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The Effect of Public Policies and Prices on Youth Smoking

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This article empirically tests the effects of various tobacco control measures on youth cigarette demand using a 1996 nationally representative survey among U.S. high school students. Our measures of public policies allow more precise estimates of their impact compared to previous studies. The two-part model corrects for heteroscedasticity and features a novel approach to evaluating youth access laws based on actual compliance rates. This resolves the difficulty of measuring their active enforcement, the lack of which is frequently blamed for insignificant findings with respect to their effectiveness. We found youth access laws to have a negative effect on smoking probability. Relatively strong clean indoor air laws may also reduce the probability of smoking. The presence of all tobacco control policies combined and higher cigarette prices lower both smoking participation and smoking intensity. The teen-specific cigarette price has a larger impact on cigarette demand than commonly tested state average price.

JEL Classification: I18

1. Introduction

Government regulation of the market for tobacco products can be justified in a number of ways. Smoking is associated with market failures such as negative externalities and imperfect information among market participants, and these failures provide one rationale for government intervention. Another is the huge health care costs associated with the health consequences of smoking. The cost of medical treatment for smokers and second-hand smokers inflates health insurance premiums for everyone, regardless of smoking participation; in addition, many of these expenses are paid from public funds.

Youth is of particular interest for public policy makers and economists who study smoking behavior. The evidence from recent economic studies indicates that adolescents are significantly more responsive than adults to changes in cigarette prices (U.S. Department of Health and Human Services [USDHHS] 1994). In addition, the vast majority of smokers complete their initiation prior to their 21st birthday (Gilpin et al. 1994). Therefore, focusing preventive efforts on youth seems to be the most effective way to achieve a long-term reduction in smoking prevalence. Public policy makers are also concerned with youth-specific smoking externalities. Almost all first use of cigarettes occurs during the high school years (Kessler 1995). At that age, consumers typically underestimate the health consequences of smoking and the risk of nicotine addiction (Kessler 1995; Johnston, O'Malley, and Bachman 2001), thus underestimating the price of smoking to them.

The annual prevalence of cigarette smoking in the United States has been declining since the 1970s, stabilizing in the 1990s with approximately 62 million smokers in 1996, which represented

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23.2% of the U.S. population (USDHHS 1996). Even though this figure is not high relative to smoking in other countries (the world average smoking prevalence in 1997 was 29%; World Health Organization, 1997), the declining trend in cigarette consumption has substantially slowed in the 1990s.

It is particularly troubling that the slight decrease in smoking prevalence among adults in the 1990s was accompanied by an increase in smoking participation among youth and young adults. The evidence of this trend was detected in several nationally representative surveys. For example, the 1997 Youth Risk Behavior Survey (YRBS) reported an increase in average smoking prevalence among high school students from 27.5% in 1991 to 36.4% in 1997. According to the Centers for Disease Control and Prevention, the number of 12th grade high school students who started smoking as a daily habit jumped from 708,000 in 1988 to 1,200,000 in 1996, an increase of 73% (CDC 1995, 1996, 1997, 1998).

However, statistics at the end of the 1990s suggest a respite from this trend in increased youth smoking prevalence. The YRBS reported a decline in smoking participation for 9th graders between 1997 and 1999 (by 17%), but very little change for 10th and 11th graders (decline by 2%), and a slight increase in smoking prevalence among 12th graders (by 8%). In 2000, the Monitoring the Future Surveys (MTFS) reported a decrease in smoking participation among all three surveyed high school ages (Johnston, O'Malley, and Bachman 2001).

There is an economic explanation for this trend in smoking prevalence among youth. Even though the federal cigarette excise tax was raised twice in the beginning of the 1990s, real prices of cigarettes fell in the subsequent period. Between 1993 and 1996, the real price of a pack of cigarettes, adjusted for inflation, dropped by 10% (Tobacco Institute 1997). Real cigarette prices began to rise again toward the end of the 1990s. Between 1997 and 1999, the real price of a pack of cigarettes adjusted for inflation increased by 48% (Orzechowski and Walker 2000). This sudden change was partly triggered by a new financial liability of tobacco companies toward 46 states under the Master Settlement Agreement (November 1998) amounting to a $206 billion financial burden for the industry over the following 25 years. The increasing smoking prevalence among youth and young adults in the early 1990s and its decreasing trend toward the end of the decade suggest that this age group is highly sensitive to cigarette price incentives.

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

Not all states were similarly aggressive as far as the taxing of tobacco and antismoking policies are concerned. Over time, the differences between state levels of taxation began to widen. The largest gap developed between tobacco producing and nonproducing states. As of November 1, 2002, state excise taxes ranged from 2.5 cents a pack in the state of Virginia to $1.51 a pack in Massachusetts. Tax differences on state and municipal levels create incentives for interstate smuggling. Certain states are also particularly known for their strong antismoking policies, the most outstanding being Arizona, California, and Massachusetts. This may result in smokers self-selecting to states with less stringent smoking restrictions, which may further complicate the evaluation of the real effect of these policies on smoking behavior.

At the beginning of the 1990s, the federal government took the initiative in the area of enforcement and inspection. For example, in July 1992, Congress passed the Synar amendment requiring states to enact and enforce laws that prohibit tobacco sales to consumers under the age of 18. Under the regulations of this amendment, states must actively inspect and enforce the laws. They must

demonstrate (by conducting annual, random, and unannounced compliance checks of retailers selling tobacco products) that the age limits access laws are being enforced. Otherwise, they are subject to reductions in their substance abuse block grant funds. However, in 2001 the General Accounting Office expressed some doubts with respect to the methods and accuracy of the enforcement data because states had an incentive to underestimate violation rates.

The differences in cigarette prices, public policies, and their enforcement across states provide health economists with an opportunity to assess their effects on the demand for cigarettes. These findings are relevant not only for the formulation of health policy in the United States, but also in other countries, thus helping curb the global tobacco epidemic.

2. Previous Research

The first economic studies addressing the issue of adult versus youth cigarette demand appeared in the 1980s. Lewit, Coate, and Grossman (1981) studied the smoking behavior of young respondents (12–17 years old) in the years 1966–70. Using a two-part model, they estimated an overall price elasticity of −1.44, which largely exceeded the previous estimates based on macro data studies. The authors hypothesized that young consumers might be more price responsive than adults because of lower disposable income. They also found that antismoking advertising had a negative effect on smoking participation, but it did not change the number of cigarettes consumed by smokers.

Wasserman et al. (1991) studied adult and youth smoking behavior while controlling for state level antismoking regulations. Contrary to previous estimates, they found an insignificant effect of price on the amount smoked by young smokers. The authors attributed this result to a positive correlation between cigarette prices and state smoking policies. They argued that models that do not control for public policies produce upward-biased estimates, since they ignore this correlation (an omitted variable bias).

Chaloupka and Grossman (1996) used the Monitoring the Future data on 110,717 high school students from 1992 to 1994 to study price elasticities, the effects of smoking restrictions, and the effects of rules limiting youth access to tobacco products. Their two-part model controlled for cigarette excise taxes and estimated price elasticities between −0.846 and −1.450, supporting the hypothesis about higher responsiveness of youth to cigarette price changes.

Gruber (2000) estimated a state fixed effects model with a time trend employing survey data from two different sources: the Monitoring the Future Surveys (1991–1997) and the Youth Risk Behavior Surveys (1991–1997). He found that older teens (17–18 years old) are relatively more responsive to price (price elasticity of smoking prevalence −0.67) than younger teens (13–16 years old), whom he did not find price sensitive at all. However, the author did not address the issue of smoking uptake or social versus commercial sources of cigarettes for these different age groups.

DeCicca, Kenkel, and Mathios (2001) used the 1988 National Education Longitudinal Surveys to estimate ordered probability models and discrete time hazard models of smoking onset. They found no significant effect of state taxes on the smoking onset among high school students. However, taxes were measured only in three different time points within a state, reducing their variation. The same model estimated without state fixed effects found a negative and significant effect of price on smoking initiation. The results of this study apply only to regular smokers, not to experimenters or occasional smokers.

While estimates of price sensitivity vary from study to study, the current consensus among health economists is that youths are more price responsive than adults, with the overall price elasticity of youth cigarette demand being in the range of −0.9 to −1.5 (USDHHS 1988).

Several economic studies have evaluated the effect of clean indoor air laws on youth cigarette demand. For example, Chaloupka (1991) applied his rational addiction model on longitudinal data and concluded that smoking restrictions in public places have a negative effect on average cigarette consumption.

Chaloupka and Grossman (1996) employed a two-part model to assess the effects of smoking restrictions. In order to avoid the problem of highly correlated policy variables, they controlled for each of them one by one in separate models of cigarette demand. This approach produced a smaller standard error and higher price elasticity compared to a model including all policy variables. However, these estimates suffered from an omitted variable bias. The authors concluded that cigarette control policies (restrictions on smoking in restaurants, in retail stores, and in private work) had little impact on the average number of cigarettes smoked by smokers, but that they reduced smoking participation among students if the policies were relatively strong.

Chaloupka and Wechsler (1997) also used data on college students and a two-part model to find that relatively stringent limits on smoking in public places had negative and significant effects on smoking participation, and some restrictions could reduce the quantity of cigarettes smoked by smokers.

Gruber (2000) applied a state fixed effects model with a time trend to evaluate five different clean indoor air laws, each one represented by an individual dummy variable. He did not find them to have a significant effect on youth cigarette demand. However, Gruber admitted that high correlation among these variables and their small variation within a state may have disguised their true effect.

To summarize, current economic literature does not provide a clear answer as to the effect of clean indoor air laws on youth cigarette demand, even though there is some evidence that relatively strict regulations may be effective in reducing the demand for cigarettes.

The issue of youth access to tobacco products has received a lot of attention among public policy makers in the United States since the mid-1990s. However, there is very little economic evidence that these supply-side measures affect youth cigarette demand as intended. Jason et al. (1991) evaluated the reaction of local merchants and high school students to newly introduced restrictions on youth access to cigarettes in a suburban community of Chicago. They found that active enforcement of the law by regular compliance checking led to a substantial reduction of cigarette sales to youth (sales rate dropped from 70% to 5%), to a reduction of experimentation and regular smoking among junior high school students (by over 50%), and to an increased community awareness of the problem of adolescent smoking.

Chaloupka and Grossman (1996) studied the effects of rules limiting youth access to tobacco products using a two-part model. The authors controlled for the existence of the law (but not enforcement or compliance) by a dummy variable. They found that these limits had very little effect on either smoking participation or smoking intensity and hypothesized that weak enforcement might be responsible for these findings.

Rigotti et al. (1997) tested the effect of enforcement on youth access to tobacco and on youth smoking behavior in a 2-year controlled study in Massachusetts. By use of multiple logistic regressions to estimate mixed-effects models, the study concluded that even though the compliance of local retailers increases in controlled communities (82% compliance rate as opposed to a 45% compliance rate in communities with no special enforcement measures), the effect on youth access was small (ability to purchase decreased a little), and there was no effect on tobacco use in the controlled communities.

Chaloupka and Pacula (1998) examined the effects of youth access restrictions while controlling for monitoring and enforcement of and compliance with these laws. Using the 1994 Monitoring the Future Surveys data on high school students, they found that most state and local tobacco control

policies did not have statistically significant effects on youth smoking with the exception of relatively strong restrictions. However, the combined effect of all antismoking measures on smoking participation was negative and statistically significant.

Gruber (2000) tested the effect of youth access laws using a state level youth access index that he augmented based on the measure developed by Alciati et al. (1998) for the National Cancer Institute. His state fixed effects model indicated that youth access restrictions may reduce the quantity of cigarettes smoked by young smokers.

So far, the economic literature has not provided clear evidence on the effect of tobacco control measures other than price on youth cigarette demand. The absence of clear results from various studies is usually attributed to measurement errors, high level of correlation among various policies, lack of enforcement, and the endogenous nature of policy variables in the cigarette demand equation. The analysis in this paper is based on a novel approach to assessing tobacco control policies aimed specifically at youth—youth access laws. It overcomes the difficulty of measuring active enforcement by evaluating the impact of actual compliance with the law. Further, it studies the effect of clean indoor air laws by creating an index reflecting both state and local restrictions. Employing this index, which is more comprehensive than indices used in previous studies, helps to deal with the problem of multicollinearity among numerous policies regulating smoking behavior.

3. Data and Methods

The data on cigarette smoking among high school students were collected for the project "The Study of Smoking and Tobacco Use among Young People," which is funded by the Robert Wood Johnson Foundation. Audits and Surveys Worldwide (ASW) conducted the survey between March and June of 1996. All questionnaires were self-administered, and participants were assured of the anonymity and confidentiality of their responses. A total of 17,287 questionnaires were completed and processed.

The participating 202 high schools included all types of schools in the United States—public, private, and parochial. The original sample of institutions was drawn in four parts. The first part represented a core sample of 100 U.S. high schools. The second part was a supplementary sample of 40 schools from areas heavily populated by African Americans. The third part, also a supplementary sample, consisted of 40 schools from areas heavily populated by Hispanics. The last part was drawn from a supplementary sample of 20 schools from high poverty areas. Because the final set of high schools oversampled schools in African American, Hispanic, and high poverty communities, different weights were employed to account for this fact. On average, 80% of the students in the sample of selected classes participated in the study taking into account both absenteeism and students who chose not to participate. The descriptive statistics for the weighted survey sample are listed in Appendix Table A1.

Two measures of youth cigarette smoking are constructed from the survey data. The first is a dichotomous indicator of smoking participation assuming a value of 1 if a person smoked at least 1 day in the last 30 days before the survey, 0 otherwise. This variable defined a smoker for the purpose of this study. Of the sampled population of high school students, 31.4% are smokers, which is comparable to smoking participation estimated in other nationally representative surveys in the United States from the same period.[1]

[1] For example, the 1996 Monitoring the Future Survey estimated that smoking prevalence among 10th grade high school students was 30.4%. The Youth Risk Behavior Survey estimated 36.4% smoking prevalence among all high school students in 1997.

The second measure of smoking is a continuous variable and describes the average number of cigarettes consumed during the last 30 days before the survey. According to the survey, an average high school smoker consumes 163 cigarettes per month (about 6.5 cigarettes per day). However, there is a substantial variation among students. The median of the monthly cigarette consumption for the sample is 45 cigarettes, which indicates that the majority of the high school smokers are infrequent, experimental smokers.

One of the unique features of this survey is that it obtained information on students' perceptions (both smokers and nonsmokers) of the price of a cigarette pack. The primary advantage of this price measure is that it is teen specific. Young smokers generally differ from adult smokers in brand choices, packaging preferences, preferred points of sales, and sources of cigarettes (Johnston et al. 1999). Given these differences (confirmed by the behavior of the survey sample), combined with the relatively low reported monthly cigarette consumption, we would expect teens to pay higher average sales prices for cigarettes than adult smokers (state average price provided by the Tobacco Institute reflects mostly an adult smoker behavior). Comparing the means of perceived prices ($2.353) with the mean of state average cigarette price obtained from the Tobacco Institute ($1.890) confirms our expectation. The second advantage of perceived price as a measure is that it is local specific, reflecting the influence of local cigarette taxes and price promotions that are not captured by state level prices. Using this price measure in the cigarette demand equation can provide more accurate estimates of youth responses to cigarette price changes.

The main disadvantage of perceived price is its potential endogeneity.[2] People who smoke have an incentive to search for lower cigarette prices, causing a downward bias in the perceived price. On the other hand, smokers may have better information than nonsmokers as far as true cigarette prices in the area. The problem of endogeneity was partly alleviated by creating the variable average perceived price across students in each high school and excluding the individual's own perception. Thus each individual within a school who reported cigarette price has a slightly different average price measure. In order to retain observations on students who did not provide their perception of cigarette prices, a school average perceived price (based on the rest of the students who answered the question) was assigned to them.

In addition to the perceived price, an average state price of a cigarette pack was matched to the survey based on the location of the respondent's high school. This price (in cents) represents a weighted average of single pack, carton, and vending machine cigarette prices in a state, including state excise taxes. Prices of both branded and generic cigarettes were used to compute the average. The state average price is the most comprehensive measure of price in this study. It was obtained from a reliable source (the Tobacco Institute), and it does not suffer from an endogeneity problem. However, it represents an average price for an average smoker, including adults, and this price may not accurately reflect prices that youths face. In addition, state average price is not local specific and it does not include local cigarette taxes. Using this price measure in the cigarette demand equation will provide estimates that are directly comparable with those in the literature but may not be youth specific. Comparing results based on cigarette demand models with two different prices will reveal how sensitive the estimates are with respect to the price measures employed in the model. The descriptive statistics for the state average price are recorded in Table A2.

There are two additional price-related variables matched to the survey. They control for the possibility of cigarette smuggling between states. The first variable is continuous and it is defined as

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[2] A statistical test for endogeneity of the perceived price variable cannot be performed because the second equation of the system with the perceived price as the dependent variable cannot be identified.

the difference between state average price in each youth's state of residence and state average price in the lowest price state within 25 miles of the youth's county of residence. If the respondent lives in a county that is more than 25 miles from the state border, or the state across the border has higher cigarette prices, the value of this variable is zero. The second variable is defined much like the first one, but it represents the difference in state excise taxes between states for those respondents who live in a county within 25 miles from the neighboring state. The difference between average state prices controls for smuggling in models using state average price; the difference between state taxes is used in models with average perceived price. The failure to account for smuggling incentives can lead to an underestimating of the price elasticity of the cigarette demand equation. Table A2 shows the descriptive statistics for the two smuggling variables.

Recognizing that tobacco control policies can be important determinants of youth smoking, this analysis also matched these measures to the survey data based on each respondent's location code. There was some risk that these policies can also capture state and local sentiment toward smoking and toward youth access to tobacco products, which makes them potentially endogenous. Fortunately, the problem of respondents' self-selection according to their smoking status is minimal in this analysis because high school students usually have little influence on household location decisions. The inclusion of public policies into cigarette demand equation improves the quality and precision of resultant price estimates. If the policies are omitted and they happen to be positively correlated with a price measure, the price effect on smoking will be overestimated (Wasserman et al. 1991).

There are two groups of public policies controlled for in the models, each of them recorded at three governmental levels: state, county, and city/town. The first group includes clean indoor air (CIA) laws such as smoking restrictions in private workplaces, smoking restrictions in restaurants, smoking restrictions in shopping areas, and smoking restrictions in other places (including government workplaces). The second group is linked to laws restricting youth access to tobacco products: restrictions on sale of cigarettes through vending machines and bans on distribution of free cigarette samples.

The state level data were obtained from the Centers for Disease Control and Prevention (CDC). Over the years, the CDC (CDC 2000) has created a comprehensive system for collecting data on state tobacco control legislation, and it is considered a very reliable source of information. The measurement error, which can bias estimated coefficients toward zero, should be relatively small in these data. Another advantage of the state level data over the county and city/town levels data is their territorial coverage: If a law is enacted at the state level, it generally applies to the whole territory of the state. It becomes more difficult to avoid state regulations for youth with relatively limited mobility as compared to local laws, which can be avoided by much shorter travel. For this reason, state regulations are expected to be more effective.

The Americans for Nonsmokers' Rights organization (ANR 1997) provided the county and city/town level data. The system for collecting information on antismoking legislation from counties and cities/towns is relatively new. There are still numerous local restrictions/regulations that are not tracked centrally. This analysis assumes that if a county or a city is not included in the ANR data set, no local antismoking policies exist in this area. In addition, if a policy exists on the county level, it is not certain that all parts of the county are subject to it (depending on incorporated/unincorporated status of the location). Because it was impossible to distinguish between nonexistence of policies and missing observations, the information on policies might not be always accurate. Owing to the problems with the local level data, a model assessing their impact by controlling for state specific effects would not provide reliable estimates. To reduce coefficients' biases caused by the possible measurement error, the county and city policy data were combined with the state level data. The

resulting policy variables represent the existence of either state or county or city policy in a location. They are comprehensive measures of public policies to which a smoker is exposed. Their descriptive statistics can be found in Table A2.

Many factors can change the intended impact of a policy. One of them is the existence of state law preemption over local legislation. Preemption is a provision in state (or federal) law that eliminates the power of local (or state and local) governments to regulate tobacco. Preempting local tobacco policy with weaker state or federal laws can positively affect demand for cigarettes. A dummy variable for the existence of preemption of local policies controls for the effect of this provision.

Another factor affecting policies' impact is their active enforcement. Four dummy variables were created to account for the existence of enforcement laws. The variables indicate whether a civil or a criminal penalty is imposed for noncompliance with youth access laws, whether the minor is subject to a fine if he/she breaks these laws (as opposed to the sales person or the license holder), and whether graduated fines (both criminal or civil) exist for a repeated offense of youth access policies.

Both the enforcement and preemption data came from the Synar Regulation State Summary FFY97 (USDHHS 1997), a report on enforcement efforts that each state must provide to the federal government. The FFY97 summary details the situation in fiscal year 1996, the year of the respondents' survey. The descriptive statistics for these variables are in Table A2.

A preliminary regression analysis using the ordinary least squares (OLS) method has determined that the tobacco control policies employed in this study are collinear.[3] Collinearity causes coefficient estimates to be sensitive to a model's specification and increases their standard errors. One of the possible ways to deal with the presence of multicollinearity is to have one policy represent the whole set of policies in an equation. However, this method will likely lead to an omitted variable bias.

Another way to address multicollinearity is to create an index that represents a whole group of public policies. One index was constructed for CIA laws by adding up all dummy variables, each representing the existence of a particular CIA restriction, regardless of the governmental level adopting the policy. Another CIA index represents only complete, 100% restrictions. The maximum of each index is 4 and the minimum is 0. The descriptive statistics for both indices can be found in Table A2. The disadvantage of using an index in an analysis is that it implicitly assigns each included policy the same marginal effect on cigarette demand. This limitation must be taken into account when interpreting the results.

The evaluation of the effects of youth access laws on youth smoking is also challenging. Previous studies attribute the small or insignificant effect of these restrictions to the lack of active enforcement (Chaloupka and Grossman 1996; Chaloupka and Pacula 1998). In order to measure the real effect of youth access laws, data on compliance with these laws were added to the survey from State Synar Profiles. A simple regression analysis revealed that compliance is a positive function of three enforcement measures (the exception is fines for minors). Compliance (the descriptive statistics are in Table A2) is also a function of vending machines restrictions and bans on free cigarette sample distribution. Therefore, the level of retailers' compliance with age limits on cigarette purchase can serve as a proxy for both existence of and active enforcement of youth access laws.

Because some of the dependent variables are of a limited nature, corresponding econometric methods had to be employed. A two-part model of cigarette demand is estimated based on a model developed by Cragg (1971) in which the propensity to smoke and the intensity of cigarette consumption are modeled separately.

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[3] Several correlation coefficients based on Pearson correlation coefficients reach up to level 0.6; the condition index ranges from 95 to 104, depending on the price measure used in the regression; and the variance inflation factors exceed 3.2.

In the first step, a smoking participation equation is estimated by using a probit specification for complex survey samples. The second part of the model estimates smoking intensity (monthly cigarette consumption) only for those who are defined as smokers. Because the error term in this equation is heteroscedastic and not normally distributed, the generalized linear model (GLM) is employed. A diagnostic Park test for correct distributional function suggested the use of a gamma family distribution with a log link function for the GLM[4] (Manning and Mullahy 2001).

All models control for basic sociodemographic characteristics of an individual, income variables, cigarette prices, smuggling incentives, and public policies in various ways. An analysis evaluating the effects of an aggregate variable (such as state average price) on microlevel data (e.g., smoking among survey participants) can bias estimates of standard errors downward if individual disturbances are not independent within a group. Even though this interdependence does not bias coefficients, not accounting for it can lead to spurious findings of statistical significance of aggregate regressors (aggregate price measures and public policies in this case). To avoid this bias, the t values were adjusted for clustering at the state level using the STATA cluster form of the Huber–White variance estimator (Huber 1967; White 1980), which is robust both as to heteroscedasticity and as to within-cluster dependence. The state level clustering option controls for the multiple levels of clusters because the STATA variance estimator used for complex sampling surveys allows any amount of correlation or clustering within the primary sampling units. This estimator is more robust compared to those explicitly accounting for secondary sampling because they rely on more assumptions.

The effect of price is expressed as price elasticity. Three types of price elasticity can be computed from the two-part model: participation (or prevalence) price elasticity, conditional demand (or consumption) price elasticity, and total price elasticity. Participation price elasticity, based on the probit models, is an estimate of the percentage change in youth smoking prevalence when cigarette prices increase by 1%,

$$\varepsilon_1 = \sum(dP_i/dPr_i)/n \times \left(\sum Pr_i/n\right) \Big/ \left(\sum P_i/n\right),$$

where ε_1 represents participation price elasticity, P_i represents the probability of smoking of individual i, Pr_i represents price an individual i is exposed to, and n represents the number of respondents.

The price coefficients from the GLM form the base for estimating conditional demand price elasticity. It measures the percentage change in the average number of cigarettes smoked by those who continue to smoke even after a 1% change in cigarette price,

$$\varepsilon_2 = d(\ln C_i)/dPr_i \times \left(\sum P_i/n\right),$$

where ε_2 represents conditional demand price elasticity, C_i represents the number of cigarettes for individual i conditional upon smoking, and the rest of the variables are defined as above.

Total price elasticity summarizes the total effect of cigarette prices on cigarette demand while taking into account the nonlinearity of both functional forms. The slope for computing this elasticity is obtained as the average of the slope of smoking probability multiplied by conditional demand, and the slope of smoking intensity among smokers multiplied by the probability of smoking,

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[4] Alternatively, it is possible to apply White's (1980) heteroscedastic estimator on an untransformed dependent variable. This approach also leads to consistent variance and covariance estimates.

$$\Psi = dP_i \times C_i + P_i \times dC_i, \qquad \varepsilon = \Psi \times \left(\sum P_i/n\right) \Big/ \left(\sum C_i/n\right),$$

where Ψ represents average marginal effect, ε represents total elasticity, and the rest of the variables are defined as above.

The marginal effects and the level of statistical significance from the cigarette demand equation assess the effect of various public policies.

4. Results

Table A3 in the Appendix displays the effects of individual public policies on smoking participation and on smoking intensity among high school students.

The first column of the table lists the public policy and price variables included in the model. The second and third columns represent marginal effects of these variables on the probability of being a smoker in two models, each using a different price measure. The fourth and fifth columns show the policies' marginal effects on smoking intensity among smokers, again from two models controlling for two different prices. The numbers in parentheses represent standard errors adjusted for clustering. The last row of the table contains participation (second and third columns) and conditional demand (fourth and fifth columns) price elasticities.

Only some policies have the expected effect on youth cigarette demand represented by these models. Restrictions on smoking in restaurants have a negative effect on both smoking participation and smoking intensity with the coefficients being statistically significant (at the 10% level) in two out of four models. Smoking restrictions in shopping areas and limiting cigarette sales through vending machines may reduce smoking participation, but results are not statistically significant. Restrictions on smoking in private workplaces and in other places and bans on free samples distribution do not have the expected results.

Apart from the policies themselves, the enforcement of youth access laws may have a negative effect on smoking participation (with the exception of imposing a fine on a minor), but the results are mostly not statistically significant. The existence of graduated fines for vendors' repeated offense might possibly reduce smoking probability. Preemption of local laws by state legislatures and smuggling opportunities are associated with increased smoking prevalence, but only the results for smuggling are statistically significant. All public policies variables exhibit joint significance under both the nonlinear Wald test and likelihood-ratio test.

Higher prices negatively affect both smoking prevalence and smoking intensity in all of these models. However, state average price is not significant in the conditional demand equation. It is possible that the presence of multicollinearity is responsible for this finding. The differences between state average prices are primarily based on differences in state excise taxes. Because taxes represent one of the tobacco control policies, they are highly correlated with other antismoking measures. When the equation uses average perceived price instead, the multicollinearity is substantially reduced and the price effect is negative and significant even in the second part of the model. The total price elasticity (taking into account the nonlinearity of functional forms) based on the model using the state average price is -0.589, and -0.916 based on the model using the average perceived price.

Table A4 presents results from the youth cigarette demand models, which control for one policy variable at a time, and for the two price-related variables—cigarette prices and smuggling incentives. These models demonstrate how individual policies affect cigarette consumption when multicollinearity is eliminated at the expense of introducing omitted variable bias.

All CIA policies have the expected sign in the first part of the model and, with the exception of restrictions in private workplaces, are statistically significant. The nonsignificant effect of workplace restrictions, which were found to be associated with lower cigarette consumption in some previous studies (Evans, Farrelly, and Montgomery 1999), can be attributed to limited exposure of high school students to these restrictions.

The effect of CIA on smoking intensity is less clear. Marginal effects are mostly negative, but not statistically significant. The only significant result (CIA in other places) has an unexpected sign. It is possible that these other restrictions capture the effects of some unobservable characteristics not being controlled for in the model. In addition, this variable represents rather mild restrictions, which are often adopted for the image if not accompanied by more stringent measures.

Variables controlling for youth access restrictions have either an insignificant or an unexpected effect on youth smoking behavior. This confirms previous findings with respect to these variables (Chaloupka and Pacula 1998) and possibly relates to weak enforcement and poor compliance with the law.

None of the enforcement variables has statistically significant impacts on cigarette demand. However, with the exception of fine for minor, they all have a negative sign in the second part of the model, indicating a possible impact on the number of cigarettes consumed by smokers. The anecdotal evidence suggests that police officers confronted by other serious crimes pay limited attention to imposing penalties for breaking tobacco control measures—a possible reason for the weak performance of the enforcement variables in the models. The positive effect of punishing minors for use or possession of cigarettes is also not surprising, given the popularity of this policy among tobacco companies. This provision puts the responsibility on the minor rather than on the retailer, who still has the incentive to maximize sales.

Preemption of local and/or state tobacco use restrictions increases the probability of being a smoker, and it may also enhance smoking intensity, but the results are not statistically significant. Price and smuggling variables in these models performed similarly to the model controlling for all policy variables—price coefficients are negative and significant with the exception of state average price in the second part of the models; smuggling incentives have a positive impact on smoking decision but an insignificant effect on smoking intensity. Students may not be sufficiently mobile or smoke with enough intensity to take advantage of cheaper cigarettes across the border, but they may consider this possibility for their future purchases. The smuggling variable may also capture peer effect on the decision to smoke.

Econometric complications with estimating the effect of individual tobacco control measures led to the final model specification (Table A5) where the group of CIA variables is replaced by the CIA index and the youth access measures and their enforcement are represented by compliance with these laws. There are two model variations: The top of the table presents model I, which controls for all CIA laws by an index; the bottom of the table presents model II, which controls for only complete, 100% CIA restrictions (also by an index). The column headings indicate the first (probit) and the second (GLM) part of the model as well as the price measure employed in the regression. The variables of interest are listed in the first column of the table.

The index representing clean indoor air (CIA) laws has a negative coefficient in both parts of the model, and this result is independent of the price measure used in the regression. However, the results are not statistically significant. A possible interpretation of the lower significance is that the selected restrictions, such as restrictions in private or government workplaces, are of low importance to high school students. In addition, a possible measurement error in the index variable, particularly with respect to restrictions at local levels, can bias coefficients toward zero.

The 100% CIA restrictions in model II also exhibit negative coefficients, which are larger and more statistically significant than in model I. This is an indication that stronger restrictions are more effective in achieving the expected results with respect to youth smoking behavior. Results for the second part of the model are statistically not significant. These findings indicate that CIA laws may affect the decision of high school students of whether to smoke or not, but may not influence smoking intensity among current smokers.

The coefficient of the preemption variable, which controls for nonexistence of local tobacco controls, is positive in all models and statistically significant in their first parts. This suggests that the tobacco companies' strategy to lobby for state preemption clauses in order to control fragmented local legislation is successful and leads to a higher smoking prevalence in the area. The result can also be interpreted as local laws creating, more effectively than state laws, an atmosphere where smoking is a behavior of lower social acceptance. The hypothesis about tobacco control policies being a reflection of local sentiment toward tobacco would correspond to this finding.

Retailers' compliance with the youth access laws, which serves as a proxy for the laws' existence and their active enforcement, has a negative effect on both the decision to smoke and smoking intensity. The results are statistically significant in the first part of model I (under a two-tailed test indicated in the tables) and in the first part of model II (under a one-tailed test). This leads to a conclusion that youth access restrictions have a negative effect on smoking prevalence and perhaps smoking intensity among high school students when they are complied with. The previous findings in the literature regarding poor performance of the youth access laws may have been affected by the failure to control for actual compliance with these laws. The result is subject to the assumption that the compliance variable is not endogenous to the cigarette demand model reflecting local sentiment toward smoking.

The variable controlling for smuggling has the expected positive and statistically significant coefficient in all first parts of the models. The nonsignificant result in the smoking intensity equation may reflect the fact that high school students are less mobile and buy smaller numbers of cigarettes compared to adult smokers. These constraints make cigarette shopping outside the state unattractive. However, the inclusion of the variable in the model is necessary for obtaining unbiased price coefficients.

Price has a negative effect on both probability to become a smoker and on number of cigarettes consumed by a smoker. The results are highly significant with the exception of state average price in the second part of the model. Price elasticities for both price measures are recorded in the last rows of model I and model II. The total price elasticity (taking into account the nonlinearity of functional forms) for state average price is -0.722 (model I) and -0.763 (model II), and for average perceived price -0.997 (model I) and -1.003 (model II). Given that state average price is a price measure more suitable for an average smoker, who is expected to be less price sensitive compared to a young smoker, the elasticities based on this price measure constitute a lower limit of youth cigarette demand elasticity. The price elasticities computed from models with the average perceived price are considered an upper limit of youth cigarette demand elasticity due to the potential endogeneity of this price measure. Comparing these elasticities with the estimates in the existing literature, they fall into the lower range of consensus on youth price elasticity, which is between -0.9 and -1.5. The price elasticity results are, for example, comparable to those in Chaloupka and Grossman (1996).

The estimates for the socioeconomic and demographic determinants of cigarette demand in the final model specification with state average price and CIA index (model I) are presented in Table A6. The results generally conform to expectations. Age raises both the probability of becoming a smoker and monthly cigarette consumption. Female high school students are more likely to smoke than their

male counterparts, but men smoke with higher intensity once they decide to pursue the habit. White students are more likely to smoke than black, Hispanic, and Asian students, and they also smoke more cigarettes per month. Black students are the least likely to smoke, and if they do, they smoke the smallest amount of all races. Frequent attendance at religious services has a strong inverse relationship with smoking, and even weaker religiosity reduces smoking intensity. Those who live alone have a higher probability of smoking compared to those who live with parents. An incomplete family (e.g., when parents are separated/divorced, or if one of them deceased) is another factor positively affecting youth smoking. Parental educational attainments (a proxy for the family income) do not generally affect the smoking decision at a statistically significant level, but more educated fathers may have a negative influence on their children's smoking participation. On the other hand, mother's education, which increases her probability of being employed and spending less time with her children, may increase the probability of her children smoking. Students' personal income, as described by the number of hours worked and by the amount of pocket money, has a positive and significant effect on both smoking participation and smoking intensity.

5. Summary and Discussion

This analysis evaluated the effect of numerous public policies and cigarette prices on youth smoking behavior. The estimates were refined by controlling for the existence of preemption and enforcement efforts toward these laws. In addition, the study assessed the effectiveness of youth access restrictions through the actual compliance with the law, thus overcoming the problem of inadequate enforcement. The availability of information on both state and local restrictions further improved the accuracy of estimates compared to most previous studies. The results indicate that both prices and other public policies can be used to curb youth cigarette smoking.

The analysis including all public policies in one model produced mixed results due to the difficulty of separating their individual effects. Nevertheless, the estimates suggest that the best candidates for a successful antismoking policy are smoking restrictions in restaurants. Other factors that may negatively affect youth smoking intensity are the existence of civil penalties and graduated fines for repeated offenses of youth access laws. Civil penalties have a higher probability of being enforced because police officers usually consider them more appropriate for the seriousness of the offense. The possibility of gradually increasing the punishment also gives police an option to initially impose a less severe penalty. Punishing a minor for cigarette use is not associated with lower cigarette demand. It does not change the incentives of cigarette sellers (does not affect cigarette supply), and teenage smokers may see this law as a chance to challenge the society's rules put in place by the older generation. However, the combination of all tobacco control policies in this model is joint significant and reduces youth cigarette demand.

The assessment of individual policies free from the effect of other tobacco control measures suggests that some CIA restrictions can reduce smoking participation, but they may not affect smoking intensity. Graduated fines for repeated offenses performed best out of all enforcement variables in terms of statistical significance negatively affecting both smoking intensity and smoking participation. As in the previous model, fines for minors do not affect youth behavior in the intended way, which may explain why this policy is favored by the industry at the expense of other, potentially more effective measures. However, all these results must be interpreted with caution, since omitted variable bias may mask the true effects.

Preemption of local or state tobacco control measures is linked to higher youth cigarette demand. The results are statistically significant in the first part of the model and suggest that local regulations are more effective compared to laws adopted by state or federal legislatures. However, this finding, as well as findings regarding other public policies, is subject to the condition that policy variables are exogenous in the cigarette demand equation. If they instead reflect state sentiments toward smoking, the interpretation of the results can be problematic.

The final model specification employed an index representing all clean indoor air laws and replaced youth access laws and their enforcement by the actual compliance with those laws. This approach attempted to solve the problems of multicollinearity and omitted variable bias encountered in the first two model specifications. Even though the use of an index is not without limitations, its coefficient summarizes the overall impact of a certain policy type. Compliance with youth access laws serves as a proxy for existence, enforcement, and compliance with the law, which allowed assessing the true effect of these restrictions. The majority of the clean indoor air index coefficients are negative, but only one of them, representing the 100% restrictions, passes the test of statistical significance in the model of smoking participation. Larger coefficients for 100% CIA restrictions suggest that complete smoking restrictions are more effective in reducing cigarette demand compared to partial restrictions.

Assessing the effect of youth access laws through actual compliance with them proved to be a successful strategy. Several previous studies assessing the effects of these restrictions found them statistically insignificant in the youth cigarette demand equation. There was also an attempt to control for enforcement of these laws, but the existence of an enforcement law does not always imply its application in police practice. Controlling for the compliance level captures both the existence and the degree of active enforcement of the law. The compliance level has a negative effect on both probability and intensity of smoking across all models. The statistical significance of the results indicates that the effect of youth access laws operates through lowering smoking rates rather than through reducing smoking intensity among high school students. This proves that youth access laws are an important component of a successful public policy approach to youth smoking prevention. This finding is a unique contribution of the study to the economic literature on smoking.

The effect of cigarette prices is relatively consistent across all model specifications. Both perceived price and state level price negatively affect smoking participation and smoking intensity. Youth-specific perceived price exhibits a larger effect on smoking behavior, particularly on smoking intensity, compared to average state price appropriate for an average smoker. The analysis predicts that a 10% increase in cigarette prices will lead to a 3.5–4.9% reduction in the smoking rate among high school students. Those who would continue to smoke even after this price change would lower their cigarette consumption by 33 to 37 cigarettes per month (based on perceived price measure). The total price elasticity based on this analysis rages from -0.7 to -1.0, and suggests that a 10% increase in cigarette prices will reduce the total demand for cigarettes among high school students by 7% to 10%. This means that higher cigarette prices will lead to a substantial reduction in both smoking participation and average cigarette consumption among high school students. Further, the results support the hypothesis that youths are more price responsive than are adults in their demand for cigarettes (adults' price elasticity is believed to be between -0.3 and -0.5 according to several recent economic studies).

Price simulation of a \$0.50 increase in state average price (i.e., 26.5%) indicates that the total youth cigarette demand in 1996 would decline by 19.1% with the smoking rate falling from 31.4% to 28.5%. According to the Monitoring the Future Survey report from 2001, smoking among 8th and 10th graders was at its peak level in 1996. Since then smoking rates have been steadily declining while real cigarette prices have experienced an opposite trend. This development corresponds to the predictions based on this analysis.

Appendix

Table A1. Descriptive Statistics for the Survey Sample

Variable	*N*	Mean	Standard Deviation
Age	16,514	15.748	0.028
Male	16,514	0.496	0.005
Black	16,514	0.147	0.003
Hispanic	16,514	0.104	0.002
Asian	16,514	0.030	0.001
Other race	16,514	0.051	0.002
Infrequent religious services	16,514	0.407	0.005
Frequent religious services	16,514	0.374	0.005
Live with others	16,514	0.040	0.002
Live alone	16,514	0.006	0.001
Live in a city	16,514	0.404	0.005
Live in a suburb	16,514	0.244	0.004
Parents never married	16,514	0.050	0.002
Parents separated	16,514	0.052	0.002
Parents divorced	16,514	0.195	0.004
Parents deceased	16,514	0.003	0.001
Father deceased	16,514	0.033	0.002
Mother deceased	16,514	0.011	0.001
Father completed high school	16,514	0.255	0.004
Father has some college	16,514	0.151	0.004
Father completed college	16,514	0.201	0.004
Father more than college	16,514	0.112	0.003
Mother completed high school	16,514	0.280	0.004
Mother has some college	16,514	0.173	0.004
Mother completed college	16,514	0.203	0.004
Mother more than college	16,514	0.092	0.003
Father not working	16,514	0.079	0.003
Mother not working	16,514	0.176	0.004
Average hours worked per week	16,514	7.647	0.103
Pocket money per week	16,514	37.390	0.574
Smoked a cigarette in last 30 days	16,514	0.314	0.005
Number of smoking days	4593	18.060	0.209
Number of cigarettes per day	4358	6.503	0.145
Number of cigarettes per month	4358	163.335	4.468
Average perceived price	16,514	2.353	0.003

Table A2. Descriptive Statistics for Public Policy Variables and Price

Variable	*N*	Mean	Standard Deviation
CIA private workplace	16,514	0.722	0.448
CIA restaurants	16,514	0.747	0.435
CIA stores	16,514	0.463	0.499
CIA other places	16,514	0.975	0.155
CIA index	16,514	2.907	1.187
100% CIA index[a]	16,514	1.005	0.779
Vending machines	16,514	0.841	0.365
Samples	16,514	0.845	0.362
Civil penalty	16,514	0.523	0.500

Table A2. Continued

Variable	*N*	Mean	Standard Deviation
Criminal penalty	16,514	0.586	0.493
Fine for minor	16,514	0.293	0.455
Graduated fines	16,514	0.675	0.468
Compliance	16,514	0.623	0.131
Preemption	16,514	0.198	0.398
Smuggling—price difference	16,514	2.861	10.737
Smuggling—tax difference	16,514	2.037	7.598
State average price	16,514	188.985	21.581

[a] 11,603 students living in 24 states are exposed to some kind of complete, 100% CIA restriction. Because the CIA measure consists of both state level and local policies, students in one state may be exposed to a different number of 100% restrictions. 6739 students living in 21 states are exposed to one 100% restriction, and 4864 students from 11 states are exposed to two 100% restrictions. The remaining 4911 students in 21 states are not exposed to any 100% restrictions.

Table A3. Marginal Effects of Public Policies, Smuggling and Price on Youth Cigarette Demand (All Policy Variables Included)

	Price Variable			
	Marginal Effects from Probit		Marginal Effects from GLM	
Public Policy Variable	State Average Price	Average Perceived Price	State Average Price	Average Perceived Price
CIA				
Private workplace	0.033	0.030	1.322	−1.026
	(0.023)	(0.022)	(16.903)	(17.601)
Restaurants	−0.045	−0.050*	−29.776*	−22.986
	(0.029)	(0.027)	(16.151)	(16.681)
Stores	−0.004	−0.0006	14.746	13.785
	(0.013)	(0.012)	(12.985)	(13.175)
Other places	0.038	0.035	32.709**	35.063**
	(0.029)	(0.027)	(14.232)	(13.661)
Access				
Vending machines	−0.032	−0.031	10.444	14.230*
	(0.023)	(0.021)	(10.26)	(8.458)
Samples	0.045**	0.041**	25.773**	22.504
	(0.016)	(0.014)	(13.978)	(15.438)
Enforcement				
Civil penalty	0.013	0.012	−19.502*	−13.888
	(0.018)	(0.018)	(11.77)	(11.534)
Criminal penalty	0.007	0.007	−10.596	−9.732
	(0.021)	(0.019)	(13.036)	(13.426)
Fine for minor	0.024	0.023	23.523**	19.425*
	(0.017)	(0.016)	(11.113)	(9.983)
Graduated fines	−0.008	−0.007	−9.430	−11.863
	(0.018)	(0.018)	(8.899)	(9.473)
Preemption	0.030	0.024	−8.089	−7.973
	(0.021)	(0.019)	(11.967)	(11.748)
Smuggling	0.001**	0.001**	−0.216	−0.112
	(0.0004)	(0.0005)	(0.260)	(0.345)

Table A3. Continued

Public Policy Variable	Price Variable			
	Marginal Effects from Probit		Marginal Effects from GLM	
	State Average Price	Average Perceived Price	State Average Price	Average Perceived Price
Price	−0.0007*	−0.055**	−0.040	−33.219*
	(0.0004)	(0.021)	(0.219)	(18.526)
Price elasticity	−0.393*	−0.414**	−0.052	−0.543*

All equations also include a constant. $N = 16{,}514$ for probit, $N = 4358$ for GLM.
* Variable significant at 10% level based on two-tailed test after its standard error was adjusted for clustering.
** Variable significant at 5% level based on two-tailed test after its standard error was adjusted for clustering.

Table A4. Marginal Effects of Individual Public Policies on Youth Cigarette Demand (Policy Variables Tested Individually)

Public Policy Variable	Price Variable			
	Marginal Effects from Probit		Marginal Effects from GLM	
	State Average Price	Average Perceived Price	State Average Price	Average Perceived Price
CIA				
Private workplace	−0.005	−0.005	−10.238	−8.733
	(0.016)	(0.015)	(12.688)	(11.678)
Restaurants	−0.036*	−0.035**	−17.813	−14.660
	(0.019)	(0.016)	(13.456)	(11.908)
Stores	−0.025**	−0.022*	−1.470	0.492
	(0.012)	(0.012)	(13.201)	(12.658)
Other places	−0.038**	−0.031*	16.105	23.514**
	(0.020)	(0.017)	(11.806)	(10.745)
Access				
Vending machines	−0.015	−0.013	17.709	20.352**
	(0.018)	(0.016)	(13.198)	(9.821)
Samples	0.045*	0.038*	20.639	18.202
	(0.024)	(0.022)	(17.06)	(17.818)
Enforce				
Civil penalty	0.011	0.011	−2.226	0.298
	(0.019)	(0.016)	(14.047)	(11.183)
Criminal penalty	0.006	0.003	−1.428	−3.364
	(0.018)	(0.015)	(14.864)	(13.169)
Fine for minor	0.024	0.020	12.362	10.243
	(0.015)	(0.015)	(10.794)	(10.641)
Graduated fines	−0.016	−0.015	−9.734	−9.877
	(0.016)	(0.015)	(13.571)	(12.824)
Preemption	0.044**	0.038**	6.978	4.528
	(0.016)	(0.016)	(11.811)	(11.757)

All equations also include a constant. $N = 16{,}514$ for probit, and $N = 4358$ for GLM.
* Variable significant at 10% level based on two-tailed test after its standard error was adjusted for clustering.
** Variable significant at 5% level based on two-tailed test after its standard error was adjusted for clustering.

Table A5. Marginal Effects of Public Policy Groups and Smuggling Variables

	Price Variable			
	Marginal Effects from Probit		Marginal Effects from GLM	
Public Policy Variable	State Average Price	Average Perceived Price	State Average Price	Average Perceived Price
Model I				
CIA index	−0.003	−0.003	−3.291	−2.629
	(0.007)	(0.006)	(6.137)	(5.560)
Preemption	0.038**	0.032*	2.824	1.493
	(0.018)	(0.017)	(13.8)	(13.605)
Compliance	−0.099*	−0.106*	−16.826	−10.422
	(0.053)	(0.058)	(53.518)	(51.887)
Smuggling	0.001**	0.002**	−0.058	0.026
	(0.0003)	(0.0003)	(0.250)	(0.334)
Price	−0.001*	−0.066**	−0.154	−34.813*
	(0.0003)	(0.027)	(0.228)	(19.478)
Price elasticity	−0.351*	−0.492**	−0.199	−0.562*
Model II				
100% CIA index	−0.013*	−0.012	−1.497	0.415
	(0.008)	(0.008)	(8.645)	(7.964)
Preemption	0.038**	0.032**	5.780	4.056
	(0.014)	(0.014)	(11.247)	(11.499)
Compliance	−0.084	−0.094	−20.591	−17.081
	(0.057)	(0.062)	(53.176)	(50.579)
Smuggling	0.001**	0.002**	−0.043	0.021
	(0.0003)	(0.0004)	(0.257)	(.343)
Price	−0.001*	−0.063**	−0.186	−36.627**
	(0.0003)	(0.027)	(0.213)	(18.759)
Price elasticity	−0.347*	−0.474**	−0.241	−0.592**

All equations also include a constant. $N = 16{,}514$ for probit, and $N = 4358$ for GLM.
* Variable significant at 10% level based on two-tailed test after its standard error was adjusted for clustering.
** Variable significant at 5% level based on two-tailed test after its standard error was adjusted for clustering.

Table A6. Effect of the Socioeconomic and Demographic Determinants on Cigarette Consumption

Variable	Probit, Marginal Effects	OLS, Marginal Effects
Age	0.011** (0.005)	10.935** (4.684)
Male (female left out)	−0.017** (0.008)	13.180** (6.125)
Black (white left out)	−0.180** (0.014)	−91.180** (13.518)
Hispanic (white left out)	−0.074** (0.012)	−81.354** (7.125)
Asian (white left out)	−0.133** (0.015)	−9.172 (35.276)
Other race (white left out)	−0.026 (0.022)	2.539 (18.326)
Infrequent religious services (no services left out)	0.002 (0.012)	−34.948** (5.900)
Frequent religious services (no services left out)	−0.088** (0.016)	−70.672** (6.259)
Live with others (live with parents left out)	−0.003 (0.022)	−4.530 (21.682)
Live alone (live with parents left out)	0.127** (0.049)	86.646 (68.897)
Live in city (live in town, village left out)	−0.008 (0.014)	1.976 (7.688)

Table A6. Continued

Variable	Probit, Marginal Effects	OLS, Marginal Effects
Live in suburbs (live in town, village left out)	−0.010 (0.017)	−7.630 (10.439)
Parents never married (parents married left out)	0.018 (0.019)	15.441 (21.687)
Parents separated (parents married left out)	0.053** (0.025)	45.793** (23.659)
Parents divorced (parents married left out)	0.069** (0.013)	31.447** (8.930)
Both parents deceased (both parents alive left out)	0.036 (0.052)	22.768 (60.058)
Father deceased (both parents alive left out)	0.017 (0.028)	81.335** (28.859)
Mother deceased (both parents alive left out)	0.089** (0.045)	128.219* (94.37)
Father completed high school (father less than HS left out)	−0.019 (0.015)	−6.856 (9.943)
Father has some college (father less than HS left out)	−0.038** (0.015)	−11.743 (11.222)
Father completed college (father less than HS left out)	−0.024 (0.015)	−18.916 (15.663)
Father more than college (father less than HS left out)	−0.013 (0.021)	−11.035 (11.271)
Mother completed high school (mother less than HS left out)	0.016 (0.015)	9.199 (14.746)
Mother has some college (mother less than HS left out)	0.0002 (0.019)	−3.332 (16.302)
Mother completed college (mother less than HS left out)	0.015 (0.017)	−22.377 (15.615)
Mother more than college (mother less than HS left out)	0.015 (0.020)	−9.310 (22.425)
Father not working (father working left out)	0.023 (0.014)	38.234** (16.711)
Mother not working (mother working left out)	−0.015 (0.013)	28.791** (10.379)
Average hours worked per week	0.003** (0.0005)	1.362** (0.343)
Pocket money per week	0.001** (0.0001)	0.308** (0.076)

Source: Computed from the survey data by the author.

* Variable significant at 10% level based on two-tailed test after its standard error was adjusted for clustering.

** Variable significant at 5% level based on two-tailed test after its standard error was adjusted for clustering.

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