impacTEEN

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The Effect of Cigarette Prices on Youth Smoking

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THE EFFECT OF CIGARETTE PRICES ON YOUTH SMOKING

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Abstract

Prior economic research provides mixed evidence on the impact of cigarette prices on youth smoking. This paper empirically tests the effects of various price measures on youth demand for cigarettes using data collected in a recent nationally representative survey of 17,287 high school students. In addition to commonly used cigarette price measures, the study also examined the effect of price as perceived by the students. This unique information permits the study of the effect of teen-specific price on cigarette demand. The analysis employed a two-part model of cigarette demand based on a model developed by Cragg (1971) in which the propensity to smoke and the intensity of the smoking habit are modeled separately. The results confirm that higher cigarette prices, irrespective of the way they are measured, reduce youth cigarette smoking. The split of the price effect on smoking probability and on smoking intensity depends on the price measure used in the model. The largest impact on cigarette demand has the teen-specific, perceived price of cigarettes.

Key words: youth smoking, price effects

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, the young people are making a decision about smoking, they may not be fully aware of the health consequences of smoking. 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. 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 [4], 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 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 a 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 [5]. 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 [6]. 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 in the 1990's, public officials designed and adopted numerous anti-smoking policies. 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 is 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 [7]. The tax differences on state and municipal levels create incentives for smokers to “shop around” and look for lower cigarette prices in other localities. If the purchase of cigarettes occurs in a low tax state and the consumption or sale of the product in a high tax state then the transaction is defined as smuggling.

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 policy measures across states, provide excellent opportunities for health economists to study the effects of prices and other anti-smoking measures on the demand for cigarettes. The main purpose of this study is to evaluate price effects on smoking among young people.

2. PREVIOUS RESEARCH

One of the first micro level studies on the economics of youth smoking appeared in the 1980's. Lewit, Coate, and Grossman (1981) [8] studied the smoking behavior of young respondents (12 – 17 years old) in years 1966-70. Their demand equation tested retail prices of cigarettes while controlling for various socioeconomic factors such as age, sex, race, family size, income, labor force status of mother, and for smuggling. The two-part-model estimated an overall price elasticity of –1.44, a figure higher than the same estimates from the previous 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 price has more effect on the decision to smoke at all than on the number of cigarettes smoked by a smoker. Anti-smoking advertising had a negative effect on smoking participation but it did not change the number of cigarettes consumed by smokers.

In 1982, Lewit and Coate [9] used data with respondents 20 to 74 years old. They concluded that smuggling can bias results and that the smuggling incentives should be controlled for. Dividing the sample into three age groups (20 – 25, 26 – 35, 36 – 74) and estimating separately the respective price responsiveness confirmed the hypothesis about the higher price elasticity among youth, perhaps also due to shorter smoking history (the addiction to nicotine did not have a chance to fully develop), higher discount rate for future consumption, and the multiplying effect of peer pressure which is stronger for young adults than for older consumers. As in the 1981 study, price had a larger effect on a person's decision to smoke than on the number of cigarettes consumed by a smoker.

Wasserman, et al. (1991) [10] also analyzed respondents from 20 to 74 years old. Their demand equation controlled for state level antismoking regulations and found insignificant effects of prices on the amount smoked by young smokers. The authors attributed this result to a positive

correlation between cigarette prices and state smoking policies and argued that the results of previous studies are biased upwards since they ignored this correlation (an omitted variable bias). They also estimated price elasticities by years and found that they differ. For example the results for 1970, 1974, and 1985 were 0.06, -0.017, and –0.23 respectively, which led them to hypothesize that the elasticities were increasing over time, perhaps because of growing awareness of cigarette harm. However, the results of Wasserman, et. al (1991) were supported by a relatively small sample with only 1,891 respondents.

Chaloupka in his 1988 [11], 1990 [12] and 1991 [13] publications studied the addictive nature of smoking. He applied his rational addiction model on longitudinal 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. Chaloupka agreed with Wasserman, et al. (1991) regarding price sensitivity of young adults because he also found them less responsive compared with older age groups. This result cast serious doubt on the hypothesis of higher price sensitivity of younger respondents as it was supported by a much larger respondents' sample.

Because of the Wasserman, et al. (1991) and Chaloupka (1991) results, the issue of price responsiveness of young individuals was subjected to further investigation. In 1994, Douglas and Hariharan [14] addressed the issue of smoke initiation, which is primary related to youth smoking participation. They analyzed retrospective data from the 1978 and 1979 Smoking Supplements to the National Health Interview Survey by applying a hazard model called the split population duration model. They did not control for smuggling opportunities (which might bias the price effect towards zero), and did not include public policies in their models. The results of this

analysis confirmed the effect of various socio-demographic variables on smoking initiation but the authors did not find prices to be a significant determinant of youth smoking.

Chaloupka and Grossman (1996) [15] 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. They estimated two part models with excise taxes as a price measure. The range of the estimated cigarette price elasticities for various models [(–0.846) - (–1.450)] supported the hypothesis about higher responsiveness of youth to cigarette price changes.

In 1997 Chaloupka and Wechsler (1997) [16] 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.

Evans and Farrelly (1998) [17] estimated overall price elasticities for two different age groups (18-24 and 25-39) and found the younger one to be more responsive to a change in cigarette prices (price elasticities were –0.63 and –0.42 for the two groups, respectively). Having information on cigarette brand choices in their data set, they investigated if a tax change can change smokers' preferred brands. They found that an increase of taxes could induce compensating behavior towards longer cigarettes or towards cigarettes with higher nicotine and tar content. The younger age group (18-24) had particularly strong substitution reaction so that a tax increase can actually result in higher tar/nicotine intake for those smokers who continue to smoke despite the tax increase.

Chaloupka and Pacula (March 1998) [18] 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 regarding state monitoring activities, enforcement of regulations limiting youth access to tobacco, and compliance with them. Controlling for smuggling, 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 consumers react to price changes according to general economic principles – an increase in price leads to a decrease in consumption. Prices not only control the quantity of cigarettes consumed, but they also affect smoking prevalence among the young population. 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.

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. 17,287 questionnaires were completed and processed.

The participating high schools include all types of schools in the U.S. – public, private, and parochial. The original sample of 200 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.

The core national sample of high schools was selected in three stages. In the first stage, a sample of counties was randomly selected, with probability proportional to population. In the second stage, a sample of schools was drawn from the selected counties, with probability proportional to the number of students enrolled in grades 9 through 12. In the last stage, a sample of classes was drawn from each school. Only one class per grade was chosen to participate in the survey. All students enrolled in these classes constituted the selected sample of respondents.

Twenty-seven percent of the originally selected 200 high schools refused to cooperate or did not respond to the ASW request to conduct the survey. Similar ones based on the original school's demographic profile replaced these schools. At the end, the total number of participating institutions exceeded the originally intended 200 high schools by 2 due to late agreement from

schools for which a substitute had already been recruited. Because this sample of high schools oversampled schools in African-American, Hispanic, and high poverty communities, different weights were employed to account for this fact.

Four 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 there are fewer smokers in this survey. For example, the Monitoring the Future project [19] estimated smoking prevalence among 10^{th} grade high school students 30.4 percent; in the studied sample only 27.4 percent of 10^{th} grade students smoke. The Youth Risk Behavior Survey [4] 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. When the appropriate weights are used to adjust for oversampling of certain ethnic and income groups in the studied sample, the estimated population's smoking prevalence is 31.4 percent, a figure comparable to other nationally representative surveys.

The next three measures of smoking are continuous variables and describe smoking intensity of those qualified as smokers. The intensity variables are: the average number of days during the last 30 days before the survey when the respondent smoked at least one cigarette, the average number of cigarettes smoked in a day when the respondent smoked, and the average number of cigarettes consumed during the last 30 days before the survey. The descriptive statistics of these variables for 4,358 smokers (95 percent response rate) in Table 1 inform about smoking behavior of high school smokers.

About 30 percent of current smokers in the sample smoked daily, but a half of the smokers smoke 15 days or less during a month. They smoked on average nearly 6 cigarettes in a "smoking day", but a half of them smoked 3 or less cigarettes in a day when they smoked. About one quarter of the sample smoked only 1 cigarette a day. The low median monthly consumption (45 cigarettes or less per month for a half the smokers) indicates that the majority of the smokers in the sample report being infrequent 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. Three measures of local teen-specific price were constructed from this information: Individually Perceived Price, Average Perceived Price in a high school, and the Smokers' Average Perceived Price in a high school. In addition to the perceived prices, three other price measures were matched to the survey based on the location of the respondent's high school. The first is State Average Price (in cents) for a pack of cigarettes, obtained from the Tobacco Institute (TI) [5]. It 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 second merged price is State Excise Tax (in cents) levied on a pack of cigarettes (also obtained from the Tobacco Institute). The source of the third price measure was the ACCRA Cost of Living Index, a quarterly publication of the American Chamber of Commerce Researchers Association (ACCRA) [20]. It represents an average price (in $) of a carton of Winston cigarettes in selected metropolitan statistical areas (MSA) in the first and second quarters of 1996, respectively. Table 2 presents the descriptive statistic for all price measures used in the analysis.

Each of the price measures has some advantages and disadvantage over the others. Their analysis is helpful for correctly interpreting the regression estimates in the following chapter.

One of the primary advantages of the Individually Perceived Price 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 than an average point-of-sale (used for example for computing State Average Price by the Tobacco Institute). Comparing means for all measures of perceived prices with the mean of State Average Price confirms this behavior. The second advantage of the perceived prices is that they are local-specific reflecting the existence of local cigarette taxes and price promotions that are not captured by State Average Prices.

The main disadvantage of the perceived prices is their potential endogeneity [21]. 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 in two steps. First, Average Perceived Price and Smokers' Average Perceived Price were averaged across students in a high school. Second, different price measures were employed for estimates of price effects in two parts of the cigarette demand: the smoking participation was estimated using Smokers' Average Perceived Price (because smokers know better local cigarette prices); the smoking intensity equation employed Average Perceived Price (computed for both smokers and non-smokers) balancing the smokers' incentives to search for cheaper cigarettes. Creating the high school averages of perceived prices also solved the problem of missing information on Individual Perceived Price for 1358 respondents. Assigning Average Perceived Price measures 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.

The advantage of State Average Price is that it came from a very reliable informational source and it does not suffer from endogeneity, as do perceived prices. It is the most comprehensive measure of price in this study because it takes into account various brands and various types of sale. However, it represents an average price for an average smoker, including adults, and this price may not accurately reflect prices that youth faces. In addition, disadvantage of State Average Price is that it is not local-specific and it does not include local cigarette taxes.

The advantage of State Excise Tax as a price measure is that all cigarette buyers are subject to it. Moreover, it is the cigarette tax that is a public policy tool for a cigarette price manipulation. The disadvantage is that the state tax is not local-specific; it represents a different portion of the total cigarette price (depending on local prices, the brand of choice and the type of sale) and it is only a small fraction of the total cigarette price. The recent strategy of tobacco companies to run price promotions in states with high excise taxes even weakens the effect of taxes on cigarette consumption.

The main advantage of ACCRA prices is that they are local-specific. This advantage is substantially reduced by the fact that only 28 percent of high school locations are covered by the ACCRA price information. For the rest of the locations a price from the closest possible ACCRA location was assigned with information of the quality of the match. However, the primary disadvantage of the ACCRA price is its choice of cigarette brand (Winston) and of packaging (a carton); none of those are popular among high school students - Winston is a brand of choice for only 0.9 percent smokers in the analyzed sample, and cigarettes by cartons are bought by only 4.6 percent of them.

There are nine additional price related variables matched to the survey. Two of them 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 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 the other price measures.

The seven remaining price data quality indicators capture the quality of match between the ACCRA price locations and the survey locations. There are three quality-of-match dichotomous variables for each of the two quarters – a perfect match, a match within MSA or county, and a match outside MSA or county but within 100 miles. The seventh variable assumes a value of one if the ACCRA location changes between first and second quarter of 1996, zero otherwise.

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. However, their exclusion, on the other hand, may lead to an omitted variable bias in the estimates of price coefficients. If the omitted policies are positively correlated with a price measure, the price effect on smoking will be overestimated. To improve the quality and precision of the price estimates, all models control for the existence of public policies on both state and local levels.

There are two groups of public policies controlled for in the models. The group of Clean Indoor Air (CIA) laws includes smoking restrictions in private workplaces, smoking restrictions in restaurants, smoking restrictions in shopping areas, and smoking restrictions in other places (including government workplaces). Because these policies are highly correlated, it was necessary to create a CIA index to avoid the estimate's imprecision and instability resulting from the presence of multicollinearity in the models. The CIA index was constructed by adding up all dummy variables, each representing an existence of a particular CIA restriction. The information on CIA policies was obtained from the Centers for Disease Control and Prevention, CDC (for the state level) [22] and from the Americans for Nonsmokers' Rights organization, ANR (for the county and city levels) [23].

One additional variable controls for the performance of the CIA index. It is a dummy for 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 control with weaker state or federal laws can positively affect demand for cigarettes. The information on preemption laws comes from State Synar Profiles [24], a summary of enforcement efforts that each state must provide to the federal government.

The second group of public policies controlled for is Youth Access restrictions on tobacco. Several previous studies testing Youth Access restrictions in a cigarette demand function found very little or insignificant effect of these laws, possibly due to the lack of their active enforcement [15], [18]. 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 all enforcement measures. Compliance is also a positive function of the two Youth Access indices (one created from the CDC and ANR information, the other obtained from Tobacco Control

journal) [25]. Therefore, the models used the level of retailers' compliance with the Youth Access laws as a proxy for the laws' existence and their active enforcement, which can inform on the real effect of the Youth Access legislature on youth cigarette demand.

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. The cigarette demand model controls for basic sociodemographic characteristics of an individual, various income variables, smuggling incentives, Clean Indoor Air laws (by an index reflecting both state and local restrictions), preemption of local laws, Youth Access laws (by the compliance proxy), and for various measures of price.

For all models, 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, intensity) price elasticity, and total price elasticity. Participation price elasticity uses price coefficients from the Probit regression models. It represents the percentage change in the prevalence of smoking caused by one percent change in 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 the cigarette price. Total price elasticity is the sum of smoking participation and conditional demand price elasticities. However, there is an emerging literature that suggests that this method is not appropriate for calculating total elasticities, particularly in certain circumstances (see [26] and

[27] for a complete discussion). However, the 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.

All estimates are presented with 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 clustering adjustment, and once with the adjustment. As a result, it is possible to compare to what extent potential inter-group correlation affects significance of variables of interests. The standard errors adjusting for clustering were computed with the robust variance estimator in STATA using school/location as the clustering variable. This procedure, known also as Huber or White estimator, corrects for within-cluster dependence.

4. RESULTS

Table 3 demonstrates the effects of the seven price measures on smoking participation among high school students.

Each table line represents one model of smoking participation. The models differ by a price variable listed in the first column of the table. The second column represents coefficients from the Probit model with two t-values in parentheses, the second one being adjusted for clustering. The third column shows the marginal effects of prices on the probability of being a smoker (i.e. how the chance of a person becoming a smoker changes if the price is changed by one unit). The last column contains participation price elasticities for each model computed from marginal effects, average prices and average smoking participation in the sample.

Price has a negative effect on smoking participation independent of the selected price measure. However, there are differences in terms of the coefficients' statistical significance and participation elasticities computed for different prices. For example, the coefficient of State Excise Tax loses significance when the standard error is adjusted for clustering. The smallest participation price elasticities were computed for state cigarette tax and for ACCRA prices. The results can be affected by the weaknesses of these price measures, as mentioned before. In addition, the quality-of-match indicators are statistically significant in some models. It means that the quality of price match is important for obtaining estimates that are more accurate. The difference between price elasticities computed for the ACCRA 1st and 2nd quarters' prices also indicates that the use of this measure of price for the sample at hand is questionable.

As expected, the participation price elasticity is higher for Average Perceived Price than for Smokers' Average Perceived Price because non-smokers have tendencies to overestimate cigarette prices. Even though the appropriate perceived price measure for the participation

equation should be the one taking into account both smokers' and non-smokers' price perception, the price as perceived by smokers will eliminate the bias caused by non-smokers' higher price perception. In addition, it can be expected that smokers have more accurate cigarette price information in a particular area. The Smokers' Average Perceived Price elasticity is a conservative estimate of the effect of prices on smoking participation. It is interesting to note that this conservative estimate, -0.342, is not very far from the estimate of price elasticity computed for State Average Price, -0.416. The measure of State Average Price is frequently used in studies on youth smoking demand.

Table 4 summarizes the effects of the seven price measures on the number of cigarettes a high school smoker consumes during a month if he/she continues to smoke even after the cigarette price had been changed. Each table line represent one log-linear model of smoking intensity with the log of the number of cigarette smoked in a month as the dependent variable. The models differ by the price variable listed in the first column of the table. The second column lists the OLS coefficients (which also represent marginal effects) with their respective t-values. The last column presents the price elasticities of the conditional demand computed from marginal effects and average prices.

Compared to the price effect in the first part of the model, statistical significance is lower in its second part. With the exception of State Excise Tax, the effect of prices is still negative, but only perceived prices have significant coefficients. As a result, it is possible to have a different conclusion regarding the conditional demand price effect. The conclusion will depend on the price measure selected for the equation. Because the difference between conditional price elasticities computed for the ACCRA 1st and 2nd quarter prices is rather large, the problematic use of these two price measures with the sample at hand is confirmed. The unexpected positive

coefficient of State Excise Tax is not significant and it signals that state cigarette tax is also not an appropriate price measure to be used with the studied sample.

The price measures still left for consideration are all three perceived prices and state average cigarette price. As expected, the conditional price elasticity is higher for Smokers' Average Perceived Price than for Average Perceived Price because smokers have incentives to search for lower cigarette prices. Even though the appropriate perceived price measure for the conditional demand equation should be the one provided by smokers, the price as perceived by both groups will eliminate the bias caused by smokers' looking for lower cigarette prices. The Average Perceived Price elasticity is a conservative estimate of the effect of prices on smoking intensity. In this case, the conservative estimate of -1.028 is quite high and differs from the estimate of price elasticity computed for State Average Price, -0.247. However, there are reasons to believe that perceived prices more accurately reflect cigarette prices that youth is exposed to. In that case, the conditional youth demand for cigarettes would be price-elastic. Comparing the first and the second part of the model, perceived prices have a stronger effect on the number of cigarettes consumed in a month than on smoking participation. This effect is opposite for State Average Price: its effect is stronger for a participation decision compared to a smoking intensity decision.

Table 5 summarizes the results of this analysis by listing the total price elasticities for all seven previous price measures and for one mix model. The total price elasticity for the mix model in the fourth column was computed by adding the participation price elasticity for Smokers' Average Perceived Price and the conditional price elasticity for Average Perceived Price. The total price elasticity for the remaining columns was computed as the sum of the price elasticity of participation (Probit models) and the price elasticity of the conditional demand (OLS models) for the indicated price measure.

The total price elasticity for the mix model is the lowest among all perceived prices because it is the most conservative estimate using this type of price measure. Nevertheless, even this conservative estimate is greater than one. This means that a 1 % increase in price will decrease smoking among high school students by nearly 1.4 %. The total price elasticity of State Average Price is only about half of this estimate. The results for the remaining prices are considered less important for this analysis due to their limitations as explain above. The total price elasticity of perceived prices falls into the upper range of some recently estimated price elasticities for young smokers, which is from -0.9 to -1.5. The total price elasticity computed for State Average Price, -0.663, corresponds, for example, to findings of Evans and Farrelly (1998) [17]. It is possible to conclude that the effect of cigarette prices as perceived by youth on both smoking participation and conditional demand is larger than the effect of the conventional price measure - State Average Price.

The performance of other variables of interest in these models is summarized in Table 6. Each column of Table 6 represents one model using the price measure indicated by the column heading. The rows contain coefficients of a particular public policy or a smuggling incentive across various models. Results for the probability of smoking participation are summarized in the top part of the table; the bottom part of the table shows results for the conditional demand part of the two-part model.

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. However, the results are statistically significant in less than half of the models. 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 a 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. 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 and it is statistically significant for the probability of smoking participation. It can be interpreted as local law creating more effectively than state law 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. The previous findings regarding poor performance of the Youth Access laws might have been 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 the first part of the model but it is not significant in its second part. 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.

The estimates for the socioeconomic and demographic determinants of cigarette demand in the model with State Average Price are presented in the Appendix (Table 7) and 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

The results of this analysis indicate that higher cigarette prices would result in substantial reductions in both smoking participation and average cigarette consumption among high school students. For example, if state average prices would rise by $0.50 (i.e. 26.5%), the 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. However, the choice of price variable in an equation affects the predicted reaction among high school smokers. Given the price measures advantages, disadvantages and their subsequent performance in the cigarette demand function, the most appropriate prices for the data at hand are State Average Price and both Average Perceived Prices.

Focusing on these three price measures, the total estimated price elasticity of cigarette demand fell in a range of -0.66 to -1.63. 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). The study found that high school students are more responsive to the price of cigarettes as they perceive it compared to average state price or to state excise tax. If the perceived prices more accurately reflect the prices youth is paying for their cigarettes, the price elasticity of this consumer group is even higher than estimated by studies using state average price. This finding is a unique contribution of this study to the economic literature on smoking.

The effect of public policies on youth smoking was measured by high school students' reaction to Clean Indoor Air laws and to Youth Access laws. The 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 can be explained by less importance of the selected laws for the population being enrolled full time at school.

The policies limiting youth access to cigarettes are measured by the actual level of retailers' compliance with these laws. This unique approach eliminates the frequently cited reason for mixed findings regarding performance of these laws, which is their active enforcement. 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 public policy recipe for curbing youth smoking.

Preemption of local laws by state legislature 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 a policy does not reflect state sentiments towards smoking. In that case, the interpretation of a policy's effect can be problematic. Nevertheless, their inclusion in the cigarette demand equation alleviates a potential omitted variable bias with respect to price estimates.

It will be interesting to follow the smoking trends in the U.S. at the turn of the century when cigarette prices should rise thanks to the $206 billion Settlement with the tobacco industry. If the predictions of this Settlement are correct and cigarette prices increase from 25 to 45 cents over the next 25 years, then youth smoking will decline by 15.4% - 27.6% using the Perceived Price conservative elasticity estimate, or by 8.8% - 15.8% using the State Average Price elasticity estimate.

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APENDIX

Table 1: **Descriptive statistics for smoking intensity variables**

Variable's name	Mean	Median	Mode	Standard Deviation
# of "smoking days"	16.274	15	30 (29.5%)	11.657
# of cigarettes/day	5.734	3	1 (23.8%)	7.048
# of cigarettes/month	138.639	45	2 (6.3%)	216.384

Source: Computed from the survey data by the author

Table 2: **Price measures**

Variable	N	Mean	Std
Individually Perceived Price of a Cig. Pack in $	15 156	2.381	0.792
Average Perceived Price of a Cig. Pack in a High School in $	16 514	2.378	0.255
Smokers' Average Perceived Price of a Cig. Pack in a HS in $	16 514	2.230	0.247
State Average Cigarette Price per a Pack in Cents (TI)	16 514	188.985	21.581
State Cigarette Excise Tax per a Pack in Cents	16 514	36.068	15.721
ACCRA price, 1st quarter	15 328	17.631	2.548
ACCRA price, 2nd quarter	15 328	17.609	2.508

Source: Computed by the author from the survey , from the Tobacco Institute information, and from the American Chamber of Commerce

Table 3: **Participation price effects**

Price	Coefficient	Marginal effect	Elasticity
Individually Perceived Price	-0.265** (-15.292; -11.548)	-0.088	-0.722
Average Perceived Price	-0.120** (-4.594; -2.866)	-0.071	-0.605
Smokers' Average Perceived Price	-0.130** (-2.703; -1.652)	-0.043	-0.342
State Average Cigarette Price	-0.002** (-3.386; -2.180)	-0.001	-0.416
State Cigarette Excise Tax	-0.001 (-1.605; -1.053)	-0.0004	-0.259
ACCRA price, 1st quarter	-0.010* (-1.986; -1.319)	-0.003	-0.191
ACCRA price, 2nd quarter	-0.014** (-2.756; -1.797)	-0.004	-0.264

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

Table 4: **Conditional demand for cigarettes**

Price	Coefficient/ Marginal effect	Elasticity
Individually Perceived Price	-0.384** (-7.282; -5.939)	-0.915
Average Perceived Price	-0.432** (-3.648; -2.386)	-1.028
Smokers' Average Perceived Price	-0.557** (-4.492; -2.954)	-1.243
State Average Cigarette Price	-0.001 (-0.945; -0.649)	-0.247
State Cigarette Excise Tax	0.0003 (0.162; 0.112)	0.056
ACCRA price, 1st quarter	-0.005 (-0.375; -0.269)	-0.077
ACCRA price, 2nd quarter	-0.013 (-1.057; -0.749)	-0.218

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

Table 5: **Total price elasticity**

Indiv. Perceived Price	Average Perceived Price	Smokers' Average Perceived Price	Mix of average price measures	State Average Cigarette Price	State Cigarette Excise Tax	ACCRA price, 1st quarter	ACCRA price, 2nd quarter
-1.637	-1.633	-1.585	-1.370	-0.663	-0.203	-0.268	-0.482

Table 6: **Coefficients of public policies and smuggling variables**

Model Variable	Indiv. Perceived Price	Average Perceived Price	Smokers' Average Perceived Price	State Average Cigarette Price	State Cigarette Excise Tax	ACCRA price, 1st quarter	ACCRA price, 2nd quarter
Smoking Probability - PROBIT							
CIA index	-0.012 (-1.066; -0.717)	-0.014 (-1.234; -0.796)	-0.021 (-1.855; -1.214)	-0.014 (-1.268; -0.822)	-0.023* (-2.103; -1.409)	-0.026* (-2.267; -1.480)	-0.025* (-2.209; -1.434)
Preemption	0.113** (3.595; 2.292)	0.119** (3.947; 2.528)	0.123** (4.049; 2.578)	0.135** (4.445; 2.810)	0.123** (4.057; 2.602)	0.076* (2.371; 1.627)	0.077** (2.382; 1.645)
Compliance	-0.465** (-5.069; -2.919)	-0.463** (-5.231; -3.028)	-0.479** (-5.399; -3.091)	-0.457** (-5.154; -3.037)	-0.497** (-5.609; -3.206)	-0.561** (-6.074; -3.474)	-0.569** (-6.125; -3.506)
Smuggling	0.007** (4.836; 3.408)	0.007** (4.738; 3.192)	0.007** (4.615; 3.087)	0.004** (4.328; 2.854)	0.006** (4.419; 2.958)	0.007** (4.423; 3.067)	0.007** (4.559; 3.152)
Conditional Demand - OLS							
CIA index	-0.048* (-1.728; -1.372)	-0.032 (-1.133; -0.836)	-0.029 (-1.032; -0.798)	-0.049 (-1.707; -1.201)	-0.058* (-2.090; -1.456)	-0.055* (-1.916; -1.334)	-0.049 (-1.719; -1.233)
Preemption	0.132* (1.779; 1.333)	0.111 (1.507; 1.072)	0.128 (1.738; 1.259)	0.119 (1.609; 1.173)	0.109 (1.471; 1.062)	0.100 (1.278; 0.940)	0.105 (1.330; 0.985)
Compliance	-0.397* (-1.777; -1.576)	-0.498** (-2.232; -2.068)	-0.448** (-2.000; -1.897)	-0.574** (-2.540; -2.425)	-0.626** (-2.787; -2.596)	-0.446** (-1.929; -1.833)	-0.434** (-1.873; -1.765)
Smuggling	0.001 (0.247; 0.307)	0.002 (0.572; 0.639)	0.003 (0.895; 0.966)	0.0001 (0.029; 0.033)	-0.0003 (-0.077; -0.086)	-0.001 (-0.405; -0.481)	-0.001 (-0.283; -0.332)

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

Table 7: **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)
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)

Table 7: **Effect of the Socioeconomic and Demographic Determinants on cigarette consumption (continue)**

Variable	Probit, marginal effects	OLS, marginal effects
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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