*** (0.049)
Cure probability (never fail probability)	0.430*** (0.027)	0.429*** (0.027)	0.429*** (0.027)	0.430*** (0.027)
Observations	52707	52707	52707	52707

Standard errors are shown in parentheses.
* p < 0.10, ** p < 0.05, *** p < 0.01