impacTEEN

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The Effect of Public Policies and Prices on Youth Smoking

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THE EFFECT OF PUBLIC POLICIES AND PRICES ON YOUTH SMOKING

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Abstract

Prior economic research provides mixed evidence on the impact of public policies on youth smoking. This paper empirically tests the effects of various tobacco control measures on youth demand for cigarettes using data collected in a recent nationally representative survey of 17,287 high school students. The combination of comprehensive measures of numerous public policies with information on law preemption, enforcement tools and actual compliance with the law allows more precise estimates of these policies' effects, compared to previous studies. All cigarette demand models control for the effect of price, which is represented both by a commonly used price measure and by a measure of price as perceived by the students - another unique feature of this study. The method known as a two-part model (developed by Cragg, 1971) estimates the propensity to smoke and the intensity of the smoking habit separately. The results indicate that relatively strong Clean Indoor Air Laws as well as Youth Access Laws have a negative effect on both smoking probability and on smoking intensity among high school students. Compliance with Youth Access Laws rather than their enforcement evaluates the real effect of these restrictions because an existence of an enforcement measure does not always lead to higher law compliance. The analysis also confirms that higher cigarette prices, regardless of the way they are measured, reduce youth cigarette smoking. Teen-specific, perceived price of cigarettes has the largest impact on cigarette demand.

1. INTRODUCTION

Smoking is associated with several market failures such as negative externalities and imperfect information of the market participants. The health consequences of smoking result in huge health care expenses partly paid from public funds. In addition, the cost of medical treatment for smokers inflates health insurance premiums for everyone regardless of smoking participation. Lower labor market productivity is another result of engagement in tobacco consumption. These market failures can justify government interventions in the market for tobacco products.

Youth is of particular interest for public policy makers and economists because it is the most effective group to target for smoking prevention programs[1] and because there are some additional externalities associated with youth smoking. Almost all first use of cigarettes occurs during the high school years. At that age, consumers are either not well informed or they do not consciously process information on the health hazards of smoking. At the time when the young people are making a decision about smoking, they may not be fully aware of the health consequences of their behavior. Youth typically underestimates the risk of addiction to cigarettes and mistakenly assumes that they can quit easily in a few years.

The annual prevalence of cigarette smoking in the United States stabilized in 1990's with approximately 62 million smokers in 1996, which represented 23.2 percent of the U.S. population[2]. Even though this figure is not high relative to smoking in other countries (the world average smoking prevalence in 1997 was 29 percent[3]), the declining trend in cigarette consumption from the 1980's ended.

[1] 1994 Report of the Surgeon General: "Preventing Tobacco Use Among Young People"
[2] U.S. Department of Health and Human Services, 1996; CDC, 1996
[3] WHO: "Tobacco or Health: a Global Status Report", 1997

It is particularly troubling that the slight decrease in smoking prevalence among adults in the 1990's 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 1998 Youth Risk Behavior Survey reported an increase in average smoking prevalence among high school students from 27.5 in 1991 to 36.4 percent in 1997. According to the Centers for Disease Control and Prevention, the number of 12^{th} 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 percent.

There is an economic explanation for this rising trend. Even though the Federal cigarette excise tax was raised twice in the beginning of the1990's (by 4 cents in 1991 and by another 4 cents in 1992, resulting in 24 cents tax per pack), the real prices in the subsequent period fell. Between 1993 and 1996, the real price of a pack of cigarettes adjusted for inflation fell by 10 percent (Tobacco Institute, 1997). The observed price decline was partly a result of the Philip Morris Company's decision to reduce the price of Marlboro cigarettes, which was followed by competitive price adjustments by other major cigarette manufacturers. The lower price of Marlboro cigarettes provided an additional economic motivation for youth to increase the demand for cigarettes because Marlboro is the most preferred brand among teenagers. In 1993, Marlboro was the brand of choice for 60 percent of teenagers, but the overall market share for this brand was only 23.5 percent (CDC, 1994a). The stable smoking rates of adults in the 1990's and increasing smoking prevalence among youth in the same period would support the hypothesis of higher cigarette price responsiveness of younger age groups.

To discourage the use of tobacco products among the younger generation, public officials designed and adopted numerous anti-smoking policies since the beginning of the 1990's. 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 anti-smoking policies are concerned. Over time, the differences between state levels of taxation began to widen. The largest gap developed between tobacco producing and non-producing states. As of December 31, 1999, state excise taxes ranged from 2.5 cents a pack in the state of Virginia to $ 1 a pack in Hawaii and Alaska (CDC, 2000). The tax differences on state and municipal levels create incentives for inter-state smuggling. There are also certain states particularly known for their strong anti-smoking policies, the most outstanding being Arizona, California and Massachusetts. This may result in smokers self-selecting to states with less stringent smoking restrictions.

At the beginning of the 1990's, 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 have to 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.

The United States, with their different prices and public policies across states, provide an excellent opportunity for health economists to study the effects of tobacco control measures on the demand for cigarettes. These results can be very valuable not only for public policy makers in the U.S., but also for global approach toward curbing tobacco epidemic.

2. PREVIOUS RESEARCH

One of the first micro level studies on the effect of public policies on smoking appeared in the 1980's. Wasserman, et al. (1991) estimated cigarette demand equation for both youth and adults while controlling for state level antismoking regulations. Contrary to some previous studies 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, which do not control for public policies produce upward-biased estimates since they ignored this correlation (an omitted variable bias).

Jason et al. (1991) addressed the issue of youth access laws and their active enforcement. In his local study of a suburban community of Chicago, he measured reaction of local merchants and high school students to new local legislation restricting youth access to cigarettes. He found that active enforcement of the law by regular compliance checking let to substantial reduction of cigarette sales to youth (sales rate dropped from 70 to 5 percent), to reduction of experimentation and regular smoking among junior high school students (by over 50 percent), and to increased community awareness of the problem of adolescent smoking.

Chaloupka in his 1988, 1990 and 1991 studies applied for the first time the Becker's and Murphy's Model of Rational Addiction on individual level data from the Second National Health and Nutrition Examination Survey (1976 – 1980). While controlling for age, race, gender, education, income, physical activity and cigarette prices he found adjacent complementarities in cigarette consumption, supporting the hypothesis of rational addiction. He also concluded that smoking restrictions in public places have a negative effect on average cigarette consumption by a smoker.

Keeler et al. (1996) analyzed the interactive effects of oligopoly pricing, state taxation, and anti-smoking regulations on retail cigarette prices by state between 1960 and 1990. Their nonlinear least squares model employed state panel data and found that producers discriminate state with more stringent state and local anti-smoking laws. They also concluded that state taxes are more than passed on to consumers (one cents translates to 1.11 cents) and that sellers offset state and local tobacco control policies with lower prices, which reduces the effects of the tobacco control regulations.

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 in both public and private places, and the effects of rules limiting youth access to tobacco products. To solve the problem of highly correlated policy variables they included them into the cigarette demand equations one by one. This approach produced a smaller standard error and higher price elasticity compared to a model including all policy variables but the estimates suffered from an omitted variable bias. The two part model with cigarette excise taxes as a price measure estimated price elasticity between –0.846 and –1.450. The authors concluded that cigarette control policies reduce smoking but in a different way than Chaloupka (1991): restrictions on smoking in restaurants, retail stores and in private workplaces had little impact on average number of cigarettes smoked by smokers but they discouraged students from picking up a smoking habit if the restrictions were relatively strong. Limits on youth access to tobacco had very little effect but the authors hypothesized that weak enforcement might be to blame.

If students spent most of their time at school and not at workplaces, then the estimated small impact of these rules in Chaloupka and Grossman (1996) is understandable. Evans, Farrelly, and Montgomery (1996) decided to test the effect of workplace smoking limitations on a sample of workers from the supplement to the National Health Interview Survey. The demand equation controlled for year of survey, age, age squared, income, family size, education, ethnicity, marital status, region and the type of

urban setting of permanent residence. Cigarette taxes were used as a price measure. Workplace bans on smoking decreased both smoking participation (by 6.6%) and a consumption of cigarettes by smokers (by 2.3 cigarettes a day). To eliminate a possibility of self-selection of workers according to their smoking habits, the authors estimated also a simultaneous equations model where they used the supply of nonsmoking jobs in an industry and the size of the work site as instruments. They concluded that self-selection is not an issue in their data and that the results do not suffer from an omitted variable bias.

In 1997 Chaloupka and Wechsler (1997) estimated price and policy effects on the smoking behavior of 16,500 college students. The study supported the hypothesis that young adults exhibit relatively high price sensitivity to cigarette prices: the overall price elasticity ranged from –0.906 to –1.309. Only 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.

DeCicca, Kenkel, and Mathios (1997) tested an ordered probability model for the cigarette demand function on a longitudinal data set. The cross-sectional data on 8^{th}, 10^{th} and 12^{th} grade students came from the National Education Longitudinal Surveys for 1988, 1990 and 1992. In the model, they controlled for age, race, religion, family size, father's and mother's education, father's and mother's occupation, marital status of parents, school's performance, drop out status, region of residence and rural/urban status. They used cigarette taxes as a price measure, license requirements to sell tobacco products as a tobacco policy measure, and jail time for illegal sales of cigarettes as a measure of the tobacco policy enforcement. The estimates of the tax elasticities of participation for the 8^{th}, 10^{th} and 12^{th} grades were –0.68, -0.52 and –0.48 respectively. Both the measure of a tobacco policy and the measure of its enforcement were found insignificant in the cigarette demand equation.

Rigotti et. al. (1997) tested the effect of enforcement on the youth access to tobacco and on youth smoking behavior in a two-year controlled study in Massachusetts. The analysed data came from both the

survey of high school students, and the attempted purchases by minors. The authors employed multiple logistic regressions to estimate mixed-effects models, which examined the differences between communities. They concluded that even though the compliance of local retailers increases in controlled communities (82 % compliance rate as opposed to 45 % compliance rate in communities with no special enforcement measures), the effect on youth access was only 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 limits on youth access on smoking rates among 1994 respondents (8^{th}, 10^{th}, and 12^{th} grade) of the Monitoring the Future Project. Because previous mixed results on the effects of tobacco control policies were attributed to lack of enforcement, they added to the data variables controlling for state monitoring activities, enforcement of regulations limiting youth access to tobacco, and compliance with them. The authors estimated the total price elasticity of cigarette demand at –1.141, with the price elasticity of participation –0.618 and the conditional price elasticity –0.523. Most state and local non-tax tobacco control policies did not have statistically significant effects on youth smoking with the exception of relatively strong restrictions. However, when the policy variables were tested for joint significance, their combined effect on smoking participation was significant.

The single most consistent conclusion from the economic literature on the demand for cigarettes is that price increases lead to a decrease in smoking. While the estimates of those responses vary from study to study, the current consensus for the overall price elasticity of youth cigarette demand centers in the range from –0.9 to –1.5. The evidence on the effects of public policies is less clear. The mixed results from various studies are usually attributed to measurement errors, high level of correlation among various policies, lack of enforcement, and endogenous nature of policy variables in the cigarette demand equation. The lack of consensus on the importance of non-price based tobacco control policies makes it

an important topic to study. The evidence on the effects of different policies can help decision makers to decide on the most effective tobacco control program.

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 & 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 include all types of schools in the U.S. – 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 the African-American population. The third part, also a supplementary sample, consisted of 40 schools from areas heavily populated by the Hispanic population. 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. The descriptive statistics for the survey sample are listed in Table 1.

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 one day in the last 30 days before the survey, 0 otherwise. This variable defined a smoker for the purpose of this study. There are 27.8 percent of smokers among the 16,514 students who answered the question about

smoking participation. When compared with smoking participation estimated in other nationally representative surveys in the USA from the same period[4] there are fewer smokers in this survey. However, when the appropriate weights are used to adjust for oversampling of certain ethnic and income groups, the estimated population's smoking prevalence is 31.4 percent, a figure comparable to other nationally representative surveys.

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. Each of 4,358 smokers (95 percent response rate) smoke on average 139 cigarettes per month (about 6 cigarettes per day). However, there is a substantial variation among students. The median of the monthly cigarette consumption is 45. Therefore, half of the smokers in this sample smoke 45 cigarettes or less in a month. It 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 non-smokers) 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, points of sales, and sources of cigarettes. Given the relatively low reported monthly cigarette consumption, preferred packaging and usual purchasing places of the survey sample, it can be expected that teens are buying their cigarettes in places with higher average sales prices as compared to an average point-of-sale (used for example for computing state average price by the Tobacco Institute). The second advantage of the perceived price is that it reflects the existence of local cigarette taxes and price promotions that are not captured by commonly used price measures.

[4] For example, the Monitoring the Future project estimated smoking prevalence among 10th grade high school students 30.4 percent; in the studied sample only 27.4 percent of 10th grade students smoke. The Youth Risk Behavior Survey estimated 36.4 percent smoking prevalence among all high school students in 1997; the studied sample reveals 27.8 percent smoking prevalence for high school students in 1996.

However, perceived price is potentially endogenous[5]. Those who smoke have incentives to search for lower cigarette prices and their perceived price can be downward biased. On the other hand, smokers may have better information than non-smokers as far as true cigarette prices in the area. The problem of endogeneity was alleviated by creating Average Perceived Price, an average of perceived price for all students in a high school. Creating this variable also solved the problem of missing information for 1358 respondents. Assigning school's average perceived prices to these students improves the precision of estimates and can even reduce bias of the results if the missing observations are systematic with respect to Individual Perceived Price.

In addition to the perceived price, one external price measure of a cigarette pack was matched to the survey based on the location of the respondent's high school. State Average Price (in cents) is 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 are 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 youth faces. Comparing means for Average Perceived Price ($2.378) and for State Average Price ($1.890) confirms that a high school student buys more expensive cigarettes than an average smoker. In addition, State Average Price is not local-specific and it does not include local cigarette taxes.

There are two additional price related variables matched to the survey that control for smuggling between states. If the possibility of smuggling is not accounted for, it can lead to an underestimating of the price elasticity of the cigarette demand equation. The first "smuggling" variable is continuous and it is

[5] 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.

defined as 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 "smuggling" variable is defined similarly as the first one but it represents a 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 using Average Perceived Price.

Numerous measures describing tobacco control policies were matched to the survey data based on each respondent's location code. These policies can be important determinants of youth smoking. They can also capture state and local sentiment towards smoking and towards youth access to tobacco products, which makes them potentially endogenous. The problem of respondents' self-selection according to their smoking status is minimal in this analysis because high school students have usually a small influence on a household location decision. However, the inclusion of public policies to cigarette demand equation improves the quality and precision of the 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 consists of two laws restricting youth access to tobacco products:

restrictions on sale of cigarettes through vending machines, and ban 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 created a comprehensive system of 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 towards 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 on 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) provided the county and city/town level data. The system of collecting information on anti-smoking legislature 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 anti-smoking 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 non-existence of policies and missing observations, the information on policies might not be always accurate. 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 an existence of either state or county or city policy in a location. They are comprehensive measures of public policies a smoker is exposed to.

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, which 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 accounting 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 (1997), a report of enforcement efforts that each state must provide to the federal government. The FFY97 summary details the situation in the financial fiscal year 1996, the year of the respondents' survey.

The analyzed tobacco control policies are highly collinear, which makes their coefficient estimates sensitive to a model specification and increases standard errors of the estimates. One of the possible ways of dealing with the presence of multicollinearity is to create an index that represent a whole group of public policies. The index was constructed for CIA laws by adding up all dummy variables, each representing the existence of a particular CIA restriction, irrespective of the governmental level adopting the policy. 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 index limitation must be taken into account when interpreting the results.

Apart from multicollinearity, there is another problem in assessing the effects of Youth Access laws. Several previous studies found very little or insignificant effect of these restrictions, possibly due to the lack of their active enforcement (Chaloupka and Grossman, 1996; Chaloupka and Pacula, 1998). In order to measure the real effect of Youth Access laws, the data on enforcement measures and 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 tested enforcement measures (the exception is fee imposed on minor). Compliance is also a positive function of Youth Access laws. Therefore, the level of retailers' compliance with the Youth Access laws servers as a proxy for the laws' existence and their active enforcement.

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 the smoking habit are modeled separately. In the first step, a smoking participation equation is estimated by using a Probit specification. The OLS technique is employed in the second step when the natural logarithm of monthly cigarette consumption is estimated only for those who are defined as smokers. All models control for basic sociodemographic characteristics of an individual, income variables, cigarette prices, smuggling incentives, and for public policies in various ways.

The effect of price is expressed as price elasticity. It is possible to compute three types of price elasticity from the two-part model: participation (or prevalence) price elasticity, conditional demand (or consumption) price elasticity, and total price elasticity. Participation price elasticity uses price coefficients from the Probit models. It represents the percentage change in the prevalence of smoking caused by a one percent change in the price of cigarettes. Conditional demand price elasticity uses price coefficients from the log-linear regression estimated by OLS technique. It measures the percentage change in the average number of cigarettes smoked by those who continue to smoke even after a one percent change in cigarette price. Total price elasticity is the sum of smoking participation and conditional demand price elasticities[6].

[6] There is an emerging literature that suggests that this method is not appropriate for calculating total elasticities, particularly in certain circumstances (see Mullahy, 1998; Manning, 1998 for a complete discussion). However, the

The marginal effects and the level of statistical significance measure the effect of public policies in the cigarette demand equation. The level of significance is expressed by two t-values, one computed by commonly used techniques, and the other adjusted for clustering. When an analysis evaluates the effects of an aggregate variable (such as State Average Price) on micro level data (e.g. smoking among survey participants) a standard estimating procedure can lead to a downward bias in standard errors. The reason for the bias is that individual disturbances in a group structure do not have to be independent within a group. This interdependence does not bias coefficients, but not accounting for it can lead to spurious findings of statistical significance of aggregate regressors (aggregate price measures and public policies in this case). The models are therefore estimated twice: once without the clustering adjustment, and once with the adjustment. As a result, it is possible to compare to what extent potential inter-group correlation affects the significance of variables of interests. The standard errors adjusting for clustering were computed with the Huber/White robust variance estimator in STATA using school/location as the clustering variable.

4. RESULTS

Table 2 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 variables included in the model. The second and third columns represent marginal effects of these policies on the probability of being a smoker from two models with different price measures. The fourth and fifth columns show the policies' marginal

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purpose of this research is to compare findings with the existing literature, and hence this method is used. It is important, therefore, to interpret the findings with respect to the total demand elasticity cautiously.

effects on smoking intensity among smokers, again from two models with two different prices. There are two t-values in parentheses under each estimate: the first one is computed by a standard technique, the second one is 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 negative effect in these models of cigarette demand. Restrictions on smoking in restaurants have a negative coefficient in all four models and the result is statistically significant in one of them (OLS coefficient in model using State Average Price). Limiting cigarette sale through vending machines has a negative effect on both smoking participation and conditional demand in models using State Average Price. The results from models using Average Perceived Price are mixed and are not statistically significant. Smoking restrictions in shopping areas also produced negative coefficients in three out of four models but the effect is not statistically significant. Restrictions on smoking in private workplaces, in other places, and bans on free sample distribution do not have the expected results.

Apart from the policies themselves, two other aspects also have a negative effect in both parts of the model: the level of compliance with Youth Access laws and the existence of graduated fines for their repeated offense reduce both smoking probability and smoking intensity. Preemption of local laws by state legislatures and smuggling opportunities are associated with increased smoking prevalence and higher smoking intensity among high school students in models using State Average Price. This result is statistically significant. The preemption and smuggling variables are not significant in models using the youth specific price measure, Average Perceived Price.

The mixed results for public policies can be interpreted in several ways. First, there is the problem of collinearity among these variables. It affects coefficients' precision and stability. Second, estimates can suffer from omitted variable bias if policies reflect local sentiment towards tobacco use,

which is not controlled for in the equation. Third, some policies may not be relevant for curbing youth smoking. For example, the exposure of high school students to smoking restriction in private workplaces is probably small. Further, the anecdotal evidence suggests that civil or criminal penalties for non-compliance with Youth Access laws are often not enforced by police officers who, confronting other serious crimes, do not view breaking these laws as a serious offense. The positive and significant effect of punishing minors for use or possession of cigarettes is 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. All included policies exhibit joint significance under both the nonlinear Wald test and Likelihood-ratio test.

Prices negatively affect both smoking prevalence and smoking intensity in this model of youth cigarette demand. However, State Average Price is not significant in the conditional demand equation. It is possible that the presence of multicollinearity is responsible for the insignificance of this price coefficient. 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 anti-smoking measures. When the equation uses Average Perceived Price instead, the multicollinearity is eliminated and the price effect is negative and significant even in the second part of the model. The total price elasticity (calculated by adding the participation and the conditional demand price elasticities) for State Average Price is -0.980, and for Average Perceived Price -1.850.

Problems with estimating the effects of individual tobacco control measures led to the final model specification where the group of CIA variables is replaced by the CIA index and the Youth Access measures are represented by compliance with these laws.

Table 3 summarizes the results for the variables of interest from the final model specification. 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 100 percent CIA restrictions (also by an index). The column headings indicate the first and the second part of the model as well as price measure employed in the regression. The studied variables 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 statistically significant in only one model (conditional demand equation with State Average Price). A possible interpretation of the lower significance is that the selected restrictions are less important to high school students. For example, it can be expected that smoking restrictions in private or government workplaces will not affect smoking behavior of a person who is a full time student. There is also the possibility of a measurement error in the index variable, particularly with respect to restrictions at local levels, which are believed to be less accurately recorded. A measurement error in an independent variable can bias coefficients towards zero. Comparing the effect of all CIA restriction (including also partial smoking restrictions) with their 100 percent counterparts, all marginal effects are higher and mostly more significant for the 100 percent CIA index. This is an indication that relatively strong restrictions are more effective and their effects are more certain with respect to youth smoking behavior. To summarize, the CIA restrictions have the expected, negative effect on both smoking probability and smoking intensity, even though the results are not always statistically significant.

The coefficient of the Preemption variable, which controls for non-existence of local tobacco controls, is positive in all models. With the exception of OLS coefficients in the model controlling for the all CIA restrictions index, the results are statistically significant. It is often a strategy of tobacco companies to lobby for preemption clauses in state laws because it is easier for them to control concentrated state legislation than fragmented local legislation. In this way, they have a guarantee that no local authorities can pass a law with stronger smoking restrictions that would hurt local cigarette sales.

The result can be also 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, performed similarly across all models: it has a negative and statistically significant coefficient. It is suspected that the previous findings in the literature regarding poor performance of the Youth Access laws were affected by the failure to control for actual compliance with these laws. In this analysis, Youth Access limits have a negative effect on both smoking prevalence and smoking intensity among high school students when they are complied with. The result is subject to the assumption that the compliance variable is not endogenous to the cigarette demand model reflecting local sentiment towards smoking.

The variable controlling for smuggling has the expected positive coefficient in all but one model. The results are statistically significant in the participation equation. The non-significant 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 little attractive. However, the inclusion of the variable in the model is necessary for obtaining unbiased price coefficients.

Price has negative effect on both probability to become a smoker and on number of cigarettes consumed by a smoker. The results are mostly 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 elasticities for youth cigarette demand were computed as the sum of the price elasticity of participation (Probit models) and the price elasticity of the conditional demand (OLS models) for the appropriate price measure.

The total price elasticity for State Average Price is -0.663 (Model I) and -0.769 (Model II). Given that this price measure is more suitable for an average smoker who is less price sensitive compared to a young smoker, the estimate for State Average Price should be considered a lower limit of youth cigarette demand elasticity. The total price elasticity for Average Perceived Price is -1.633 (Model I) and -1.675 (Model II). If the endogeneity in the perceived prices was not completely removed by creating school averages, the estimate for Average Perceived Price should be considered an upper limit of youth cigarette demand elasticity.

The expected reaction of high school students to a cigarette price change depends on the price measure used in the model. A 1 % increase in price can lead either to 1.6 % decrease in smoking using youth specific prices, or to 0.7 % decrease in smoking using average state price, only half of the first response. The demand for cigarettes is price elastic using Average Perceived Price, and it is price inelastic using State Average Price. Therefore, the choice of price leads to different conclusions on the total amount of collected taxed: if the correct price measure is Average Perceived Price, the total amount of taxes collected from smokers will decline, if the correct price measure is State Average Price, the total amount of taxes from smokers will increase.

Comparing the results from this analysis with the existing literature, the price elasticity of Average Perceived Price falls into the upper range of consensus on youth price elasticity, which ranges from -0.9 to -1.5. The price elasticity computed for State Average Price corresponds, for example, to findings of Evans and Farrelly (1998) and Tauras and Chaloupka (1999).

The estimates for the socioeconomic and demographic determinants of cigarette demand in the final model specification with State Average Price and CIA index including all restrictions are presented in Table 4. The results generally conform to expectations. Age raises both the probability of becoming a smoker and monthly cigarette consumption. The gender dummy has an opposite sign in the two parts of

the model but the results are not statistically significant. Sex doesn't seem to be an important determinant of cigarette demand among younger age groups. White high school students are more likely to smoke than students of other races. Whites also smoke on average more cigarettes in a month. Black students are the least likely to be smokers and if they are, they smoke the smallest amount of all races. Religiosity, described by the frequency of attendance at religious services, has a strong inverse relationship with smoking. Living arrangement is also an important determinant in both participation and conditional demand models. Those who live alone have a higher probability to start smoking and, if they already smoke, to smoke higher amounts than those who live with parents. An incomplete family (e.g. when parents were never married, or if they are separated/divorced, or if one of them deceased) is another factor positively affecting youth smoking. The family income variables expressed in the form of parental educational attainments vary in signs and significance in the two parts of the model. The youth's personal income as described by the number of hours worked and by the amount of pocket money has positive and significant effect on cigarette demand.

5. SUMMARY AND DISCUSSION

This analysis evaluated the effect of numerous public policies. The estimates were refined by controlling for the existence of preemption and enforcement efforts towards these laws. The availability of information on both state and local restrictions also improved estimates precision compared to most previous studies. The results indicate that both prices and public policy measures can be used to curb youth cigarette smoking.

The analysis of individual public policies produced mixed results due to the difficulty of separating the effects of individual policies. Nevertheless, the estimates from this model indicate that the

best candidates for a successful anti-smoking policy are smoking restrictions in restaurants, limited cigarette sale through vending machines, and smoking restrictions in shopping areas. Another factor that negatively affects youth cigarette demand is the existence of graduated fines for a repeated offence of Youth Access laws. Unlike the other tested enforcement measures, the graduated fines implicitly build in repeated checks on policy compliance. The discretion of a policy officer on the initial level of punishment increases the probability of applying this enforcement measure in practice. A good enforcement strategy increases the level of retailers' compliance with Youth Access laws, which will further reduce youth smoking.

Due to problematic assessment of individual policies, the next set of models used an index for the whole group of Clean Indoor Air laws and replaced the group of Youth Access laws by the actual compliance with those laws. Even though the use of indices is not without limitations, an analysis of their effects can indicate the overall impact of a certain policy type. The results indicate that laws restricting smoking in various places (CIA laws) have a negative effect on both smoking probability and smoking intensity among the studied group. The effect is not statistically significant at conventional levels, which may reflect less importance of some of the selected laws for the population being enrolled full time at school.

To better understand the effect of CIA laws, the coefficient estimates were used for a public policy simulation. This technique predicts that a community with no CIA restrictions can reduce youth smoking participation on average by 1.8 percentage points by adopting all tested CIA laws (i.e. smoking restrictions in private workplaces, smoking restrictions in restaurants, smoking restrictions in retail stores, smoking restrictions in other places including government workplaces). The same community could reduce youth smoking rate by 3.1 percentage points if it makes all the smoking restrictions complete bans (100 percent smoking restrictions in private workplaces, restaurants, stores, and other places). The

average smoking rate among the participating high school students would decrease by 0.5 percentage points if all communities in the sample adopted all CIA laws, and by 2.3 percentage points if these laws were complete bans.

The effect of policies limiting youth access to cigarettes was assessed through the actual level of retailers' compliance with these laws. The several previous studies measuring the direct effect of these restrictions found them insignificant in the youth cigarette demand equation. There was also an attempt to control for enforcement of these laws. However, this analysis indicates that the existence of an enforcement law does not imply its actual use in police practice. Therefore, instead of controlling for enforcement measures, this model controls for the result of active enforcement - compliance with the law. The compliance level has a negative and statistically significant effect across various models on both probability and intensity of smoking. This robust result suggests that Youth Access laws are an important item in a successful public policy approach to youth smoking prevention.

Preemption of local laws by state legislatures may have a positive effect on smoking probability. 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 towards smoking, the interpretation of the results can be problematic.

The inclusion of public policies in the cigarette demand equation alleviates a potential omitted variable bias with respect to price estimates. These estimates indicate that higher cigarette prices would result in substantial reductions in both smoking participation and average cigarette consumption among high school students. The total estimated price elasticity of cigarette demand fell in a range of -0.66 to -1.67. The estimates support the hypothesis that youth is more price responsiveness than are adults in their demand for cigarettes (adults' price elasticity is believe to be between -0.3 to -0.5 according to several recent economic studies). Price simulation indicates that youth cigarette demand can decline by 17.5

percent (participation would drop from 27.8 to 24.8 percent and the average monthly consumption would decrease from 139 to 130 cigarettes) if state average prices rise by $0.50 (i.e. 26.5%). However, the study indicates that high school students may be even more responsive if the available measure of youth specific cigarette prices more accurately reflects the prices youth is paying for their cigarettes. This finding is another unique contribution of this study to the economic literature on smoking.

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APENDIX

Table 1: **Descriptive Statistics for the Survey Sample**

Variable	N	Mean	Standard Deviation
Age	16514	15.662	3.234
Male	16514	0.452	0.498
Black	16514	0.195	0.396
Hispanic	16514	0.226	0.418
Asian	16514	0.038	0.191
American Indian	16514	0.011	0.105
Other Race	16514	0.054	0.227
Infrequent Religious Services	16514	0.418	0.493
Frequent Religious Services	16514	0.369	0.483
Live with Others	16514	0.050	0.217
Live Alone	16514	0.007	0.082
Live in a City	16514	0.508	0.500
Live in a Suburbs	16514	0.202	0.402
Parents Never Married	16514	0.068	0.251
Parents Separated	16514	0.062	0.241
Parents Divorced	16514	0.182	0.386
Parents Deceased	16514	0.004	0.061
Farther Deceased	16514	0.038	0.191
Mother Deceased	16514	0.013	0.112
Father Completed High School	16514	0.246	0.431
Father Has Some College	16514	0.139	0.346
Father Completed College	16514	0.176	0.381
Father More than College	16514	0.097	0.296
Mother Completed High School	16514	0.267	0.443
Mother Has Some College	16514	0.159	0.366
Mother Completed College	16514	0.177	0.382
Mother More than College	16514	0.081	0.274
Father not Working	16514	0.092	0.289
Mother not Working	16514	0.193	0.395
Average Hours Worked per Week	16514	6.784	10.203
Pocket Money per Week	16514	35.930	57.898
Smoke a Cigarette in Last 30 Days	16514	0.278	0.448
Number of Smoking Days	4593	16.274	11.657
Number of Cigarettes per Day	4358	5.734	7.048
Number of Cigarettes per Month	4358	138.639	216.383
Average Perceived Price	16514	2.378	0.255

Table 2: **Marginal Effects of Individual Public Policies, Smuggling and Price on Youth Cigarette Demand**

Price Variable		State Average Price	Average Perceived Price	State Average Price	Average Perceived Price
Public Policy Variable		Marginal Effects From Probit		OLS coefficients	
Private workplace	CIA	0.033** (2.734; 1.771)	0.014 (0.159; 0.131)	0.028* (2.361; 1.560)	-0.008 (-0.085; -0.069)
Restaurants	CIA	-0.026 (-1.827; -1.170)	-0.143 (-1.326; -1.162)	-0.030* (-2.123; -1.355)	-0.094 (-0.900; -0.779)
Stores	CIA	-0.0004 (-0.037; -0.025)	-0.061 (-0.831; -0.649)	0.005 (0.523; 0.357)	-0.056 (-0.785; -0.628)
Other places	CIA	0.053 (1.986; 1.186)	0.585** (2.707; 2.171)	0.049 (1.876; 1.180)	0.618** (2.880; 2.352)
Vending machines	Access	-0.041** (-3.239; -1.922)	-0.019 (-0.203; -0.162)	-0.038** (-3.012; -1.839)	0.011 (0.117; 0.095)
Samples	Access	0.049** (3.989; 2.776)	0.352** (3.461; 2.890)	0.046** (3.725; 2.685)	0.337** (3.309; 2.637)
Compliance	Access	-0.098** (-5.056; -2.701)	-0.072 (-0.495; -0.419)	-0.098** (-5.087; -2.646)	-0.093 (-0.638; -0.541)
Civil penalty	Enforce	0.014 (0.984; 0.875)	-0.082 (-0.747; -0.649)	0.015 (1.058; 0.997)	-0.035 (-0.321; -0.295)
Criminal penalty	Enforce	0.011 (0.765; 0.603)	-0.043 (-0.404; -0.325)	0.014 (0.944; 0.756)	-0.030 (-0.286; -0.236)
Fine for minor	Enforce	0.033** (2.963; 1.965)	0.355** (4.268; 4.136)	0.032** (2.856; 1.958)	0.317** (3.840; 3.961)
Graduated fines	Enforce	-0.010 (-0.967; -0.633)	-0.160** (-2.077; -1.911)	-0.008 (-0.792; -0.506)	-0.177** (-2.323; -2.070)
Preemption		0.039** (3.169; 1.939)	-0.077 (-0.874; -0.819)	0.033** (2.729; 1.653)	-0.081 (-0.935; -0.869)
Smuggling		0.001** (3.001; 2.436)	-0.003 (-1.102; -1.235)	0.002** (3.285; 2.935)	-0.002 (-0.598; -0.623)
Price		-0.001** (-3.503; -2.444)	-0.074** (-4.429; -2.908)	-0.002 (-1.572; -1.160)	-0.512** (-4.025; -2.887)
Price elasticity		-0.510	-0.632	-0.470	-1.218

Notes: The critical t-values are 2.58 (2.33), 1.96 (1.64), and 1.64 (1.28) at the one, five and ten percent significance levels, respectively, based on a two-tailed (one-tailed) test. All equations also include a constant. N=16514 for probit and N=4358 for OLS.

* Variable significant at ten percent level based on one-tailed test after its standard error was adjusted for clustering.

** Variable significant at five percent level based on one-tailed test after its standard error was adjusted for clustering.

Table 3: **Marginal Effects of Public Policy Groups and Smuggling Variables**

Price Variable		State Average Price	Average Perceived Price	State Average Price	Average Perceived Price
Public Policy Variable		Marginal Effects From Probit		OLS coefficients	
CIA index	Model I	-0. 005 (-1.268; -0.822)	-0.005 (-1.234; -0.796)	-0.058* (-2.090; -1.456)	-0.032 (-1.133; -0.836)
Preemption		0. 045** (4.445; 2.810)	0.040** (3.947; 2.528)	0.109 (1.471; 1.062)	0.111 (1.507; 1.072)
Compliance		-0.150** (-5.154; -3.037)	-0.152** (-5.231; -3.028)	-0.626** (-2.787; -2.596)	-0.498** (-2.232; -2.068)
Smuggling		0.001** (4.328; 2.854)	0.002** (4.738; 3.192)	-0.0003 (-0.077; -0.086)	0.002 (0.572; 0.639)
Price		-0.001** (-3.386; -2.180)	-0.071** (-4.594; -2.866)	-0.001 (-0.945; -0.649)	-0.432** (-3.648; -2.386)
Price elasticity		-0.416	-0.605	-0.247	-1.028
100% CIA index	Model II	-0. 008 (-1.646; -0.992)	-0.008 (-1.566; -0.970)	-0.075* (-1.967; -1.326)	-0.061 (-1.610; -1.123)
Preemption		0. 048** (5.189; 3.352)	0.043** (4.560; 2.979)	0.154** (2.274; 1.717)	0.130* (1.914; 1.374)
Compliance		-0.146** (-5.009; -2.896)	-0.149** (-5.111; -2.900)	-0.546** (-2.398; -2.285)	-0.472** (-2.232; -1.917)
Smuggling		0.001** (4.316; 2.850)	0.002** (4.698; 3.163)	0.0001 (0.062; 0.071)	0.002 (0.566; 0.649)
Price		-0.001** (-3.759; -2.481)	-0.073** (-4.899; -3.169)	-0.002 (-1.304; -0.909)	-0.441** (-3.806; -2.532)
Price elasticity		-0.442	-0.627	-0.327	-1.048

Notes: The numbers in parentheses are t-values. The first value is not adjusted for clustering, the second one is. The critical values are 1.64 and 1.28 at the five and ten percent significance levels, respectively, based on a one-tailed test. Constant included.

* Variable significant at ten percent level based on one-tailed test after its standard error was adjusted for clustering.

** Variable s ignificant at five percent level based on one-tailed test after its standard error was adjusted for clustering.

Table 4**: Effect of the Socioeconomic and Demographic Determinants on cigarette consumption**

Variable	Probit, marginal effects	OLS, marginal effects
Age	0.009** (2.986; 2.510)	0.118** (4.874; 4.406)
Male (Female left out)	-0.004 (-0.579; -0.496)	0.054 (0.933; 0.836)
Black (White left out)	-0.191** (-19.415; -14.651)	-1.334** (-13.213; -11.878)
Hispanic (White left out)	-0.074** (-7.397; -5.971)	-0.929** (-11.532; -9.853)
Asian (White left out)	-0.117** (-6.592; -7.089)	-0.119 (-0.666; -0.729)
Other race (White left out)	-0.046** (-3.029; -3.004)	-0.257** (-2.120; -1.671)
Infrequent Religious Services (No Services left out)	-0.011 (-1.093; -1.066)	-0.300** (-3.953; -3.829)
Frequent Religious Services (No Services left out)	-0.089** (-8.442; -7.523)	-0.618** (-7.369; -7.104)
Live with Others (Live with Parents left out)	0.019 (1.094; 1.038)	-0.014 (-0.105; -0.100)
Live Alone (Live with Parents left out)	0.141** (3.141; 3.058)	0.603** (2.127; 1.729)
Live in City (Live in Town, Village left out)	0.003 (0.363; 0.278)	0.045 (0.625; 0.554)
Live in Suburbs (Live in Town, Village left out)	-0.002 (-0.182; -0.138)	0.036 (0.439; 0.368)
Parents Never Married (Parents Married left out)	0.042** (2.515; 2.516)	0.404** (3.021; 2.833)
Parents Separated (Parents Married left out)	0.059** (3.689; 3.419)	0.340** (2.828; 3.102)
Parents Divorced (Parents Married left out)	0.067** (6.855; 7.297)	0.442** (6.375; 6.336)
Both Parents Deceased (Both Parents Alive left out)	0.034 (0.552; 0.551)	-0.064 (-0.135; -0.132)

Table 5**: Effect of the Socioeconomic and Demographic Determinants on cigarette consumption (continue)**

Variable	Probit, marginal effects	OLS, marginal effects
Farther Deceased (Both Parents Alive left out)	0.045** (2.269; 2.082)	0.612** (3.918; 4.083)
Mother deceased (Both Parents Alive left out)	0.042* (1.274; 1.298)	0.521** (2.113; 2.241)
Father Completed High School (Father Less than HS left out)	-0.020* (-1.624; -1.508)	0.126* (1.303; 1.361)
Father Has Some College (Father Less than HS left out)	-0.036** (-2.538; -2.436)	0.053 (0.471; 0.421)
Father Completed College (Father Less than HS left out)	-0.011 (-0.798; -0.773)	-0.130 (-1.185; -1.121)
Father More than College (Father Less than HS left out)	-0.002 (-0.139; -0.136)	-0.056 (-0.434; -0.460)
Mother Completed High School (Mother Less than HS left out)	0.023** (1.725; 1.703)	0.193** (1.916; 1.908)
Mother Has Some College (Mother Less than HS left out)	0.013 (0.891; 0.840)	0.103 (0.895; 0.839)
Mother Completed College (Mother Less than HS left out)	0.013 (0.875; 0.892)	0.190* (1.612; 1.541)
Mother More than College (Mother Less than HS left out)	0.016 (0.861; 0.897)	0.186 (1.295; 1.263)
Father not Working (Father Working left out)	0.011 (0.891; 0.929)	0.262** (2.607; 2.532)
Mother not Working (Mother Working left out)	-0.022** (-2.297; -2.154)	0.155** (2.058; 2.080)
Average Hours Worked per Week	0.003** (7.076; 6.711)	0.009** (3.113; 2.859)
Pocket Money per Week	0.001** (7.714; 7.494)	0.003** (5.295; 4.387)

Source: Computed from the survey data by the author

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