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*A Policy Research Partnership
to Reduce Youth Substance Use*

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Youth Smoking Uptake Progress: Price and Public Policy Effects

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Abstract

The increases in smoking prevalence among U.S. youth during the 1990's, and the growing evidence that adolescents become regular smokers at earlier ages, have attracted significant attention from public health officials. Preventing experimental young smokers from becoming established smokers may be the most effective way of achieving a long run reductions in smoking in the whole population.

The paper addresses the gaps in knowledge about the impact of tobacco control policies on youth smoking uptake by examining the differential effects of cigarette prices, Clean Indoor Air laws, youth access laws, and other socio-economic factors on smoking uptake among nationally representative sample of U.S. high school students. Five clearly defined uptake stage categories are developed in order to classify 16,815 survey participants.

The results suggest that cigarette prices are negatively related to moving from lower to higher stages of smoking uptake and that higher prices have an increasing impact as an individual's risk of smoking uptake gets larger. Youth access laws are significantly and negatively associated with moving to higher stages of smoking uptake. The effect of these restrictions is strongest for students who completed, or almost completed their uptake process as these students are more dependent on commercial sources of cigarettes. Interrupting adolescents' progress on the smoking uptake continuum substantially reduces their probability of becoming daily, addicted smokers.

1. INTRODUCTION

The increases in smoking prevalence among U.S. youth during the 1990's¹ attracted significant attention among public health officials. This unfavorable trend and the growing evidence on the addictive nature of cigarette smoking² made youth the primary focus for numerous tobacco control programs.

Several nationally representative surveys indicate that the age by which adolescents become regular smokers has markedly decreased over the past 50 years.³ Smoking initiation usually occurs during the high school ages and the cigarette uptake process for the majority of current adult smokers is completed before they are 21 years old. At the ages of smoking uptake, youths are either not well informed or do not fully process information on the health hazards of smoking. Youth typically underestimate the health consequences of smoking and the risk of nicotine addiction. At the same time, a teenage smoker in the early stages of the smoking uptake process may be less addicted to cigarettes and can be a good target for smoking prevention programs. Preventing experimental young smokers from becoming established smokers may be the most effective way of achieving long run reductions in smoking in the whole population.

Smoking prevention campaigns, however, have so far had limited success in keeping adolescents from smoking initiation.⁴ The effect of these campaigns on youth smoking is often not clear and economic research has produced conflicting results. Most of these studies evaluate the impact of tobacco control policies using measures of the current smoking prevalence, usually defined as having a cigarette in the last 30 days. These measures cannot capture complex smoking behavior, particularly at its developing stage, and they are not a good predictor of who will enter adulthood as an addicted smoker.⁵

There are many behavioral transitions involved in an adolescent converting from a never smoker to an established smoker and this process can take several years.⁶ The two basic transitions are the one from never smoker to experimental smoker, and the one from experimenter to established smoker. An established smoker (defined by consuming over 100 cigarettes in his/her lifetime) is assumed to be addicted to nicotine because he/she meets many of the addiction criteria specified by the American Psychiatric Association.⁷

Economic studies typically ignore the different stages of smoking uptake because the only difference between established smokers and experimenters is the quantity of consumed cigarettes. However, it can be expected that price and other public policies will have varying effects on more precisely defined smoking behavior. Different tobacco control programs may exhibit varying time lags in their effects on youth at different stages of smoking uptake. To obtain sensible feedback on the effectiveness of a preventive intervention, it is necessary to assess the reaction of youth in different stages of the uptake process.

Two social science theories help to explain the process of smoking uptake. The first, the social cognitive theory, implies that future smoking initiation is positively associated with the determination to smoke sometime in the future.⁸ Therefore, an intention to smoke in the future increases the probability of moving to higher stages of the uptake process.⁹ The second theory, the self-efficacy theory, stresses the importance of a person's expectations about his or her ability to behave in a certain way.¹⁰ Applied to smoking behavior, this theory focuses on the ability to refuse a cigarette offered by a friend. The combination of current smoking experience, future smoking intentions, and the ability to refuse a cigarette are important smoking-related cognitions that can significantly predict an individual's future smoking behavior.¹¹

The impact of tobacco control policies on adolescents' smoking uptake is of utmost importance for public policy makers. The level of smoking uptake provides them with an early warning signal and can help them design policies to decrease smoking prevalence. Studying the uptake process is also important for the development of effective assistance programs for current smokers.

This paper addresses the gaps in knowledge about the impact of tobacco control policies on youth smoking uptake by examining the differential effects of cigarette prices, clean indoor air laws, youth access laws, and other socio-economic factors on smoking uptake among U.S. high school students.

2. PREVIOUS RESEARCH

The majority of cross-sectional studies of teen smoking find price to be an effective tool in reducing both smoking prevalence and smoking intensity.

Lewit and his colleagues^{12,13} conducted the first studies using individual level data. Their results suggested that youth are more price-responsive than adults in their demand for cigarettes. Their data from Cycle III of the Health Examination Survey (1966– 1970) revealed that the impact of price on adolescent smoking (a total price elasticity of -1.44) was about three times that for adult smoking.

Among the more recent studies, Chaloupka and Grossman¹⁴ employed two-part methods to examine cigarette smoking among high school students participating in the 1992 - 1994 Monitoring the Future surveys. Smoking by younger persons was found very responsive to cigarette prices with an overall price elasticity of demand -1.313 . The study also concluded that only strong smoking restrictions could reduce smoking prevalence. The same restrictions did not impact students' smoking intensity, and limits on youth access to tobacco had very little effect over all.

Harris and Chan¹⁵, using data from the 1992–1993 Tobacco Use Supplement to the Current Population Survey, provide consistent evidence that price responsiveness falls with age. Their estimated elasticities range from -0.996 for 15-17 age group to -0.329 for 27-29 age group.

Gruber¹⁶, however, found the opposite of Harris and Chan using data from the 1991 through 1997 Monitoring the Future surveys, and the 1991, 1993, 1995, and 1997 Youth Risk Behavior Surveys. He found that older teens (17 - 18 years old) are relatively more responsive to price (price elasticity of smoking prevalence -0.67) than younger teens (13 - 16 years old), who he did not find price sensitive at all. Smoking restrictions were not found to effect youth smoking, but youth access restrictions could reduce the quantity of cigarettes smoked by smokers.

Nevertheless, some studies of teen smoking questioned price sensitivity of young people. Wasserman, et al.¹⁷ used data from the Second National Health and Nutrition Examination Survey (1976– 1980) and found insignificant effects of prices on youth smoking. They 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).

Chaloupka¹⁸ also suggested that young adults were not responsive to changes in cigarette prices. He came to this conclusion using data from the Second National Health and Nutrition Examination Survey (1976–1980) and applying the Becker and Murphy (1988) model of rational addiction to cigarette smoking.

The literature analyzing the process of smoking initiation (and also smoking cessation) is rather scattered due to the demand for high quality data (preferably longitudinal, nationally representative data) that became available only in the last decade.

Choi et al.¹⁹ tested whether the probability of future current established smoking is associated with both previous smoking experience and cognitions regarding future smoking using two longitudinal datasets: the Teenage Attitudes and Practices Survey (1989 and 1993), the California Tobacco Survey (1993 and 1996). They found that the high-risk cognition individuals (may try a cigarette soon, or may smoke within a year, or may accept a cigarette offered by a friend) have a higher probability of becoming current established smokers in the future than low-risk cognition individuals. The probability of reaching the top of the uptake scale ranged from 5.6% for low-risk cognition never smokers to 83% for high-risk cognition current established smokers.

Liang et al.²⁰ used data from the 1992, 1993, and 1994 Monitoring the Future Surveys project and investigated the differential effects of cigarette price and tobacco control policies on five levels of smoking intensity. A Threshold of Change Model developed by Hedeker et al.²¹ demonstrated that higher prices increased the thresholds of moving from less frequent smoking to more frequent smoking and that price had a larger effect on the thresholds associated with greater levels of smoking intensity.

Wakefield et al.²² studied the relation between smoking restrictions (at school, at home, in public places) and smoking uptake, and these restrictions and smoking prevalence among high school students. They used data collected by Audits & Surveys Worldwide in 1996, the same data as this analysis. Using a five-point scale of smoking uptake the study concluded that more restrictive rules on smoking at home as

well as in public places were associated with a higher probability of being in an earlier stage of smoking uptake, and with a lower 30 day smoking prevalence. School restrictions had a similar effect only if they were strongly enforced.

Emery et al.²³ analyzed the price responsiveness of teens categorized by their smoking experience. A two-part model of cigarette demand used data from the 1993 Teenage Attitudes and Practices Survey (TAPS). The results suggested that state-level cigarette prices are not a significant determinant of cigarette experimentation, but that both current and established smokers were price responsive (total price elasticity was -1.70 and -2.24, respectively). The authors attributed the non-responsiveness of cigarette experimenters to their non-commercial cigarette sources (borrowing, receiving cigarettes as gifts, stealing). Based on the Emery et al. conclusions it can be expected that those at the further end of the uptake continuum will be more price sensitive than those at its beginning.

Tauras et al.²⁴ examined the impact of cigarette prices and youth access laws on youth smoking initiation. They used the Monitoring the Future survey of 8th and 10th graders for 1991-93 and the longitudinal follow-ups to these surveys. They estimated a discrete-time hazard model that included region, a time trend, price (state average price from the Tobacco Institute), and numerous youth access laws (individual indicators and a summary index). Only individuals at risk of initiating smoking (non-smokers at baseline) entered the model. The study found that real cigarette prices have a negative impact on smoking initiation (the results were significant for two out of three dichotomous indicators of smoking status) with the average price elasticity of initiation ranging between -0.27 and -0.96. The impact of price on smoking initiation was greater for the measures reflecting more regular, heavier smoking. In contrast, youth access policies generally had little or no impact on smoking initiation, although some individual policies were occasionally found to have a negative and significant impact.

There are also few unpublished studies using the National Education Longitudinal Surveys of 1988 that produce mixed evidence on the impact of price and policy on the onset of daily smoking among high school students. DeCicca, et al.²⁵ found little effect of price on the onset of daily smoking in these data.

When Dee and Evans²⁶ re-examined these results they suggested price elasticity for the onset of daily smoking -0.63 .

To summarize, the issue of whether price can affect smoking uptake or smoking initiation is not fully resolved. However, there is emerging evidence that the transition from being a non-smoker to being an established smoker can be stopped by higher cigarette prices, and that those at the final stages of this transition are more price responsive than those at the beginning stages.

3. DATA AND METHODS

The data on youth cigarette smoking employed in this study were collected between March and July 1996 for the Robert Wood Johnson Foundation supported project “The Study of Smoking and Tobacco Use Among Young People”.

The 202 participating high schools included all types of high schools in the U.S. – public, private, and parochial. Apart from the core sample of schools representing about 50% of the total, there were three supplementary schools' samples: schools from areas heavily populated by African-Americans, schools from areas heavily populated by Hispanics, and schools from high poverty areasⁱ.

Numerous variables describing socio-economic status were created from the survey. The variable Age is a continuous variable informing on the respondent's age in year and it ranges from 13 to 19. A set of dummy variables controls for racial/ethnic affiliation with respect to the White category. There are two dichotomous indicators reflecting the respondent's religiosity: infrequent attendance at religious services (a few times a year or once/twice a month during the last year), and frequent attendance at religious services (weekly or more than once a week during the last year). The effects of these are measured against those who do not participate in religious services. Each respondent's household arrangement is described by two dummy variables - Live with Others and Live Alone. They compare their effect with the situation when the

ⁱ More detailed description of the survey can be found in Ross, H. and Chaloupka, F.J. (2000), or in Wakefield, M. et al, (2000).

respondent is living with his/her parent(s). The dummy variables Live in a City and Live in Suburbs describe the location of a respondent's family home. The omitted category, against which the effect of the home's location is measured, is Live in a Town or Village. Parents' marital status is expressed by variables Divorced, Separated and Never Married (status Married omitted), their presence by variables Parents Deceased, Father Deceased, and Mother Deceased (Both Parents Alive omitted). There are eight dummy variables describing parental education (separately for mother and father) and they measure the effect of their educational attainment against those parents who did not finished high school. Two dichotomous indicators (one for father and one for mother) describe whether the parents work or not. Two continuous variables evaluate respondent's income by average number of working hours a week (computed as a midpoint of six categorical responses) and by the amount of pocket money at respondent's disposal for a week (recorded from an open-ended question).

The conceptual framework of the Uptake Continuum developed by Pierce et al. for the Report on California's Tobacco Control Program effectiveness was applied to classify respondents into five distinct categories of smoking uptake progress. The uptake categories were defined according to the answer to two sets of questions, which identify precursors to future smoking behavior.

The first question set determined the respondent's actual behavior: Have you ever smoked a cigarette?; Have you ever tried or experimented with cigarette smoking even a few puffs?; Have you smoked at least 100 cigarettes in your life?; On how many days in the last 30 did you smoke?

The second set of questions identified the respondent's intentions and expectations with respect to smoking: If one of your best friends were to offer you a cigarette, would you smoke it?; At any time during the next year do you think you will smoke a cigarette?

Only respondents who did not smoke a cigarette in the last 30 days before the survey were asked the second set of questions.

A respondent falls into the first stage of smoking uptake if he/she: never smoked a whole cigarette, never experimented with smoking, definitely will not smoke next year and definitely would not smoke cigarette offered by a friend.

The second stage of smoking uptake was assigned to those who: never smoked a whole cigarette, never experimented with smoking, but were not certain about their smoking status next year or about their ability to refuse a cigarette offered by a friend; or never smoked a whole cigarette, experimented with smoking, definitely will not smoke next year, and definitely would not smoke cigarette offered by a friend.

The third stage of smoking uptake was defined as: never smoked a whole cigarette, experimented with smoking, but is not certain about his/her smoking status next year or about his/her ability to refuse a cigarette offered by a friend; or smoked a whole cigarette, has not smoked 100 cigarettes in his life, has not smoked in last 30 days, definitely will not smoke next year, and definitely would not smoke a cigarette offered by a friend.

The fourth stage of smoking uptake included those who: smoked a whole cigarette, have not smoked 100 cigarettes in their life, have not smoked in last 30 days, but were not certain about their smoking status next year or about their ability to refuse a cigarette offered by a friend; or smoked in last 30 days, has not smoked 100 cigarettes in his life.

The last, fifth stage of smoking uptake was assigned to respondents who smoked at least 100 cigarettes in their lives. They are considered to be, or to have been, addicted smokers.

Some assumptions were made with respect to those individuals who did not answer all relevant questions, in order to retain the highest possible number of observations. It was possible to classify 16,815 out of 17,287 participants in the survey in one of the uptake stage categoriesⁱⁱ. About one quarter of the students are in the first stage of smoking uptake, but over forty percent of them belong to the two highest uptake stages. The average value of the Stage variable for the whole sample is 2.95, suggesting that an average high school student is over half way to becoming a smoker. Surprisingly, the youngest group (13

years old) had the highest percentage of established smokers. However, this age group represents only 0.5% of the whole sample, which subjects the estimate to high standard error. Disregarding the youngest age group, the risk of smoking uptake increases with age.

To evaluate the effect of price and other tobacco control policies on moving between stages of smoking uptake, the survey data were merged with two price measures and a set of public policy indicators. The first price measure represents the weighted state average of single pack, carton, and vending machine cigarette prices, including state excise taxes and was obtained from the Tobacco Institute. It is a very comprehensive price measure from a reliable information source, but it does not represent a youth or local specific price. The second price measure is youth and local specific and it was constructed from the survey, which asked “How much does a pack of cigarettes cost in your area?”. However, this perceived price may be affected by the smoking status of a respondent, which makes it potentially endogenous. Replacing this directly reported perceived price by its high schools' averages partly alleviated this problem. Ross and Chaloupka²⁷ provide justification for selecting these price measures.

Variables representing tobacco control policies were matched to the survey based on each respondent’s location. Even though these policies may capture local sentiment towards smoking, they can be also important determinants of youth smoking uptake. Controlling for their effects in the analysis will give an unbiased estimate of the price effect, but their own effects have to be interpreted with a caution. The tobacco control policies are represented by a Clean Indoor Air (CIA) index reflecting smoking restrictions, and by the level of compliance with youth access laws limiting access to cigarettes for under age students. The Clean Indoor Air index was constructed by adding up several dummy variables indicating the existence of local or state smoking restrictions in private workplaces, restaurants, shopping areas, and in other places (including government workplaces). The use of an index instead of individual dichotomous indicators alleviates the problem of multicollinearity among the individual policy indicators. The effect of youth access restrictions was measured indirectly by actual compliance with these laws because the literature suggests the

ⁱⁱ Categories are one through five.

importance of effective enforcement.²⁸ The compliance rate is defined as a percentage of unsuccessful purchasing attempts in a situation when law prohibits the sale.

The study further controls (by a dichotomous indicator) for the existence of state preemption laws that prevent local authorities from adopting more stringent local tobacco ordinances than the state law, and for cross-border shopping incentives (captured by price difference between the state of residence and a lower price in a neighboring state if it can be reached within 25 miles or less). The CIA data came from the Centers for Disease Control and Prevention (CDC) and from the Americans for Nonsmokers' Rights Foundation (ANRF); the data on compliance and preemption were taken from the Synar Regulation State Summary FFY97 created for U.S. Department of Health and Human Services²⁹.

The estimates of covariates' effects on smoking uptake were obtained from the generalized ordered logit model. This method relaxes the assumption of equal effects for the explanatory variables across the stages of change (the proportional odds assumption), which is used in the standard regression analysis of ordinal variables. The presented results correspond to the four possible sets of odds ratios from a cumulative binary logit model that can be formed from the five-category dependent variable Stage. The odds ratios for the first dividing point, between stage 1 and stages 2 through 5, correspond to the logit estimated for a dichotomous variable (stage 2-5) = 1 and (stage 1) = 0. The odds ratios for the second dividing point, between stages 1 and 2 and stages 3, 4 and 5, correspond to the logit estimated for a dichotomous variable (stage 3-5) = 1 and (stage 1-2) = 0, etc. The assumptions of the generalized ordered logit were tested by the pair-wise Wald tests and the resulting chi-square statistics were significant at conventional levels, suggesting that the use of the generalized version of ordered logit is appropriate in this case. The model was estimated using STATA statistical software.³⁰ All standard errors were adjusted for clustering at school level using Huber/White estimator correcting for within-cluster dependence.

4. RESULTS

Results for the primary variables of interest are summarized in Table 1. The first part of the table presents estimates of odds ratios from the model using the state average price, the second part of the table shows odds ratios for the model using the average price perceived by students. All results are statistically significant according to a 5% one-tailed test criterion, with the exception of the odds ratios for the Clean Indoor Air laws index.

Higher cigarette prices significantly reduce the odds of being in a higher stage of smoking uptake independent of the price measure employed in the model. The average price as perceived by students has a larger impact than the general average state price. The effect of higher prices is more pronounced in later stages of smoking uptake. For example, State average price decreased a respondent's cumulative probability of being in stage 2 to 5 of smoking uptake by 27%, but it reduces his/her probability of being in the highest smoking uptake category by 35%. This suggests that the further students are in their smoking uptake progress the more they are sensitive to cigarette prices.

The level of compliance with youth access laws significantly reduced the odds of being in higher stage of smoking uptake. The results suggest, that limits on access to cigarettes that are highly complied with have a larger impact on those who are in later stages of the smoking uptake continuum. This result supports the hypothesis that social sources of cigarettes are more important in earlier stages of smoking uptake, but when consumption reaches certain limits and consumer moves to higher stages smoking uptake, retail sources become much more important. Therefore, retailers' compliance with age limit on cigarette sale affects more those young people, who are closer to completion of smoking uptake progress.

The effect of Clean Indoor Air laws was assessed twice: once by the CIA index for any smoking restrictions, once by the CIA index including only 100% limitations on smokers. Even though the effect on uptake progress is negative, neither of these two CIA measures gives statistically significant results. Because the performance of the other variables of interest was not substantially altered when the two different CIA

indices were used, only the odds ratios from the 100% CIA model are presented in Table 1. The results from the model using the all-restrictions CIA index are available upon request.

Preemption of local tobacco regulations by state law and the possibility of shopping for cheaper cigarettes across state borders are associated with greater odds of being further in the smoking uptake process. However, cross-border incentives have very little differential impact on smoking uptake since the odds ratios are almost similar across stages, and the impact of preempting local anti-tobacco laws does not exhibit a clear pattern when moving along stages of smoking uptake.

A few of the socio-demographic variables exhibit significant and consistent effects on progress between all uptake stages. Being Black, being Asian, or regularly attending religious services are associated with lower stages of smoking uptake. Having divorced or separated parents or a deceased father will increase the odds of a teenager being in a higher category of smoking uptake. Both income (measured by the amount of pocket money) and labor force participation (measured by hours worked) increase the odds of being in a higher stage on the Smoking Uptake Continuum. There are also socio-demographic variables that are significant only for the switch to the highest categories of smoking uptake, mostly to becoming an addicted smoker. Higher age, living alone and having a mother with a college degree are positively correlated with the switch to the addicted smokers category; participating even infrequently in religious services and being Hispanic are both negatively correlated with this switch. The complete results for all socio-demographic variables are in the Appendix, Table 2. Because these results were not substantially different for the two models, only the odds ratios from model using state average price (from the Tobacco Institute) are presented.

Table 1
EFFECT OF VARIABLES OF INTEREST ON SMOKING UPTAKE

Variable of interest	Be in stage 2, 3, 4 or 5	Be in stage 3, 4 or 5	Be in stage 4 or 5	Be in stage 5
MODEL WITH STATE AVERAGE PRICE				
State average price	0.732 (0.100)	0.696 (0.091)	0.689 (0.088)	0.651 (0.107)
Compliance Rate	0.487 (0.137)	0.499 (0.139)	0.461 (0.118)	0.366 (0.108)
100% CIA laws	0.985 (0.040)	0.972 (0.038)	0.989 (0.039)	0.944 (0.046)
Preemption	1.224 (0.091)	1.246 (0.089)	1.213 (0.083)	1.249 (0.106)
Cross-Border Prices	1.005 (0.003)	1.005 (0.003)	1.005 (0.002)	1.005 (0.002)
MODEL WITH AVERAGE PERCEIVED PRICE				
Av. perceived price	0.674 (0.080)	0.652 (0.075)	0.646 (0.073)	0.605 (0.092)
Compliance Rate	0.494 (0.137)	0.507 (0.139)	0.464 (0.119)	0.364 (0.110)
100% CIA laws	0.987 (0.039)	0.974 (0.037)	0.990 (0.038)	0.947 (0.044)
Preemption	1.190 (0.086)	1.207 (0.083)	1.174 (0.078)	1.206 (0.105)
Cross-Border Prices	1.009 (0.004)	1.008 (0.004)	1.009 (0.003)	1.009 (0.003)

Notes: Odds ratios are corrected for within-cluster dependence. The numbers in parentheses represent robust standard errors. With the exception of CIA laws, all results are significantly different from 1.0 (P<0.05).

5. DISCUSSION

The study found that cigarette prices were negatively related to moving from lower to higher stages of smoking uptake. This negative effect of prices on cigarette consumption conforms to the fundamental law of economics suggesting that the demand for cigarettes, despite their addictive nature, responds to changes in prices as the demand for other normal goods.

The analysis further suggests that higher prices have an increasing impact on youth who are further along in the smoking uptake process. These differential effects of price can be expected because experimental smokers and regular smokers often get cigarettes from different sources. At the beginning stages of smoking uptake, young smokers often get their cigarettes from their friends or from other social sources, rarely paying for their cigarettes. Therefore, students in the initiation and experimentation stages may not respond as strongly to the price incentives as students in the subsequent stages of smoking uptake, when their cigarette consumption is beyond the point of everyday borrowing. As an individual is progressing towards being a regular smoker, he/she will have to purchase his/her own cigarettes. He/she will also spend more on cigarettes as he/she moves to higher stages of smoking uptake. When the amount of money spent on cigarettes constitutes a larger share of a teen's budget, economic theory predicts higher price sensitivity. The results of this analysis confirm this prediction. Yet, it is necessary to bear in mind, that these results are based on the assumption that price is exogenous determinant of smoking uptake. If the level of smoking uptake progress affects cigarette price (through social norms demanding higher cigarette taxes, for example), the estimated price effect is biased upwards.

Another interesting result is the larger effect of the youth specific price measure (Average Perceived Price) compared to the price measure applicable to an average smoker (State Average Price). If this were generally true, then price effects found in previous studies of smoking uptake among youth would be conservative estimates. However, this measure of price is potentially subject to an endogeneity bias that would inflate its estimated impact on youth smoking.

The analysis found youth access laws to have a significant and negative effect on moving to higher stages of the Smoking Uptake Continuum, and that the largest effect of these laws is at the highest stage. This is an important result, because up to now there is no consensus among tobacco control researchers regarding the efficacy of these restrictions. The difficulty of measuring the existence of these laws and their active enforcement is often cited as an obstacle. This analysis avoids these problems by measuring the behavior resulting from both existence of the laws and their active enforcement. This behavior, compliance, significantly decreases the odds of moving to higher stages of smoking uptake. The estimates also suggest that the effect of youth access laws is stronger than the price effect. Nevertheless, the results with respect to youth access laws have to be interpreted with caution for two reasons. First, all tobacco control policies are potentially endogenous. If anti-tobacco social norms cause respondents to be in lower stages of smoking uptake and at the same time increase compliance of local vendors with youth access laws, the effect of these policies as measured by regression analysis will be overstated. Second, the differences in sampling methods and inspection protocols between states in the process of compliance rates determination may introduce error in measuring the compliance rates. This error will, on the other hand, reduce the magnitude of the compliance coefficient.

The existence of Clean Indoor Air restrictions is associated with lower stage of smoking uptake, but the effect is not statistically significant. This result is in contrast to the study Wakefield et al.³¹, which analyzed the same data and found the negative effect of these policies to be significant for crossing the last two thresholds on the Smoking Uptake Continuum. There are several reasons why the results of the two analyses can differ. First, Clean Indoor Air laws are measured differently: this study employed a more commonly used five-point index while the previous study used a three-point index. Second, unlike the model of Wakefield et al., this model controls for cigarette prices and other tobacco related policies. If cigarette prices and Clean Indoor Air policies are positively correlated (e.g. states with higher cigarette excise taxes have stricter Clean Indoor Air laws), then the effect of CIA policies will be overestimated if cigarette prices are not controlled for in the model. In addition, it is possible that the effect of CIA laws in both studies is

underestimated, because they are not measured with enough precision. This is particularly true for policies at local levels, the existence of which is poorly recorded. Such an error in a variable measurement will reduce its coefficient magnitude. However, both studies found the largest effect of Clean Indoor Air laws in the highest stages of smoking uptake.

The analysis suffers from several limitations. First, cross-sectional data were employed to infer a longitudinal change in smoking status. Longitudinal data allowing the tracking of youth for an extended period would better suit this analysis, as they would document the transition of respondents stratified by their initial uptake stage. In that case, the transitions in smoking status could be modeled dynamically. A second caveat of the study is that the effect of price on cigarette consumption is not examined within each stage. Third, there is no information on the duration of various policies, and it is possible that their effect is changing over time.

Despite its limitations, the study is another piece of evidence that cigarette prices and some tobacco control policies are effective tools for controlling smoking behavior among youth. The majority of current established smokers started their addiction during high school. One in two of these smokers will eventually die of a smoking-attributable disease³². Preventing teens from reaching the highest stage of smoking uptake can be crucial in curbing smoking prevalence in the whole population and saving lives.

APPENDIX

Table 2

EFFECT OF SOCIO-ECONOMIC VARIABLES ON SMOKING UPTAKE

Socio-economic Variable	Be in stage 2, 3, 4 or 5	Be in stage 3, 4 or 5	Be in stage 4 or 5	Be in stage 5
Age	0.991 (0.020)	1.012 (0.019)	1.004 (0.019)	1.117** (0.026)
Male (Female left out)	1.004 (0.041)	1.017 (0.041)	1.035 (0.044)	1.022 (0.052)
Black (White left out)	0.589** (0.039)	0.478** (0.031)	0.340** (0.025)	0.160** (0.016)
Hispanic (White left out)	1.141* (0.081)	1.070 (0.072)	0.890* (0.057)	0.488** (0.040)
Asian (White left out)	0.659** (0.065)	0.592** (0.052)	0.582** (0.056)	0.467** (0.058)
Other race (White left out)	0.980 (0.081)	1.000 (0.078)	0.914 (0.070)	0.673** (0.068)
Live with Others (Live with Parents left out)	1.274** (0.124)	1.102 (0.092)	1.036 (0.078)	1.070 (0.102)
Live Alone (Live with Parents left out)	1.027 (0.254)	1.256 (0.279)	1.760** (0.360)	2.530** (0.254)
Infrequent Religious Services (No Services left out)	1.064 (0.058)	0.991 (0.051)	0.974 (0.048)	0.857** (0.058)
Frequent Religious Services (No Services left out)	0.682** (0.040)	0.671** (0.037)	0.687** (0.039)	0.535** (0.032)
Parents Never Married (Parents Married left out)	1.287** (0.115)	1.291** (0.100)	1.117 (0.082)	1.323** (0.136)
Parents Separated (Parents Married left out)	1.448** (0.109)	1.361** (0.094)	1.232** (0.089)	1.306** (0.108)
Parents Divorced (Parents Married left out)	1.503** (0.079)	1.429** (0.066)	1.306** (0.060)	1.570** (0.083)
Both Parents Deceased (Both Parents Alive left out)	1.210 (0.362)	1.069 (0.308)	1.281 (0.360)	1.276 (0.471)
Farther Deceased (Both Parents Alive left out)	1.367** (0.136)	1.399** (0.128)	1.268** (0.129)	1.601** (0.190)
Mother deceased (Both Parents Alive left out)	1.383* (0.262)	1.268 (0.223)	1.268 (0.205)	1.526** (0.265)
Father Completed High School (Father Less than HS left out)	0.928 (0.064)	0.963 (0.058)	0.915 (0.056)	0.963 (0.077)
Father Has Some College (Father Less than HS left out)	0.877* (0.068)	0.888* (0.056)	0.896 (0.060)	0.883 (0.071)
Father Completed College (Father Less than HS left out)	0.921 (0.072)	0.918 (0.064)	0.931 (0.067)	0.890 (0.081)

Table 2

EFFECT OF SOCIO-ECONOMIC VARIABLES ON SMOKING UPTAKE (continued)

Socio-economic Variable	Be in stage 2, 3, 4 or 5	Be in stage 3, 4 or 5	Be in stage 4 or 5	Be in stage 5
Father More than College (Father Less than HS left out)	0.877 (0.084)	0.895 (0.083)	0.970 (0.081)	0.906 (0.088)
Mother Completed High School (Mother Less than HS left out)	0.934 (0.066)	0.969 (0.061)	1.050 (0.067)	1.148* (0.090)
Mother Has Some College (Mother Less than HS left out)	0.954 (0.077)	0.953 (0.069)	0.999 (0.078)	1.103 (0.099)
Mother Completed College (Mother Less than HS left out)	0.921 (0.073)	0.946 (0.069)	1.016 (0.075)	1.190* (0.110)
Mother More than College (Mother Less than HS left out)	1.016 (0.106)	1.006 (0.091)	1.081 (0.099)	1.232** (0.128)
Father not Working (Father Working left out)	0.990 (0.066)	1.072 (0.065)	1.052 (0.057)	1.189 (0.082)
Mother not Working (Mother Working left out)	0.912* (0.045)	0.921* (0.043)	0.921* (0.042)	0.919 (0.053)
Average Hours Worked per Week	1.015** (0.002)	1.016** (0.002)	1.012** (0.002)	1.017** (0.002)
Pocket Money per Week	1.002** (0.0004)	1.002** (0.0004)	1.002** (0.0004)	1.003** (0.0004)
Live in City (Live in Town, Village left out)	0.997 (0.064)	1.035 (0.060)	0.967 (0.054)	1.008 (0.070)
Live in Suburbs (Live in Town, Village left out)	0.971 (0.071)	0.947 (0.060)	0.970 (0.060)	1.009 (0.076)

Notes: Odds ratios are corrected for within-cluster dependence. The numbers in parentheses represent robust standard errors.

* Result is significantly different from 1.0 (P<0.10) based on one-tailed test

** Result is significantly different from 1.0 (P<0.05) based on one-tailed test

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