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*A Policy Research Partnership
to Reduce Youth Substance Use*

The Impact of Prices and Control Policies on Cigarette Smoking among College Students

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The Impact of Prices and Control Policies on Cigarette Smoking among College Students

BY

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Abstract

Smoking among youths and young adults has been rising throughout the 1990's. Numerous policies have been enacted to try to reverse this trend. However, little is known about the impact that these policies have on the smoking behavior of young adults. This study uses a dichotomous indicator of daily smoking participation in the past thirty days, an ordered measure representing the frequency of cigarette consumption and a quasi-continuous measure of the number of cigarettes smoked per day on average to examine the impact of cigarette prices, clean indoor air laws and campus level smoking policies on the smoking behaviors of a 1997 cross section of college students. The results of the analysis indicate that higher cigarette prices are associated with lower smoking participation and lower levels of use among college student smokers. Local and state level clean indoor air restrictions have a cumulative impact on the level of smoking by current smokers. Complete smoking bans on college campuses are associated with lower levels of smoking among current smokers but have no significant impact on smoking participation. Bans on cigarette advertising on campus as well as bans on the sale of cigarettes on campus have no significant effect on the smoking behavior of college student smoking behavior.

I. INTRODUCTION

Over the past few decades, the American public has observed various anti-tobacco campaigns. Numerous health policy efforts have aimed to discourage tobacco consumption and over the years have created a variety of tobacco control instruments. Policies such as cigarette tax hikes, restrictions on smoking in public places and worksites, advertising constraints, anti-tobacco advertising and the issuance of health warnings have all been designed to reduce tobacco use. In general, researchers have found that while smoking among US adults has declined over the past 30 years, tobacco use remains a popular activity among adolescents and young adults. This has led many to question whether such policies are an effective way of discouraging smoking among these younger populations.

Wechsler et al (1998) found in a comparison of the 1993 and 1997 Harvard College Alcohol Study samples that cigarette smoking prevalence among college students increased during this time period by 27.8%. An increase was observed at 99 of the 116 colleges in the sample.[i] The authors conclude that the increase in smoking appears to be a consequence of the rise observed in the early 1990's among high school and middle school students. Similarly, evidence from the Monitoring the Future survey shows that smoking participation has been increasing among high school students in recent years. Statistics from the Monitoring the Future Study indicate that current smoking rates among college students, an important subset of the young adult population, have risen during this period but not nearly as fast as smoking rates among high school seniors (see Table One). One possible explanation for this divergence in smoking trends between high school students and young adults may have to do with differences in their responsiveness to tobacco control policies.

Several recent papers have examined the impact of tobacco control policies on the smoking behavior of youths, focusing predominantly on youths in high school (Chaloupka and Grossman, 1996; Chaloupka and Pacula, 1998; Evans and Huang, 1998). This paper extends this research by examining the impact of these policies on cigarette smoking by young adults, specifically college students. The college population is a particularly important one since individuals in this age group are still in the process of establishing their smoking behavior (USDHHS, 1994). Thus, policies specifically designed to reduce smoking can have a meaningful and significant effect on the developing smoking behaviors of this young population. Furthermore, the smoking behavior of college students provides important insights into the smoking trends of tomorrow's adult population.

Using data from the 1997 Harvard College Alcohol Study, the authors examine the effects of cigarette prices, state and local restrictions on smoking in public places and private worksites, and campus level policies toward smoking, cigarette advertising, and on-campus availability on cigarette consumption among a nationally representative sample of full-time college students. Smoking participation rates, the quantity of cigarettes smoked by smokers, and the level of smoking equations are estimated using various econometric methods. The estimates indicate that smoking among college students is sensitive to the price of cigarettes, with an average estimated price elasticity of smoking participation of –0.26 and an average conditional demand elasticity of –0.62. Although insensitive to individual state and local restrictions on smoking in public places and private workplaces, the authors find that there is a cumulative effect of these policies on smoking behaviors by college students. Current smokers living in areas with more comprehensive state and local restrictions smoke less. Restrictions on college campuses, however, appear to only be effective at discouraging smoking when they are actively

enforced. The existence of these policies alone has no effect on either the prevalence or the level of smoking.

II. SELECTED REVIEW OF ECONOMETRIC STUDIES OF CIGARETTE DEMAND

Over the past few decades, several econometric studies have analyzed cigarette demand and have tried to quantify its determinants. The results of this research suggest that higher cigarette taxes and prices work to significantly decrease the demand for cigarettes. The findings are based on various populations and statistical methods. In recent years, econometric research has increased its focus on the smoking behavior of youths and young adults because of the attention it has received by public health officials and policy makers. In addition, a growing number of studies have utilized individual level data samples to examine the price responsiveness of cigarette smoking among youth.

The first research to utilize individual level data and measure the price responsiveness of youth cigarette smoking was conducted by Lewit et al.(1981)   This study used the Cycle III of the Health Examination Survey to examine the impacts of higher cigarette prices and anti-cigarette advertising on teenage (ages 12-17) cigarette smoking. Lewit et al (1981) estimated two sets of equations. The first estimates the smoking behavior for all youth. The second models the demand for cigarettes by youth who are already smoking. This technique allows researchers to separate two important price effects. The first estimates the effect of price on the decision to smoke or not smoke. The second measures the effect that price has on the number of cigarettes consumed by smoking youth. Lewit et al. (1981) estimate an overall price elasticity of demand for youth of -1.44. The effect of price on the decision to smoke was estimated at –1.20 while the

impact of price on the choice of how many cigarettes to smoke was estimated to be much lower at -0.25.

Lewit and Coate (1982) focused on older persons and used the 1976 Health Interview Survey for their work. This set of data contains information on the smoking behavior of variously aged samples (subgroups aged at 20-25, 26-35 and 35-74 years) and allows for comparisons of price responsiveness of cigarette demand across different age groups. The overall adult sample (ages 20 years and over) has an estimated price elasticity of -0.42. The estimates for price responsiveness among young adults indicate that price has an even larger negative effect on smoking behavior of young adults (an estimated overall elasticity of -0.89). These findings support the earlier findings of Lewis et al (1981), which suggests that price has a larger estimated impact on discouraging the decision to smoke than on decreasing the number of cigarettes consumed.

Both of these early studies found that youth cigarette demand is more price sensitive than that of adults. Various reasons have been given for this finding. Lewit et al (1981) argued that because smoking is addictive, young smokers are more likely to adjust to price changes than adult smokers because they have had less time to develop addictive capital. Also, because of strong peer pressures surrounding the smoking behavior of young people, price effects may have multiplicative impacts on reducing youth smoking. More recently, Grossman and Chaloupka (1997) argue that because the disposable income of a young adult smoker is less than that of a comparable adult, price changes will have a larger price effect on youth because the fraction of income spent on smoking by youth is relatively larger. Grossman and Chaloupka(1997) also explain that young people tend to be more present-oriented and thus have a higher discount rate.

In this case, youths who attach greater weight to the occurrences of today will respond more readily to today's changes in cigarette prices.

More recent studies have confirmed the finding that youths are more price sensitive than adults.[ii] Using data from the 1992-1994 Monitoring the Future Surveys of 8th, 10th and 12th graders, Chaloupka and Grossman (1996) conducted a study of youth responsiveness to cigarette price changes, smoking restrictions and limits on youth access. The overall price elasticity on cigarette demand was estimated at –1.31 a finding that is very consistent with that of the 1980's estimates of Lewit et al.(1981) and Lewit and Coate (1982). Yet, unlike their earlier findings Chaloupka and Grossman (1996) do not estimate significantly different elasticities between the prevalence of smoking and the demand for cigarettes. The elasticity on the decision to smoke was estimated at -0.68 and the elasticity on the number of cigarettes demanded by smoking youths measured at -0.64.

Another study by Farrelly et al (1998) uses 13 samples of both adults and younger adults who responded to the National Health Survey between 1977 and 1992. Using models that adjust for unobserved state fixed effects that are likely to be correlated with cigarette taxes, this study finds an overall price elasticity of -0.25 for the entire sample and a young adult price elasticity of -0.58.

Far less work has been done analyzing the impact of smoking restrictions on smoking behavior, particularly among young adults. Those studies completed to date have predominantly focused on young high school or adult populations. For example, Evans, Farrelly, and Montgomery (1996) use survey data to examine the impact of work place policies on smoking prevalence and intensity among adult workers. Their statistical models allow for worker self-selection onto work sites based on previous smoking habits and work place smoking policies.

They find that workplace smoking bans reduce the probability of smoking among adults by 5% and reduce average daily consumption among smokers by 10%. Chaloupka and Grossman (1996) find that strong smoking restrictions, specifically those limiting smoking in public places, significantly reduce the prevalence of smoking among 8th, 10th and 12th grade youths. Weaker or less enforced restrictions (such as smoking restrictions in schools or other public places), however, have little or no significant impact on youth smoking prevalence. Similarly, Wasserman, et al. (1991) use several waves of the NHIS from the 1970's through the 1980's to construct an index of anti-smoking regulations and find that increasing state restrictions on smoking from just a few public places to the most comprehensive restrictions would reduce overall teenage cigarette consumption by over 40%.

Only one study has directly examined the impact of smoking restrictions on the smoking behavior of young adults. Using data from the 1993 Harvard College Alcohol Survey, Chaloupka and Wechsler (1997) estimate smoking participation rates, the quantity of cigarettes smoked by smokers and level of smoking equations for a nationally representative sample of college students. They evaluate the impact of state and local restrictions on smoking in public places and find that stricter restrictions on smoking in public places, such as those limiting smoking in restaurants, have a negative but only marginally significant impact on a young adult's decision to smoke (t = -1.37). However, restrictions on smoking in other public places have a large and significant impact on the quantity of cigarettes smoked by those young adults who do smoke. This paper updates the previous analysis by Chaloupka and Wechsler by examining how cigarette taxes and state and local smoking restriction policies affect college-age smoking prevalence and intensity. This study is distinguished by its use of a more recent version of the Harvard College Alcohol Survey and by a few minor changes made to the

dependent variables in the cigarette demand models. Additional controls for the college smoking environment are added and evaluated. The present paper estimates demand for cigarettes as a function of price, smoking regulation policies and an array of socio-demographic variables.

III. DATA AND METHODS

A. Harvard College Alcohol Survey

The data used in this study were obtained from the 1997 Harvard School of Public Health College Alcohol Study. This survey is the second one of its kind conducted by Harvard University. The first such study was administered in 1993 to a nationally representative sample of approximately 16,000 students attending 140 randomly selected four-year colleges and universities. In both years, administrators at each college were asked to provide a random sample of undergraduates drawn from the total enrollment of full-time students.[iii] Over 250 students from each school were sent an anonymous survey to their registered school address. In addition to interviewing students, school administrators were interviewed to obtain detailed information pertaining to campus policies. In 1997, one hundred thirty (93%) of the original 140 colleges were resurveyed.[iv] A new nationally representative sample of approximately 15,699 students was obtained. Student response rates varied by school, from a low of 26% to a high of 88%. Only twelve universities had response rates below 45%.

Although both the 1993 and the1997 surveys were designed to examine binge drinking behavior across US college campuses, other risky behaviors were also examined. The 1997 survey instrument was almost identical to that of the 1993 instrument, although a few additional questions regarding tobacco use and lifestyle choices were included. In 1997, each of the respondents was asked about his or her past and current smoking behavior.[v] Three different

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measures of current young adult cigarette demand are constructed from the question: "How many cigarettes a day do you smoke on average? (One pack equals 20 cigarettes)." Possible responses included none, less than one cigarette, less than a half a pack, about half a pack, more than half a pack but less than a pack, a pack, and more than a pack. The first measure is a dichotomous indicator of smoking participation or prevalence. A student is a smoker if he or she has smoked $n > 0$ cigarettes in the last 30 days (dummy=1), and a non-smoker if he or she has smoked $n=0$ (dummy=0) cigarettes in the last 30 days. The remaining two indicators measure daily consumption on a five point (0-4) and on a seven point scale (0, 0.5, 5, 10, 15, 20, 30), respectively. First, an ordered level measure attempts to capture the frequency of cigarette consumption and takes a value of zero to indicate nonsmokers, one for light smokers (less than one cigarette per day); two for moderate smokers (consuming less than half a pack or about half a pack per day) and three for heavy smokers (smoking half a pack or more per day). The other measure, although not ideal, attempts capture of actual consumption magnitudes by fixing daily consumption at the mid-point of the survey's consumption ranges. A value of 0 indicates no cigarettes smoked per day, .5 represents less than one cigarette per day, 5 indicates less than 10 cigarettes per day, 10 indicates 10 cigarettes per day, 15 represents an average of 10 to 20 cigarettes smoked per day, 20 represents a pack a day (20 cigarettes) and 30 indicates a pack or more consumed each day.

In addition to information on smoking, drinking and other risky behaviors, the student survey obtained detailed socioeconomic and demographic information. Thus it is possible to construct controls for many of the other important correlates of young adult smoking that have been identified in the literature. Variables constructed for this analysis include: the age of the respondent (in years), age squared; an indicator for gender (male), race (White, Black, Asian,

Native American), ethnicity (Hispanic or non-Hispanic regardless of race), marital status (never married, married, and divorced /separated /widowed), religiosity (very religious, somewhat religious, a little religious and not at all religious), parental education (no college by mother or father, father attended college, mother attended college, both mother and father attended college); an indicator for sorority or fraternity membership, on-campus living (single sex residence hall, co-ed residence hall, other university housing, fraternity/sorority housing, off-campus housing), student employment (hours per day spent working for wages), and student income (amount of money received from a job). In addition, it is possible to construct measures describing the basic characteristics of the college that the student attends, including the type of campus (co-ed, private, commuter or rural) and region (south, west Midwest etc.).

In 1997, the school administrator survey included an extensive series of questions pertaining to campus policies toward tobacco. Information on the rules surrounding tobacco advertising on campus, the availability and sale of tobacco on campus, and the presence of smoking restrictions and the degree of their enforcement was obtained. From these questions, the authors constructed a series of variables capturing each school's smoking policy (prohibited everywhere, prohibited in public areas, prohibited in most areas, and generally not prohibited; smoke-free areas strongly enforced, smoke-free areas weakly enforced, and smoke-free areas not enforced), general availability of cigarettes on campus (vending machines on campus, cigarettes sold in bookstore, cigarettes sold in other campus areas, and cigarettes not sold on campus), and advertising of cigarettes (cigarette ads allowed in school newspapers, cigarette ads prohibited in school newspapers, no policy regarding cigarette ads in newspapers, cigarette ads allowed on bulletin boards, cigarette ads prohibited on bulletin boards, and no policy toward cigarette ads on bulletin boards).

B. State And Local Policy Variables

In addition to the school level tobacco policy information obtained from the school administrator survey, a series of state and local tobacco policy variables were merged with the survey data. Using the state location of the school campus, the state average price of cigarettes is obtained from the Tobacco Institute's annual Tax Burden on Tobacco. The cigarette price is a state average cigarette price, based on the price of single cigarette packs, cartons and vending machine sales. It reflects the average price of a branded pack of twenty cigarettes inclusive of state level excise taxes.[vi] Based on the specific city, county and state location of each respondent's campus, additional variables reflecting cigarette smoking restrictions were added to the survey data. Four separate dichotomous variables were constructed to reflect limits on smoking in private workplaces, restaurants, retail stores and other public places at the state level. Four similar measures were constructed to capture clean indoor air restrictions at the local (city or county) level. Finally, a restrictiveness index was constructed in an effort to reduce the significant multicollinearity that exists between each of these restriction indicators. The index is the sum of all four smoking restriction measures and represents the existence of a clean indoor air policy at either the state or local measure (ie. Limitations on smoking in private workplaces will equal one if a law exists at either the state or the local level).

Summary statistics on all of the variables included in this analysis are provided in Table Two.   After eliminating individuals with missing information for gender, age, smoking, ethnicity, parental education, and hours worked, a final sample of 15,148 individuals remains.[vii] Approximately sixty percent of the sample is female and the sample is predominantly white. Hispanic ethnicity is asked as a separate question from race. Only eight percent of individuals report being of Spanish or Hispanic origin (where hispanic=0, non-hispsnic=1). The majority of

sampled students live in an off-campus house or apartment, the omitted category for the

variables indicating current living arrangements, and most attend a large public campus. About

twenty-four percent of the students sampled report being a daily smoker (smoking any positive

amount on a daily basis). On average, students report smoking approximately 2 cigarettes a day,

although there is significant variation in the amounts reported and this number includes those

individuals who do not smoke any cigarettes. When the sample is restricted to those students

who smoke, the average number of cigarettes increases to approximately eight cigarettes or less

than half a pack a day. [viii] Given that three-fourths of the sample are nonsmokers, the high

standard deviation suggests that the data on this "continuous" measure is highly skewed. This

skewness is further evident by the low value in the ordered smoking variable. Therefore, the

natural logarithm of the daily number of cigarettes smoked is used for all regressions of the

quantity consumed.

Approximately fifteen percent of the sample attend campuses where smoking is

prohibited everywhere on campus. These colleges are geographically dispersed and are located

in twelve states. Although only this small fraction of students attends colleges that prohibit

smoking everywhere on campus, over three-quarters of the sampled students (82%) attend

colleges where smoking areas and non-smoking areas are strongly enforced. Seventy-five

percent of sampled students attend colleges that prohibit the sale of cigarettes on campus, sixty-

two percent attend campuses that prohibit cigarette advertising on campus bulletin boards, and

thirty-six percent attend colleges that prohibit advertising in school newspapers.

C. Methods

OLS regression analysis is inappropriate when the dependent variables are limited in

nature, as is the case here. Given the categorical nature of the responses regarding daily cigarette

consumption and the fact that each response indicates a higher level of smoking, ordered probit

regression methods are first used to estimate the level of smoking participation. Short-run,

coefficient estimates from these models are reported in all the tables along with their associated

t-statistic. Since information is lost regarding the actual amount of cigarettes smoked by

individuals when using an ordered probit specification, the authors also estimate two-part models

of the unconditional demand for cigarettes. In the first step, the probability of youth smoking is

estimated using a logistic specification. Odd ratios and their associated t-statistics are reported

in the tables under this specification. In the second step, the natural logarithm of average daily

cigarette consumption for smokers only is estimated using ordinary least squares methods and

estimated coefficients are reported in the tables. Information from the two-part model

specification is useful for understanding the incremental impact of particular policies on the

actual number of cigarettes smoked. Further, this specification is less restrictive because it

allows the explanatory variables to have an independent effect on the decision to smoke from the

conditional quantity consumed.

IV. RESULTS

Table A1 in the appendix reports the full results from each of the basic demand models

when tobacco control policies are excluded. Only the price of cigarettes is included in each of

these models so that it is possible to evaluate the impact of the various policies on the

significance of the cigarette price variable when they are included.[ix] The remaining

specifications include all the variables included in this model, although the findings with respect

to these other variables are suppressed because of limited space. There are some interesting

findings that emerge in these basic models that should be noted. All specifications reveal that

men are less likely to smoke and smoke less than women. This finding contradicts the results reported by Chaloupka and Wechsler(1997) which indicated no significant difference in smoking between the sexes. This could be indicative of changing trends in smoking. Blacks and Asians are significantly less likely to smoke than whites. Those that report being of non-Hispanic descent report higher levels of smoking but not higher levels of smoking participation.   Level of smoking and smoking participation appears to be a decreasing function of age, although this may just be picking up a cohort effect given that only one cross-section of data are available. Although parental education appears to have a positive effect on the level of smoking, the findings from the two-part model reveal that most of this effect is through the positive impact on smoking participation but not on the quantity of cigarettes smoked by smokers. Similarly students who are married appear to have lower levels of smoking then students who are single. However, findings from the two-part model suggest that it is a strong negative impact on smoking participation that generates this result in the ordered probit. In fact, being married has a significantly positive impact on the quantity of cigarettes smoked for those who choose to smoke. Religious participation is generally associated with lower levels of smoking across all models. Living in a fraternity or sorority significantly influences smoking participation, but has a negative impact on the level of smoking for those who do smoke.   Hours of work is associated with increased levels of smoking, but here again most of the effect is on the participation equation. Finally, as in the 1993 HCAS study by Chaloupka and Wechsler (1997), cigarette prices have a negative and statistically significant effect on all the models, although prices are only marginally significant in the participation equation. This suggests that for the young adult population, who is past the age of experimentation, price has a greater impact on the quantity of cigarettes consumed.

Many of the variables included in this model are potentially endogenous, including living arrangements, religious participation, marital status, hours worked, income, and participation in a fraternity/sorority. When these variables are excluded from the regression, none of the main results discussed above change. Price becomes insignificant in the smoking participation equation (t = -1.04), but remains negative and significant in both the ordered probit (t = -1.947) and log quantity consumed specifications (t = -2.140).[x]

Table Three reports the findings when local and state tobacco control policies are included in each of the basic models. In Model A, only local tobacco control policies are included as additional regressors in each of the models. Cluster-adjusted t-statistics, adjusted for clustering at the school (local) level, are reported in parentheses. In Model B, state tobacco control policies replace local control policies in the models. Again, the cluster adjusted t-statistics are reported in parentheses, where clustering is adjusted at the state level. Finally, Model C collapses the local and state tobacco control policy measures into a single index ranging from 0 to 4 indicating an increased number of smoking restrictions at the state or local level. T-statistics in these models are adjusted for clustering at the state level.

A quick glance at the table reveals that state and local restrictions on smoking have small and rather ambiguous effects on college age smoking. None of the individual local or state tobacco control policies significantly influences the level of smoking or smoking participation among college students. [xi] However, when collapsed into a single index capturing the number of smoking restrictions the individual faces due to laws at the local and state level (Model C), the authors find that the level of smoking is significantly influenced by clean indoor air smoking restrictions. A higher restrictiveness index is generally associated with lower levels of smoking in both the ordered probit and conditional demand equations. This suggests that it is the

combination of these policies and not any singular policy that most significantly influences full-time college students.

The finding that no single policy significantly influenced smoking behavior among college students contradicts what was found by Chaloupka and Wechsler (1997) in their evaluation of the 1993 HCAS data. In their 1997 study, Chaloupka and Wechsler find that the restrictions index has no effect on smoking behavior. This is somewhat surprising, particularly because the number of smoking restrictions have increased significantly between the two surveys. It is possible, however, that at the same time local and state policies have become more pervasive, young adults have become more adept at getting around these individual policies by changing where they choose to smoke (smoking on campus, in one's living area, etcetera) as opposed to how much they smoke. Furthermore, if campus policies do not reinforce local and state smoking restrictions, then it may be relatively easy for students to evade these policies by smoking on campus.   It is important to control for campus policies, that is, to know whether campus policies reinforce or counter local and state smoking restrictions in order to evaluate the true effect of state and local policies.

Table Four presents findings when campus tobacco policies are added to the model. The findings to these model specifications are unique to the 1997 HCAS sample as information on school level smoking restrictions was not available for the 1993 HCAS cross-section. Here, three different groups of smoking policies are included: school restrictions on smoking on campus, cigarette availability on campus and cigarette advertising on campus. T-statistics presented in these tables are adjusted for clustering at the school level. Table Four indicates that the inclusion of these school policies causes the magnitude and significance of both the price and smoking index variables to change. Price becomes larger in absolute magnitude and more significant in

all three specifications. Interestingly, however, the restrictiveness index becomes smaller and less significant in the ordered probit equation but larger (in absolute value terms) and more significant in the conditional demand or level of use equation. The fact that these estimates change suggests that the exclusion of campus policies leads to a significant omitted variable bias when examining the other tobacco control initiatives.

The findings with respect to school policies are mixed. [xii] Campus prohibitions on smoking in all areas have a negative and marginally significant association with the level of smoking among current smokers relative to other types of restrictions but have no significant impact on smoking participation. Only complete bans influence smoking behavior. Strict enforcement of non-smoking areas on campus has no significant effect on smoking participation or level of conditional use but non-responsiveness regarding this policy appear to occur non-randomly which could bias these estimates toward zero. When strict enforcement is interacted with campus prohibitions, the authors do find a negative effect on smoking participation but not on the level of use. Surprisingly, the joint effect of a strict local environment and prohibition on campus is not significant in any of the specifications. This may be due to self-selection of individuals to campus environments that are consistent with their smoking behavior. Given that we examine only one year of data, we cannot ignore the possibility that sorting occurs and may influence the results. Overall, apart from price, the demographic measures, including race, age, religiosity and region are most determinative.

The measures of cigarette availability on campus have unexpected signs. That is, restrictions on the sale of cigarettes on campus are not associated with lower smoking participation or levels of use among smokers. In fact, these findings suggest that student smokers attending colleges that prohibit on-campus sale of cigarettes smoke significantly more than

student smokers attending colleges which do allow cigarette sales in some venues. This information contradicts what we would expect to find since it suggests that greater availability of cigarettes reduces their use. However, we do not have information on the relative price of the cigarettes sold in these venues or the proximity of other vendors. Furthermore, nonresponse to this question again appears to be nonrandom and significantly correlated with the likelihood that students smoke. It is therefore difficult to interpret the positive and significant coefficient in the level of use equation.

The findings with respect to advertising are similarly mixed. Bans on advertising in campus newspapers have no significant association with student smoking although bans on bulletin board advertisements are associated with lower levels of smoking for those students who do smoke. Nonreponses for both of these advertising policies, although relatively small (less than five percent of the sample) are negatively associated with smoking behavior, making it difficult to know whether these findings are robust.

V. DISCUSSION AND CONCLUSIONS

Although it is not possible to draw strong conclusions regarding the impact of campus policies on college smoking behavior, the results of this analysis do provide a number of important implications for tobacco control policy. In particular, this study provides strong evidence to support the argument that higher cigarette prices discourage both smoking participation and the level of smoking among young adults. As in the 1993 Harvard College Alcohol Survey study (Chaloupka and Wechsler, 1997), cigarette prices, under all three specifications, have a significantly negative association with smoking by college students. The average estimated price elasticity from the smoking participation equations is –0.26 while the average conditional demand elasticity is –0.62. These results clearly indicate that a 10% increase in cigarette prices, which can be obtained through cigarette tax hikes, will reduce smoking participation among college students by 2.6% and will reduce the level of smoking among current college smokers by 6.2%. Given that most smokers become addicted before the age of 20 and keeping in mind the experimental behavior of most young smokers, a decision to quit smoking at this age will most likely be a permanent one. Thus raising cigarette taxes and therefore, cigarette prices can lead to long-run health benefits for today's youth and tomorrow's adult population.

The estimates on local and state smoking restrictions reveal individual policies do not appear to significantly influence smoking among college students. However, the findings with respect to the restrictiveness index suggest that there is a cumulative effect of these policies on the level of smoking by those individuals who choose to smoke. College smokers living in areas with more restrictions on smoking in public places smoke fewer cigarettes. These findings become even more pronounced when campus level controls are included in the model. Smoking

restrictions on college campuses, however, only appear to influence smoking behavior when complete bans are imposed. Other restrictions on smoking in specific areas do not significantly influence smoking, even if they are strictly enforced. These findings together suggest that smoking behavior among college students is only influenced when the level of smoking restrictions reach some threshold level and it is no longer easy for smokers to evade these policies.

The findings with respect to the availability and advertisement of cigarettes on college campuses are generally counter-intuitive. Banning the sale of cigarettes on campus is associated with increased levels of smoking among college cigarette users, not less. Although bans of advertising on school bulletin boards are associated with less smoking by college students, similar bans in school newspapers have no effect on smoking. The inconsistency of these findings across the different measures of access and exposure suggest that these policies and their implementation are imprecisely measured in our data. The authors are also unable to explain why nonresponses occur randomly. Further investigation of these policies would be useful.

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Endnotes

[i] This analysis of change used a response rate criteria for 1993 and 1997 requiring 45% minimum in both years for a school to be included. Therefore, this rate is based on a sample of 116 schools. The measure of smoking status is based on any smoking in the past 30 days. See Wechsler et al., 1998 JAMA

[ii] For a comprehensive review of the literature, see Chaloupka and Warner (forthcoming).

[iii] For a complete presentation of the methods of the original survey see Wechsler, 1994 JAMA)

[iv] The main reason given by the ten colleges that chose not to participate in the second survey was that they were unable to provide a random sample of students and their addresses within the time frame designated by the study. For a complete description of the 1997 sample see Wechsler et al., 1998 JACH

[v] Wasserman et al. (1991) report that there is strong evidence that cigarette smoking in underreported in surveys. Yet, there is little information available on the extent of the underreporting and how underreporting is related to consumption. Thus, by assuming that all smokers underreport their smoking consumption by the same degree, the estimate on price and policy variables are not affected.

[vi] The measure employed here does not reflect the price of generic brands. Various models using a local measure of cigarette price obtained from ACCRA were also run. The findings presented here are not sensitive to the measure of price included.

[vii] Preliminary regressions including these observations reveal that these observations appear to be missing randomly. None of the dummy variables indicated a missing value were significant in earlier runs. Dropping these variables individually did not lead to a significant loss in the number of observations.

[viii] Although an average of 8 cigarettes per day seems low relative to the rest of the adult population, the finding is not surprising. College students are still largely experimental smokers. This phase in their smoking behavior is experimental and they tend to not be daily, addicted smokers.

[ix] Although studies often omit observations for students who live near a low-tax state and therefore, have access to lower-price cigarettes, this study does not subset the sample. In general, one would expect to find lower elasticities among those living close to low tax states.

[x] These short form specifications are available from the author upon request.

[xi] The inclusion of smoking restrictions is important as the omission of the policy variables from the models may lead to an overestimation of the price effect. A number of studies indicate that smoking restrictions may be correlated with after-tax price. Wasserman (1991) argues that localities with more smoking restrictions also tend to have higher priced cigarettes. This suggests a positive correlation between cigarette price and smoking restrictions. At the same time, Keeler (1998) argues that price discrimination becomes an issue in localities governed by more extensive smoking restrictions. That is, tobacco companies purposely price cigarettes at lower levels in these areas. This finding suggests a negative correlation between after-tax price and smoking restrictions. Overall, there's little evidence to support a strong correlation in either direction.

[xii] Various specifications of this model were tried, including additional indicators for restrictions in public places and in most areas (leaving no restrictions as the excluded category), but the findings with respect to these other variables were insignificant.

Table One
Thirty-Day Smoking Prevalence
Monitoring the Future Study

	1991	1992	1993	1994	1995	1996	1997
High School Seniors	28.3	27.8	29.9	31.2	33.5	34.0	36.5
Young Adults	28.2	28.3	28.0	28.0	29.2	30.1	29.9
College Students	23.2	23.5	24.5	23.5	26.8	27.9	28.3

Source: MTF Webpage (Table 2-1b)

Table A1
Basic Models of Cigarette Demand

Variable	Ordered Probit Frequency of Cigarette		Logistic(Smoke now) Current Smoking Participation		Ln (Avg Number of Cigs) Cigarettes Consumed by Smokers	
	Coef.	Robust T-stat	Odd Ratios	Robust T-stat	Coef.	Robust T-stat
Male	-0.0688	-2.979 [a]	0.8988	-2.529 [b]	-0.1786	-3.385 [a]
Black	-0.4951	-8.356 [a]	0.4414	-7.383 [a]	-0.5418	-4.073 [a]
Asian	-0.1407	-3.203 [a]	0.8232	-2.386 [b]	-0.0859	-0.870
Native American	0.1858	1.348	1.5121	1.543 [d]	-0.4385	-1.384 [d]
Other Race	-0.0087	-0.173 [a]	0.9833	-0.186	0.0118	0.136 [a]
Race missing	-0.1836	-1.569 [b]	0.7382	-1.334	-0.1914	-0.773 [c]
Hispanic	0.1131	2.171 [a]	1.0974	0.964	0.3821	3.767 [a]
Age	-0.5968	-5.540 [a]	0.4487	-3.993 [a]	-1.2381	-5.475 [a]
Age squared	0.0143	5.693 [a]	1.0192	4.065 [a]	0.0298	5.675 [a]
Father college educated	0.1198	3.409 [a]	1.2316	3.618 [a]	0.0539	0.770
Mother college educated	0.0702	1.715 [c]	1.1651	1.982 [c]	-0.0413	-0.496
Father/Mother college educated	0.1071	3.766 [a]	1.2471	4.443 [a]	-0.0656	-1.059
Married	-0.2794	-5.761 [a]	0.5733	-5.868 [a]	0.2295	2.074 [b]
Divorced/Separated/Widowed	0.3545	5.040 [a]	1.4951	2.763 [a]	0.6521	4.869 [a]
Very religious	-0.5958	-16.365 [a]	0.3661	-12.415 [a]	-0.5458	-6.480 [a]
Somewhat religious	-0.1648	-5.750 [a]	0.8051	-4.449 [a]	-0.3774	-5.494 [a]
Little religious	0.0033	0.110	1.0493	0.939	-0.1845	-2.657 [b]
Unisex dorm	-0.1569	-3.844 [a]	0.7950	-2.924 [a]	-0.2415	-2.633 [b]
Co-ed dorm	-0.0517	-1.645 [c]	0.9428	-0.899	-0.1178	-1.736 [c]
Other university housing	-0.0668	-0.968	0.8933	-0.966	0.1070	0.682
Live in fraternity/sorority	0.0569	0.824	1.1646	1.282	-0.2150	-1.475 [d]
Other housing	-0.0576	-0.978	0.8765	-1.199	0.0458	0.384
In a sorority/fraternity	0.0910	2.652 [c]	1.2324	3.275 [a]	-0.1405	-1.903 [c]
Hours worked	0.0278	3.208 [a]	1.0554	3.367 [a]	-0.0046	-0.259
Income	-0.0002	-0.558	0.9996	-0.753	0.0000	0.005
Woman's college	0.0030	0.051	0.9947	-0.036	0.1042	1.228
Black college	0.0346	0.320	0.9685	-0.115	0.2945	2.424 [b]
Community college	-0.0231	-0.635	0.9378	-0.829	0.0872	0.990
Small private campus	-0.1070	-2.778 [a]	0.7949	-2.841 [a]	0.0887	1.008
Large private campus	-0.0049	-0.132	0.9854	-0.138	0.0285	0.244
Small public campus	0.0262	0.784	1.0481	0.673	0.0043	0.049
South	0.0062	0.153	1.0264	0.34	-0.0657	-0.628
West	-0.1932	-4.963 [a]	0.7591	-2.759 [a]	-0.3118	-2.999 [a]
Midwest	0.0177	0.502	1.0503	0.703	-0.0698	-0.740
Price of cigarettes	-0.0013	-2.451 [b]	0.9983	-1.457 [d]	-0.0032	-2.581 [b]
Number of observations	15,148		15,148		3,682	
Log-likelihood	-11994.08		-8064.46			
Pseudo R2/ R-squared	0.031		0.040		0.078	

Notes: Significance is indicated as follows (all are two-tailed test): (a) indicates significance at 1% level, (b) indicates significance at 5% level, (c) indicates significance at 10% level, (d) indicates significance at 10% level for a one-tailed test. All standard errors are adjusted for clustering at the school level.

Table Two
Descriptive Statistics HCAS 1997[a]

Variable	n	Mean	Std. Dev
Measures of Smoking			
Smoke presently (1=Yes, 0=No)	15148	0.243	0.429
Avg daily number of cigarettes	15148	1.910	5.033
ln(avg number of cigs)	3682	1.312	1.451
Ordered smoking variable	15148	0.473	0.915
Individual Characteristics			
Male (Male=1, Female=0)	15148	0.400	0.490
Black	15148	0.059	0.235
Asian	15148	0.075	0.263
Native American	15148	0.006	0.074
Other Race	15148	0.078	0.269
Race missing	15148	0.011	0.106
Hispanic (Hispanic=1, Non-Hispanic=0)	15148	0.919	0.273
Age (in years)	15148	20.971	2.191
Age squared	15148	444.563	94.704
Father college educated	15148	0.161	0.368
Mother college educated	15148	0.104	0.306
Both parents college educated	15148	0.487	0.500
Married	15148	0.086	0.281
Divorced/separated/widowed	15162	0.024	0.154
Very religious	15148	0.201	0.401
Somewhat religious	15148	0.337	0.473
Little religious	15148	0.224	0.417
In a fraternity/sorority	15148	0.138	0.345
Hours worked (hours/day)	15148	2.277	2.085
Income (dollars earned/week)	15148	56.111	56.781
Living Arrangements			
Unisex dorm	15148	0.132	0.338
Co-ed dorm	15148	0.239	0.426
Other university housing	15148	0.028	0.166
Live in a fraternity or sorority	15148	0.029	0.167
Other housing	15148	0.038	0.192
University characteristics			
Woman's college	15158	0.052	0.221
All Black college	15158	0.016	0.124
Community college	15158	0.148	0.355
Small private campus	15158	0.124	0.330
Large private campus	15158	0.149	0.356
Small Public campus	15158	0.151	0.358
Region			
South	15158	0.284	0.451
West	15158	0.176	0.381
Midwest	15158	0.306	0.461

[a] All descriptive statistics are unweighted.

Table Two (Continued)
Descriptive Statistics HCAS 1997

Variable	n	Mean	Std. Dev
State and Local Policy Measures			
Price of cigarettes (measured in cents)	15158	206.981	27.109
Local private workplace smoking restrictions	15162	0.283	0.450
Local restaurant smoking restrictions	15162	0.348	0.476
Local retail store smoking restrictions	15162	0.320	0.467
Local other smoking restrictions	15162	0.357	0.479
State level private workplace smoking restriction	15162	0.535	0.499
State level restaurant smoking restrictions	15162	0.727	0.446
State level retail store smoking restrictions	15162	0.684	0.465
State level other smoking restrictions	15162	0.883	0.322
Index of state and local smoking restrictions	15162	3.308	1.239
School Smoking Policy			
Prohibit everywhere	14050	0.151	0.359
Smoke-free area strongly enforced	14050	0.817	0.386
Missing smoke-free area enforcement	14050	0.076	0.266
School Cigarette Availability			
Vending machines	14050	0.029	0.168
Missing information regarding vending machines	14050	0.043	0.202
Bookstore	14050	0.193	0.394
Missing information on book store sales	14050	0.033	0.177
Advertisements			
Prohibited in newspapers	14050	0.363	0.481
Newspapers not reported	14050	0.040	0.195
Prohibited on bulletin boards	14050	0.624	0.484
Bulletin boards not reported	14050	0.029	0.167

Table Three

Local and State Tobacco Control Policies

Variable	Ordered Probit			Odds Ratio			Ln(cigs)		
	Frequency of Cigarette Consumption			Current Smoking Participation			Cigarettes Consumed by Smokers Only		
	Model A	Model B	Model C	Model A	Model B	Model C	Model A	Model B	Model C
Cigarette Price	-0.00128 [b]	-0.00119 [c]	-0.00110 [b]	0.99827 [c]	0.99831	0.99849	-0.003165 [b]	-0.00271 [c]	-0.00265 [b]
	(0.00053)	(0.00062)	(0.00054)	(0.00119)	(0.00139)	(0.00120)	(0.00123)	(0.00151)	(0.00121)
Workplace Smoking Restrictions	0.04081	-0.03933		1.05934	0.95078		0.04582	-0.08925	
	(0.04178)	(0.02888)		(0.11134)	(0.063266)		(0.10866)	(0.07528)	
Restaurant Smoking Restrictions	-0.02008	-0.00272		0.965031	0.98170		-0.180531	-0.00308	
	(0.05254)	(0.05218)		(0.131917)	(0.07841)		(0.15411)	(0.12476)	
Retail Smoking Restrictions	-0.06647	-0.00015		0.94318	1.02838		0.016227	-0.07176	
	(0.07211)	(0.04977)		(0.12994)	(0.07872)		(0.17332)	(0.12980)	
Other Public Place Smoking Restrictions	0.06053	-0.05038		1.08017	0.92263		0.065453	-0.02761	
	(0.06519)	(0.04436)		(0.10632)	(0.07425)		(0.13668)	(0.09974)	
Restrictiveness Index			-0.02060 [b]			0.97636			-0.05124 [b]
			(0.0104)			(0.02063)			(0.02586)

Notes: Significance is designated as follows: (a) indicates significance at the 1% level (two-tailed test), (b) indicates singificance at 5% level (two-tailed test), and (c) indicates significance at 10% level (two-tailed test). All standard errors (and hence t-statistics) in Model A are adjusted for clustering at the school level. All all standard errors (and t-statistics) in models B and C are adjusted for clustering at the state level.

Model A: Local clean indoor air restrictions only

Model B: State clean indoor air restrictions only

Model C: State and local index of clean indoor air restrictions

This specification includes all the variables from the basic demand models presented in table A1 but those findings are suppressed because of limited space.

Table Four
School Policy Variables

Variable	Ordered Probit Frequency of Cigarette Consumption		Logistic(Smoke now) Current Smoking Participation		Ln (Avg Number of Cigs) Cigarettes Consumed by Smokers Only	
	Coefficient	T-stats	Odd Ratios	T-stats	Coefficient	T-stats
Price of Cigarettes	-0.0018	-3.020 [a]	0.9976	-1.892 [c]	-0.0034	-2.651 [a]
Policy Restrictiveness Index	-0.0190	-1.528 [d]	0.9866	-0.590	-0.0865	-3.530 [a]
School Smoking Policies						
Prohibit Everywhere	0.0104	0.077	1.1282	0.771	-0.2285	-1.476 [d]
Strongly Enforced	-0.0464	-1.187	0.9339	-0.937	-0.1167	-1.277
Enforcement Missing	0.0090	0.152	1.0208	0.210	-0.0547	-0.423
Prohibited everywhere * strongly enforced	-0.1309	-0.770	0.7386	-1.606 [d]	-0.0777	-0.228
Restrictiveness Index * prohibited everywhere	0.0329	1.004	1.0493	0.893	0.1103	1.236
Cigarette Availability						
Bookstore	-0.0475	-1.527 [d]	0.9391	-1.000	-0.1141	-1.761 [c]
Bookstore information missing	-0.0379	-0.483	0.8762	-1.039	0.4161	2.442 [b]
Vending Machines	-0.1398	-1.864 [c]	0.8106	-3.252 [a]	-0.1568	-0.855
Vending machine info missing	-0.1478	-2.168 [b]	0.7710	-2.807 [a]	-0.1009	-0.685
Advertisements						
Prohibited in newspaper	0.0491	1.704 [c]	1.0823	1.171	0.0264	0.375
Missing Newspaper information	-0.0904	-1.049	0.9345	-0.933	-0.4733	-3.140 [a]
Prohibited on Bulletin Boards	-0.0799	-2.779 [a]	0.8768	-2.223 [b]	-0.1193	-1.756 [c]
Missing bulletin board information	-0.0968	-0.964	0.7820	-2.429 [b]	0.1968	1.254

Notes: Significance is indicated as follows (all are two-tailed test): (a) indicates significance at 1% level, (b) indicates significance at 5% level, (c) indicates significance at 10% level, (d) indicates significance at 10% level for a one-tailed test. All t-statistics are adjusted for clustering at the school level.

This specification includes all the variables from the basic demand models presented in table A1 but those findings are suppressed because of limited space.

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