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Abstract

Adolescents with mental health problems have much higher rates of smoking than those without such problems. Although a large body of evidence suggests that higher cigarette prices reduce smoking prevalence and the quantity smoked, little is known about the interaction between mental health or behavioral problems and tobacco consumption in the general population or among adolescents. Using a national representative sample of adolescents from the National Longitudinal Study of Adolescent Health and employing validated psychiatric measures of emotional distress and behavioral problems, we estimate the price elasticity of cigarette demand for adolescents who have behavioral or emotional problems. The results indicate that these adolescents are at least as responsive to cigarette prices as adolescents with no emotional or behavioral problems.

1. Introduction

Cigarette smoking is the most preventable cause of morbidity and mortality (McGinnis and Foege 1993; Peto et al. 1994; and Mokdad et al. 2004). Medical research has established a strong link between chronic cigarette use and lung cancer at least since the 1964 Surgeon General's Report on Smoking and Health. Lung cancer accounts for about 30 percent of all cancer deaths, and about 85 percent of lung cancer deaths are attributable to tobacco use (Department of Health and Human Services 1989). Cigarette smoking is also one of the leading risk factors of cardiovascular disease, which is the largest cause of death in the United States at the turn of the twenty-first century.[1] Each year more than 400,000 Americans die from cigarette smoking, which indicates that 20% of all deaths are cigarette related (Center for Disease Control and Prevention (CDC) 2006). Youth smoking is particularly important in this context, as the epidemiological evidence indicates that individuals who avoid smoking in adolescence or in young adulthood are unlikely to ever become smokers. In developed countries, about 80 percent of adult smokers have started smoking in their teens, and across the world there is an emergent trend toward initiation of smoking at younger ages (World Bank 1999).

Although adult smoking has been declining gradually in the United States since the 1970s, there has been an increase in youth smoking during the 1990s. According to the Monitoring the Future Survey, smoking rates peaked in 1996 for 8th and 10th graders, where the rates were 21% and 30.4%, respectively. The smoking rate peaked in 1997 for high school senior s, where more than one in three high school seniors smoked. At these peak levels, the smoking rates were about 50 percent higher for 8th and 10th graders and about 30 percent higher for 12th graders in comparison to the corresponding rates that prevailed in 1991. Even though the smoking prevalence among high school students has declined since 1997, the newest information

suggests that the rate of decrease in smoking prevalence has declined, and nearly twenty-five percent of high school seniors reports current smoking (Johnston et al. 2004). Such persistence in smoking rates among adolescents is noteworthy because it pertains to a generation that has received the greatest amount of smoking prevention messages and prevention interventions of any cohorts in American history.

In January 2000, the Department of Health and Human Services launched a comprehensive and nationwide health promotion agenda, known as Healthy People 2010, which serves as a guide for improving the health of the American population during the first decade of the 21st Century. One of the target areas highlighted in Healthy People 2010 is tobacco use, with the goal of reducing the use of tobacco products among adolescents to 21 percent by 2010 (Healthy People 2010, 2003). Because academic research has identified a negative relationship between cigarette prices and smoking (e.g. Lewit and Coate 1982, Chaloupka and Grossman 1996), raising cigarette prices through the enactment of higher cigarette excise taxes has received much attention among various tobacco control strategies. The evidence on the extent of responsiveness of teenagers and young adults to cigarette prices, however, is somewhat mixed. Lewit, Coate and Grossman (1981) find that among youths between the ages of 12 and 17, an increase in cigarette prices has a fairly substantial negative impact on smoking, with an elasticity of -1.44. Although Chaloupka (1991) reports that young adults, ages from 17 to 24, are relatively insensitive to price changes, Chaloupka and Wechsler (1997) estimate a statistically significant and substantially large price elasticity for cigarette demand among college students. DeCicca, Kenkel and Mathios (2001) report that the price effect of smoking onset between the 8th grade and the 12th grade is not significantly different from zero. Gruber and Zinman (2001) conclude that the most effective policy determinant of youth smoking, particularly among older

teens, is the price. Emery, White and Pierce (2001) find that although established adolescent smokers are responsive to price changes, experimenters are not.[2]

Adolescents constitute an important age group to analyze from a policy point of view because of the adverse health impacts over the life cycle of early initiation of smoking. This age group is also an important category to analyze in and of itself because of presumed differences in risky behavior in comparison to adults, although recent research underscores their responsiveness to prices and incentives (Visser, Harbaugh and Mocan 2006 ; Mocan and Rees 2005; Gruber and Zinman 2001; Levitt 1998).

This paper focuses on a particular segment of adolescent population. Specifically, it investigates whether adolescents with mental and behavioral problems, such as depression or delinquency, respond to variations in cigarette prices. This is a question which also has important policy implications. Studies show that adolescents with mental health problems have much higher rates of smoking (Saffer and Dave 2005; McMahon 1999), and this is particularly true for depression, conduct disorder or delinquency, and attention deficit disorder. With estimates of lifetime prevalence of depression through adolescents as high as 20% (Rushton et al. 2002), and the strong evidence on co-morbidity among depression, delinquency, and substance use, it is important to develop an understanding of the efficacy of cigarette price variations for this particular population. If adolescents with mental health problems are not very responsive to cigarette prices, then policy makers ought to find other ways to reduce tobacco use among these adolescents in addition to raising taxes. If, on the other hand, they are responsive to cigarette prices, raising prices through taxes and other supply reduction policies may be considered as effective policy options.

There may be reasons for adolescents with emotional and behavioral problems to behave differently from adults and from other adolescents with no such problems. For example, the theory of rational addiction (Becker and Murphy 1988) postulates that individuals maximize utility over the life cycle by taking into account the implications of their current actions on future utility. Specifically, utility depends on the current consumption of the addictive good, non-addictive good, and the stock of past addictive consumption. The rational addict understands that while his utility rises when he consumes more today, his long-run utility is lower because consumption of the addictive good increases the stock of past consumption, which has a negative marginal utility. In this context, Becker and Murphy (1988) and Becker, Murphy Grossman (1991) show that price responsiveness is inversely related to time preference. Individuals with higher discount rates are expected to be more responsive to price in comparison with those who have low discount rates. One testable implication is that younger and less educated individuals are more-price sensitive than others (Becker, Grossman, Murphy 1991). In our context, this means that higher price-sensitivity of individuals with mental or behavioral problems is predicted if such individuals have higher discount rates. In addition, these individuals are expected to discount the future more heavily because future costs are lower for them as their expected future wages are lower. There exists research to indicate that individuals who engage in risky behaviors have higher discount rates (Chesson et al. 2006; Kirby and Petry 2004). Clinical psychology recognizes that a number of psychological disorders, including depression, co-occur with various addictions and risk-taking behaviors; and they involve some type of failure of 'self regulation" (Baumeister and Vohs 2004; Greenbaum et al. 1996). The question of whether people with emotional disorders have cognitive differences or whether they differ in their

judgments of reality is a subject of research (Dunning and Story 1991; Eisner Johnson and Carves 2008; Claypoole at al. 2007).

It should be noted that a rational addition framework is not necessary for differential price-responsiveness to emerge between individuals with and without emotional and behavioral problems. For example, Saffer and Dave (2005) show that in a static model where utility depends on the consumption of an addictive good, non-addictive good, and mental illness, the price elasticity of the addictive good can be larger for mentally ill individuals . However, whether or not individuals with emotional or behavioral problems react differently to prices is an empirical question which motivates us to analyze the potential differences in price elasticity between individuals with- and without these problems, similar in spirit to the research that analyzed the potential differences between males and females in their responsiveness to cigarette prices (Cawley, Markowitz and Tauras 2004).

Only one economic study to date has examined the interaction between mental illness and demand for tobacco and other substances. Saffer and Dave (2005) used the National Comorbidity Survey with appended price data and estimated demand functions for individuals with any lifetime mental illness. They concluded that individuals with a history of mental illness are responsive to prices and, therefore, higher excise taxes are effective even within this population. This is an important study with interesting findings. However, some issues are unexplored. Saffer and Dave (2005) use a sample that includes individuals with ages ranging from 15 to 54. Theoretical and empirical research suggest that youths respond to prices and policies differently than adults (Chaloupka 1991; Lewit and Coate 1982). Therefore, a sample of 15-to-54 year olds does not allow for a differentiation between youths and adults in their responsiveness to prices. Also, it is possible that individuals with different types of

psychological disorders might respond differently to prices. To address these issues, we use a large nationally representative sample of adolescents from grades 7 to 12, where we are able to measure the extent of their mental health and behavioral problems. By focusing on a younger age group and employing measures of emotional and behavioral problems, we aim to further our understanding on the interactions between youth smoking, mental health, and tobacco control.

The paper is organized as follows. Section 2 discusses the empirical framework and the methodology. Section 3 introduces the data used in the analyses. The results are discussed in section 4. Section 5 concludes the paper.

2. Empirical Framework

Following the previous literature (Gruber and Zinman 2001, Czart et al. 2001, Chaloupka and Wechsler 1997), we estimate two-part models for individual cigarette demand. The participation equation estimates a discrete choice model where the dependent variable is dichotomous, indicating whether the individual is a smoker. The second equation specifies an ordinary least squares for the conditional demand by those who are smokers. The dependent variable in the second equation is a continuous measure of the number of cigarettes consumed per day. The price elasticity of cigarette demand is computed as the sum of the price elasticity of smoking participation obtained from the participation equation and the price elasticity of conditional demand for cigarettes obtained from the consumption equation. Since one of our goals is to gauge the differential response to cigarette prices, we estimate the models separately for adolescents with and without emotional or behavioral problems. More specifically, we estimate models of the following form

$$CS_{ijs} = \alpha + \delta P_s + \mathbf{X}_{ijs}\boldsymbol{\beta} + \mu_s + \nu_j + \varepsilon_{is,} \quad (1)$$

where CS_{is} is a measure of the smoking indicator, or smoking intensity of person *i* who lives in county *j* of state *s*. P_s stands for the price of cigarettes is state s, X_{ijs} represents personal and family attributes of the individual, such as age, gender, race, and mother's education; μ_s stands for unobserved state-level characteristics that may impact smoking behavior, ν_j represents unobserved effects at the local (county) level, and ε_{is} random error term.

Cigarette consumption is also likely to be influenced by the behavior of the peers. Thus, Equation (1) can be revised as

$$C_{ijs} = \alpha+\delta P_s + \mathbf{X}_{ijs}\boldsymbol{\beta} +\gamma\, CPEER_{ijs}+\mu_s+\nu_j+ \varepsilon_{is,} \qquad (2)$$

where $CPEER_{ijs}$ measures the extent of the smoking behavior of person *i*'s peers. Given that Equation (2) is applicable to the behavior of each of these peers, it follows that

$$CPEER_{ijs} = f\,(P_s,\ \mathbf{X}_{-ijs}, C_{ijs}, \mu_s^*, \nu_j^*, \varepsilon^*_{ijs}), \qquad (3)$$

where $\mathbf{X}_{-ijs}$ stand for personal and family attributes of one' peers (not including one's own), and μ_s^* and ν_j^*, and are unobserved aggregate state and local effects.

Equations (2) and (3) underline the endogeneity or the reflection problem (Manski 1993, Sacerdote 2001), where both the individual's own consumption and the consumption of her peers influence each other. Furthermore, it is obvious that self-selection into a particular peer groups is endogenous, and a person's unobserved attributes that make her more likely to be associated with a particular group of friends are potentially correlated with her behavior. In other words, the error term ε_{is} is likely to be correlated with $CPEER_{ijs}$ in equation (2). Studies that are primarily interested in the analysis of the peer effects relied on random assignment of peers (such as roommates in dormitories (Sacerdote 2001) to identify the impact of peers on one's own behavior. In our case, these complications are not as important because our primary interest is the impact of price, and substitution of (3) into (2) gives

$$C_{ijs} = \eta + \pi P_s + \mathbf{X}_{ijs}\boldsymbol{\psi} + \lambda_s + \omega_j + \xi_{is}, \quad (4)$$

where the error term ξ_{is} includes the variables pertaining to the peers' exogenous attributes represented by $\mathbf{X}_{-ijs}$ in Equation (3), but by definition, they are uncorrelated with price.

In this framework we will not attempt to identify the effect of the peer's behavior on the price elasticity because the data set we employ does not allow us to address either the selection or the reflection issue. We will estimate versions of Equation (4), where the coefficient π captures the total impact of price on cigarette consumption of the individual, which consists of multiple channels, including the direct impact of price, and the impact of price that works through peers' behavior.[3]

In Equation (4) the coefficient of price might be biased if unobserved state-level determinants of smoking (λ_s) are correlated with price. Because price does not vary within a state in the data we employ, we cannot control for these unobservables using state fixed effects. Instead, we employ a large set of state-level variables that gauge the sentiment towards tobacco consumption in the state. The same concern motivated researchers to employ a state-level index as a control variable to capture smoking sentiments in the state (Gruber and Zinman 2001; DeCicca et al. 2006). Similarly, it may be important to control for local-level unobservables (ω_j) that may be correlated with both cigarette prices and smoking tendencies. Consequently, empirical models also include an extensive array of county variables that aim to gauge the socio-economic conditions of the county in which the individual resides. These variables are described in Section 3 below.

3. Data

The data used in the analysis are drawn from the first wave of the National Longitudinal Study of Adolescent Health (Add Health).[4] Add Health is a nationally representative study of

adolescents in grades 7 through 12. An in-school questionnaire was administered to every student who attended one of the sampled 132 U.S. schools on a particular day during the period between September 1994 and April 1995. A random sample of approximately 200 adolescents from each high school/feeder school pair was selected for in-home interviews, which were conducted from April 1995 to December 1995.[5] The in-home interviews constituted the core sample. In addition to the core sample, several special samples (e.g. ethnic and genetic) were also drawn on the basis of in-school interviews. The core and the special samples provide a total number of 20,745 adolescents for Wave I. Data are gathered from adolescents, from their parents, siblings, friends, romantic partners and fellow students, and from school administrators. The survey was designed to provide detailed information on teen behavior, including their emotional problems and substance use/abuse. The time period covered by our data corresponds to a period of most interest for the analyses of youth smoking, because in the 1990s youth smoking took a dramatic upswing (Gruber and Zinman 2001).

Survey administrators took several steps to maintain data security and to minimize the potential for interviewer or parental influence. First, respondents were not provided with any printed questionnaires. Rather, all data were recorded on laptop computers. Second, for sensitive topics, such as delinquent behavior and substance use/abuse, the adolescents listened to pre-recorded questions through earphones and entered their answers directly on the laptops. More detailed description of these data can be found in Mocan and Tekin (2005, 2006).

" Smoking Measures"

Measures of smoking for each individual are created based on the following question posed to each respondent. "During the past 30 days, on how many days did you smoke cigarettes?" We created a binary indicator for current smoking which takes on the value of one

for those who reported to have smoked at least one day during the past 30 days and zero otherwise. For these smokers, the survey includes information on how many cigarettes they smoked each day, which is used to calculate the average daily number of cigarettes. We use the binary indicator of smoking participation and the average daily number of cigarettes smoked as two measures of smoking throughout our analysis.

"Emotional and Behavioral Problems"

Resnick et al. (1997) developed continuous measures of emotional and behavioral problems for the Add Health data. Emotional distress is measured using a 17-item depression scale. Fourteen of these questions collect information on how frequently the respondents felt the following negative emotions during the past seven days: being bothered by things that usually do not bother them, having poor appetite, feeling blue, having trouble concentrating, feeling depressed, feeling like a failure, feeling fearful, being less talkative than usual, feeling lonely, feeling people being unfriendly toward them, feeling sad, feeling disliked by others, feeling hard to get started doing things, and feeling life not worth living. The possible responses were: 0-never or rarely, 1-sometimes, 2-a lot of times, and 3-most of the time or all of the time. The additional three questions consider the frequency of the following negative emotional states in the past 12 months: having trouble relaxing, feeling moody, and crying frequently. The possible responses to these questions were: 0-never, 1-just a few times, 2-about 1 a week, 3-almost every day, and 4-every day. The measure of emotional problems is obtained by summing up the individual's response to each of these questions. The range of the variable is from zero to 51. Behavioral problems are assessed by an 11 item delinquency scale, also based on self-reported behaviors of the Add health respondents. These items include the frequency of the following behaviors in the past 12 months: damaging property, lying to parents, committing theft, getting

into serious fights, running away from home, driving a car without permission, committing robbery, selling illicit drugs, skipping school, ever having been suspended, and being expelled from school. Respondents' choices pertaining to the first eight of these items include never, 1 or 2 times, 3 or 4 times, and 5 or more times. The last three responses are binary. Each respondent is evaluated on this behavioral problems scale by adding up the frequency of these acts. The range of the variable in the sample is from zero to 28.

From these continuous scales, we identify an individual as having emotional (behavioral) problems if he/she is ranked in the top quartile of the distribution of emotional (behavioral) problems scale. Previous research suggests that this classification is correlated with different stages of smoking uptake for the Add Health respondents (Lloyd-Richardson et al. 2002).[6] The definitions and descriptive statistics of these variables and personal and family background characteristics are reported in Table 1. The sample means indicate that smoking rates are significantly higher among adolescents with emotional and behavioral problems (those who are in the top 25th percentile) in comparison to those without these problems. The average number of cigarettes smoked in a day in the previous month is also statistically significantly higher for those in the upper quartile of the emotional problems scale and the behavioral problems scale. The difference is large in magnitude in the case of behavioral problems. For example, individuals who are in the top 25 percent of the distribution for emotional problems are almost three times more likely to smoke, and they smoke about two more cigarettes per day.

To investigate the sensitivity of the results to the measurement of the variables we implement the following strategy. First, instead of the 75th percentile, we use the 90th percentile as the cutoff to classify individuals into mental or behavioral problem groups. Second, we construct the emotional and behavioral problems scales in alternative ways by assigning different

weights to the items included. Specifically, we classify a person as being depressed if he/she reported to have ever felt depressed, ever felt that life was not worth living in the past week, or cried almost every day in the past 12 months, regardless of his/her responses to the other questions. In case of the behavioral problems, we re-calculate the index using a weighted sum, where lying to parents, running away from home, driving a car without permission, skipping school, and being suspended from school receive a weight of one, property damage and getting into a serious fight receive a weight of two, theft and selling drugs are assigned a weight of three, and committing robbery receive a weight of four. Thus, we consider certain behaviors as more serious than others in creating the behavioral problems scale.[7]

"Price and Other Explanatory Variables"

Cigarette price data were collected by the Tobacco Institute before it was dissolved. The consulting firm Orzechowski & Walker continued to collect and publish this information in the annual volume of Tax Burden on Tobacco. This publication provides cigarette price information for all 50 states and the District of Columbia. There are two prices reported for each state: average price over all brand name cigarettes and average price over all cigarettes (including generics). Following the literature, we use the price for the brand name cigarettes. Because the published price pertains to November 1, a weighted average price for the calendar year is computed.[8] Cigarette prices are deflated by a cost-of-living index to account for geographic price variations.

We control for a rich set of socio-economic and demographic variables including age, gender, race and ethnicity, religiosity, parental education, mother's work status, allowance and earned income of the adolescent, marital status of parents, total family income, and whether either parent smokes. In addition to these variables, the models include the body mass index of

the adolescent and self-reported health status. As the previous literature suggests, these measures might be correlated with youth smoking (Cawley et al. 2004).

As mentioned in Section 2 above, the average price of cigarettes in the state might be correlated with state-level sentiments towards smoking. If these sentiments also influence individuals' smoking behavior, the estimated effect of cigarette price would be biased. To guard against obtaining biased estimates of the price effect, we added eight variables that aim to control for sentiment toward smoking in the state. They are: the death rate due to smoking per 100,000 people, a dichotomous variable to indicate if vending machines are banned from locations accessible to youth but only allowed in business holding liquor licenses, a dichotomous variable to indicate if tobacco marketing is prohibited on billboards within 500 feet of schools and/or churches**,** a dichotomous variable to indicate tobacco marketing is restricted such that free samples are prohibited through mail and prohibition on free samples within 500 feet of schools; a dichotomous variable to indicate existence of a program enforcing citations or fines in state for violations, the number of full-time-equivalent staff on tobacco control per 100,000 people, total funds for tobacco control per 100,000 youth ages 17 and younger, and a dichotomous variable to indicate whether the state offers in-service training on tobacco use prevention to school health service staff.

We also control for the impact of contextual variables such as local unemployment rate, population density and a dichotomous variable to indicate if the person lives in an urban area. Also included are the proportion blacks in the county of residence in 1990, proportion Hispanics in the county in 1990, median household income in the county in 1990, the proportion voting democratic in the 1992 presidential election in the county, and proportion voting for Ross Perot in the 1992 presidential election.

Table 1 demonstrates that personal and family characteristics differ significantly between adolescents with emotional and behavioral problems and those without these problems. For example, males are more likely to have behavioral problems in comparison to females, whereas females are more likely to have emotional problems. The proportion of blacks is higher in the group with emotional problems in comparison to the full sample. The opposite is true for whites. Adolescents whose parents are smokers are more likely to have both emotional and behavioral problems.

4. Results

Table 2 displays the estimated coefficients from the binary participation equation for adolescents with and without emotional problems. Those with (without) emotional problems are the ones who are ranked in the top 25 percent (bottom 75 percent) of the distribution of the emotional problems scale in the sample. The results based on 90 percent-10 percent cut-off are discussed later in the paper. The reported coefficients are the marginal probabilities obtained from probit regressions. According to the results displayed in Table 2, a one-dollar increase in the real price of cigarettes generates about a 3 percentage point decrease in the probability of smoking for adolescents with no emotional problems, but the impact is not statistically significant. For those with emotional problems (those who are in the 75^{th} percentile of the depression scale or higher), the impact is 15.5 percentage points, about a 48% reduction from the sample mean. The participation elasticity for those with emotional problems is -1.04 as compared to the -0.33 for those without emotional problems.

For both groups, having a smoking parent is associated with an increased likelihood of smoking. Having a married parent has a negative impact on the propensity to smoke for both groups. Earned income (Salary) of the adolescent has a small but positive impact on the

probability to smoke. This could be due to an income effect, or it could be due to exposure to adults and older peers in a work environment with smoking propensity. Interestingly, higher allowance is associated with increased smoking for adolescents without emotional problems, while it has a negative effect on the smoking propensity of those with emotional problems. However, both effects are small in magnitude. Males with no emotional problems are more likely to smoke than their female counterparts, while there is no statistically significant difference between the smoking propensity between males and females with emotional problems. Adolescents with strong religious beliefs have a lower propensity to smoke. Physically healthier adolescents have a lower propensity to smoke regardless of their mental health status.

Table 3 presents the results of participation equations based on the scores of the delinquency scale. As before, the adolescents are classified into groups with and without behavioral problems based on the 75th percentile cut-off. The results are similar to those displayed in Table 2. More specifically, adolescents with behavioral problems respond to a one-dollar increase in the price of cigarettes by reducing their smoking propensity by 19 percentage points. This represents about a 43 % decrease from the sample mean. The price elasticity for smoking participation for those respondents with behavioral problems is -0.93, which is in sharp contrast to the one obtained from the sample without behavioral problems that is close to zero.

Tables 4 and 5 display the estimates from the conditional demand equations for those with and without emotional problems and for those with and without behavioral problems, respectively. As displayed in Table 4, among adolescents with emotional problems, a one-dollar increase in the real price of cigarettes reduces the number of cigarettes smoked per day by 1.6, although the coefficient is not statistically significant. For those without emotional problems, the reduction is 2.5 cigarettes per day. The corresponding price elasticities of conditional

demand for those with and without emotional problems are -0.53 and -0.89, respectively. Table 5 shows that a one-dollar increase in the real price of cigarette decreases the average daily number cigarettes by 2.2 among those in the top 25% of the behavioral problems scale. The coefficient is borderline significant with a p-value of 0.11. The corresponding value for those who are in the bottom 75% of the behavioral scale is about 1.7 cigarettes. The implied price elasticities of conditional demand for those with and without behavioral problems are -0.65 and -0.67, respectively.

The overall price elasticity of smoking for those adolescents with and without emotional problems (calculated by adding up the elasticities obtained from Tables 2 and 4) are -1.57 and -1.22, respectively. The overall price elasticity of smoking for adolescents with behavioral problems is -1.58, and it is -0.72 for those without behavioral problems. The price coefficients are not estimated with precision in some cases, but the price elasticities of smoking obtained from these models are consistent with those documented in other studies for this age, suggesting that higher cigarette prices are deterrents for youth smoking for all adolescents.[9]

The variables that are included to control for state-level sentiment towards smoking impact participation as well as consumption behavior in every regression. The death rate due smoking, the indicator variable to signify whether tobacco marketing is prohibited on billboards within 500 feet of schools or churches, the indicator variable for restricted tobacco marketing, and per capita full-time equivalent staff on tobacco control are individually significant in most regressions. Furthermore the eight tobacco sentiment variables are extremely significant determinants of behavior as a group with p-values ranging from 0.03 to 0.00. Therefore, these variables seem to represent smoking sentiment at the state-level reasonably well. Some county-level variables such as county median household income, local unemployment rate, proportion

Hispanic, proportion Black , proportion that voted Democrat and population density were also significant in most regressions.

"Robustness"

We estimated the same models displayed in tables 2-5 with one modification in the classification scheme. Specifically, we considered an individual as having emotional or behavioral problems if he/she ranked in the top 10 percent of the relevant distribution. The results, which are not reported in the interest of space, were very similar to those displayed in Tables 2-5. The top panel of Table 6 displays the calculated participation, consumption and total price elasticities obtained from both specifications (the 75^{th} percentile cut-off as well as the 90^{th} percentile cut-off). The bottom panel of Table 6 summarizes the results obtained from estimating the same set of specification using the alternative measure of emotional and behavioral problems as described in Section 2 above. Sixteen elasticity comparisons can be made between individuals with and without emotional and behavioral problems based on participation and consumption equations. In nine of these comparisons the participation or consumptions elasticities are larger for those with emotional or behavioral problems. The magnitudes of the elasticities are not very different between the two groups. The median total elasticity for those with emotional or behavioral problems is -1.58; and it is -1.09 for those without emotional or behavioral problems. These values are very similar to the widely cited total smoking elasticity of -1.31 reported by Chaloupka and Grossman (1996), as well as the elasticity of -1.44 reported by Lewit, Coate and Grossman (1981).

To test more formally whether the participation and conditional demand elasticities are statistically different between those with and without emotional or behavioral problems, we estimated models by pooling the data and adding dichotomous variables for emotional or

behavioral problems and an interaction term between the problem indicator dummy and cigarette price. In 12 out of 16 cases the interaction terms were negative, indicating that the point estimate for the price effect for those with emotional or behavioral problems was larger in absolute value in comparison to those with no such problems. This is consistent with the elasticities summarized in Table 6. However, the coefficient of the interaction term was statistically significant only in the participation equation for emotional problems when the 75-percent cutoff was employed to identify emotional problems.

Although peer effects cannot be identified properly in this study because of data limitations, it is interesting to investigate how controlling for endogenous peer effects would impact the results.[11] The data set includes a question about the smoking behavior of friends. Specifically, the question asks how many of the three best friends smoke at least one cigarette a day. The answers to this question are used as a measure of peer smoking, and included as an additional regressor. Note that a response of zero means either none of the respondent's three best friends are smokers or the respondent does not know a person who qualifies as a best friend. The coefficient of the peer smoking variable was positive and statistically highly significant in every participation and consumption regression. Overall, the estimated price coefficients in participation and consumption equations were similar to those reported in Tables 2-5. The biggest difference was seen in consumption equations equivalent to Table 5, where the estimated price coefficients were -2.36 (p= 0.101) and -1.33 (p=0.104) for those with and without behavioral problems, respectively in models with peer effects (the corresponding coefficients are -2.20 (p=0.11), and -1.66 (p=0.039) in models without peer effects, reported in Table 5). Consequently, the elasticities obtained from the models with peer effects were very similar to those reported in Table 6.

Clark and Loheac (2007) report that the structure of the peer effects is complicated (e.g. the impact of the prevalence of school-level behavior is non-linear, and age and gender-specific effects are dissimilar). They also find that peer effects are stronger in case of alcohol than cigarettes, which is consistent with the results reported in this paper regarding the relative stability of the price effect in inclusion/exclusion of peer's consumption. Although peers' consumption is an endogenous variable, the fact that the price elasticities based on Equation (4), are very similar to the ones that are obtained from estimating Equation (2) may suggest that there is no differential peer effects between adolescents with emotional or behavioral problems and those without such problems, regarding the reaction to a change in the price of cigarettes. Of course, we cannot rule out the possibility that the measures intended to represent the peer effects in our model do not appropriately capture these effects due to data limitations.

5. Conclusion

There exists a considerable literature on the impact of prices on cigarette consumption. A different line of recent research on youth risky behavior demonstrates that, similar to adults, adolescents too respond to prices and incentives. However, only limited research exists on the behavior of adolescents with emotional or behavioral problems. In this paper we investigate whether cigarette consumption of adolescents with emotional or behavioral problems responds to cigarette prices. The issue is important from an academic as well as public policy point of view. Whether adolescents behave rationally and respond to prices and incentives in the domain of risky behavior is an important question for economists to model and explain human behavior. From a policy perspective, the extent of risky behavior of adolescents is critically important for their future well-being and the potential financial burdens imposed on the society. In case of

smoking, it is well-known that smoking as a youth is strongly correlated with smoking as an adult (Gruber and Zinman 2001). Given that smoking-related illness is the leading preventable cause of death in the United States and that smokers on average live about 6 fewer years than those who never smoked (Cutler et al. 1999), it is important to explore potential mechanisms that my lead to change in youth smoking behavior.

In this paper we analyze an understudied and particularly vulnerable segment of the population: adolescents with mental health and behavioral problems. Using a nationally representative data set of adolescents, we estimate standard two-part models, controlling for personal and family attributes, local (county) characteristics, and a large set of variables that aim to control for the sentiment toward smoking at the state level. Sentiment variables explain half of the variation in cigarette prices; and controlling for price, local area characteristics and smoking sentiment variables influence both participation and consumption behaviors. Nevertheless, in the absence of a credible natural experiment that would exogenously move the cigarette price, one can never be completely certain of the unbiasedness of the estimated price effect.

Our results show that adolescents with emotional or behavioral issues, which is a group that is generally thought to be the less rational, do respond to cigarette prices. Furthermore, the estimated participation and consumption elasticities are usually larger in absolute value in comparison to those adolescents with no emotional or behavioral problems; although the difference is generally not statistically significant. The estimated elasticities are similar to those obtained by previous research using data from general adolescent population. Thus, the results underscore the significance of prices as a potential device to modify adolescent behavior, including adolescent with emotional or behavioral problems.

Table 1
Definitions and Descriptive Statistics

Variable	Definition	Full Sample	Emotional Problems[f]	No Emotional Problems	Behavioral Problems[f]	No Behavioral Problems
Smoker	= 1 if smoked during past 30 days, = 0 otherwise	0.228 (0.420)	0.325*** (0.468)	0.194 (0.395)	0.439*** (0.496)	0.158 (0.365)
Smokenum*	= Number of cigarettes usually smoked per day during past 30 days (if greater than zero)	6.303 (7.588)	6.742*** (8.135)	6.045 (7.237)	7.345*** (8.092)	5.350 (6.963)
Behav. Problem	= Behavioral Problems scale	3.141 (3.430)	4.487*** (3.898)	2.669 (3.115)	7.916*** (3.387)	1.563 (1.353)
Emot. Problem	= Emotional Problems scale	8.591 (6.643)	17.531*** (5.835)	5.452 (3.122)	11.416*** (7.668)	7.657 (5.981)
Price*	= State-specific average price of cigarettes adjusted by cost of living index	2.204 (0.229)	2.203 (0.230)	2.208 (0.227)	2.205 (0.228)	2.202 (0.232)
Male	=1 if male, = 0 otherwise	0.496 (0.500)	0.373*** (0.484)	0.539 (0.499)	0.603*** (0.489)	0.461 (0.498)
White[a]	=1 if white, = 0 otherwise	0.624 (0.484)	0.570*** (0.495)	0.643 (0.479)	0.575*** (0.494)	0.641 (0.480)
Black	=1 if black, = 0 otherwise	0.216 (0.411)	0.236*** (0.425)	0.209 (0.406)	0.224 (0.417)	0.213 (0.410)
Hispanic	=1 if Hispanic ethnicity, = 0 otherwise	0.159 (0.365)	0.184*** (0.387)	0.150 (0.357)	0.202*** (0.401)	0.144 (0.351)
BMI	= Body mass index (weight/height-squared)	22.478 (4.381)	22.855*** (4.519)	22.346 (4.325)	22.826*** (4.315)	22.363 (4.398)
Health1[b]	= 1 if better than good health	0.703 (0.457)	0.562*** (0.496)	0.752 (0.432)	0.619*** (0.486)	0.730 (0.444)
Health2	= 1 if good health, = 0 otherwise	0.239 (0.427)	0.325*** (0.469)	0.209 (0.407)	0.295*** (0.456)	0.221 (0.415)
Age	= Age in years	15.507 (1.692)	15.772*** (1.635)	15.414 (1.703)	15.774*** (1.586)	15.418 (1.718)
Religion	=1 if adheres to any religion, = 0 otherwise	0.888 (0.315)	0.879** (0.327)	0.892 (0.311)	0.854*** (0.353)	0.900 (0.301)

Allowance	= Allowance per week adjusted by cost of living index	7.870 (11.922)	8.431*** (12.879)	7.673 (11.562)	8.122 (12.607)	7.787 (11.687)
Salary	= Earned income of the adolescent per week adjusted by cost of living index	44.313 (76.987)	50.088*** (83.830)	42.285 (74.335)	54.996*** (85.160)	40.781 (73.751)
Mothered1[c]	= 1 if mother's education is less than high school, = 0 otherwise	0.165 (0.371)	0.213*** (0.409)	0.149 (0.356)	0.198*** (0.399)	0.154 (0.361)
Mothered2	= 1 if mother's education up to high school, = 0 otherwise	0.257 (0.437)	0.257 (0.437)	0.257 (0.437)	0.236*** (0.425)	0.264 (0.441)
Mothered3	= 1 if mother's education is up to GED, = 0 otherwise	0.037 (0.188)	0.044** (0.206)	0.034 (0.181)	0.043** (0.202)	0.035 (0.183)
Mothered4	= 1 if mother's education is between GED and college, = 0 otherwise	0.302 (0.459)	0.292 (0.455)	0.305 (0.460)	0.321*** (0.467)	0.295 (0.456)
Pmarried	= 1 if parents married, = 0 otherwise	0.749 (0.433)	0.702*** (0.458)	0.766 (0.423)	0.683*** (0.465)	0.771 (0.420)
Psmoke	= 1 if any of the parents smoke, = 0 otherwise	0.731 (0.444)	0.786*** (0.410)	0.712 (0.453)	0.813*** (0.390)	0.704 (0.457)
Workmom	= 1 if mother works, = 0 otherwise	0.773 (0.419)	0.754*** (0.430)	0.780 (0.414)	0.778 (0.415)	0.772 (0.420)
Number of obs		13,399	3,482	9,917	3,329	10,070

Notes: Standard deviations are in parentheses. ***, ***, and * indicate that the difference between the two groups is statistically significant difference between columns 2 and 3, and 4 and 5 at 0.01, 0.05, and 0.10 levels, respectively.

[a] Omitted category is other race.

[b] Omitted category is less than good health.

[c] Omitted category is more than college.

[f] "Emotional Problems" and "Behavioral Problems" denote those observations falling into the top 25% of the distribution of emotional problems or behavioral problems scale.

Table 2
Marginal Effects from the Participation Equation
(Emotional Problems)

	Without Emotional Problems (Bottom 75 %)		**With Emotional Problems (Top 25 %)**	
Variables	Coefficient	Standard Error	Coefficient	Standard Error
Price	-0.030	(0.038)	-0.155***	(0.062)
Salary	0.0003***	(0.00005)	0.0003***	(0.0001)
Allowance	0.001***	(0.0003)	-0.002***	(0.001)
BMI	-0.0004	(0.001)	-0.002	(0.002)
Psmoke	0.083***	(0.008)	0.075***	(0.019)
Health1	-0.117***	(0.020)	-0.153***	(0.024)
Health2	-0.038***	(0.013)	-0.052*	(0.026)
Age	0.273***	(0.038)	0.414***	(0.075)
Age2	-0.008***	(0.001)	-0.013***	(0.002)
Male	0.020*	(0.010)	0.018	(0.020)
Hispanic	-0.016	(0.013)	-0.004	(0.027)
White	0.037**	(0.015)	-0.006	(0.022)
Black	-0.104***	(0.013)	-0.228***	(0.017)
Religion	-0.045***	(0.011)	-0.055**	(0.023)
Pmarried	-0.026**	(0.011)	-0.046***	(0.017)
Mothered1	0.005	(0.011)	-0.014	(0.029)
Mothered2	-0.004	(0.009)	-0.003	(0.021)
Mothered3	0.023	(0.021)	0.085*	(0.050)
Mothered4	0.024***	(0.009)	0.031	(0.024)
Workmom	-0.006	(0.009)	0.014	(0.022)
County Characteristics [a]	Yes		Yes	
State Level Smoking Sentiment variables [b]	Yes		Yes	
N	9,917		3,482	

Notes: ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively. Robust standard errors, clustered at the state-level, are in parentheses.

[a] They include the county-level variables as described in Section 3.

[b] These include the state-level variables as described in Section 3.

Table 3
Marginal Effects from the Participation Equation
(Behavioral Problems)

	Without Behavioral Problems (Bottom 75 %)		**With Behavioral Problems (Top 25 %)**	
Variables	Coefficient	Standard Error	Coefficient	Standard Error
Price	-0.003	(0.033)	-0.188***	(0.064)
Salary	0.0003***	(0.00004)	0.0003***	(0.0001)
Allowance	0.0003	(0.0003)	0.0001	(0.001)
BMI	-0.00002	(0.001)	-0.003	(0.002)
Psmoke	0.056***	(0.007)	0.094***	(0.020)
Health1	-0.095***	(0.016)	-0.175***	(0.030)
Health2	-0.032***	(0.012)	-0.055*	(0.029)
Age	0.276***	(0.047)	0.160	(0.119)
Age2	-0.008***	(0.001)	-0.005	(0.004)
Male	-0.019**	(0.009)	-0.039	(0.025)
Hispanic	-0.023*	(0.012)	-0.034	(0.026)
White	0.041***	(0.014)	-0.004	(0.026)
Black	-0.103***	(0.010)	-0.230***	(0.021)
Religion	-0.035***	(0.012)	-0.023	(0.020)
Pmarried	-0.025**	(0.011)	0.006	(0.019)
Mothered1	0.018**	(0.009)	-0.062	(0.038)
Mothered2	0.005	(0.008)	-0.018	(0.030)
Mothered3	0.046**	(0.021)	0.004	(0.056)
Mothered4	0.026***	(0.007)	-0.0001	(0.028)
Workmom	-0.002	(0.009)	-0.011	(0.022)
County Characteristics [a]	Yes		Yes	
State-Level Smoking sentiment variables [b]	Yes		Yes	
N	10,070		3,329	

Notes: ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively. Robust standard errors, clustered at the state-level, are in parentheses.

[a] They include the county-level variables as described in Section 3.

[b] These include the state-level variables as described in Section 3.

Table 4
OLS Results--Consumption Equations for Smoking
(Emotional Problems)

	Without Emotional Problems (Bottom 75 %)		**With Emotional Problems (Top 25 %)**	
Variables	Coefficient	Standard Error	Coefficient	Standard Error
Price	-2.474***	(0.734)	-1.643	(1.642)
Salary	0.007**	(0.003)	0.006**	(0.003)
Allowance	-0.002	(0.012)	0.018	(0.030)
BMI	-0.081***	(0.028)	0.064	(0.044)
Psmoke	1.507***	(0.365)	2.095***	(0.535)
Health1	-3.515***	(0.836)	-2.410***	(0.620)
Health2	-2.114**	(0.856)	-1.008	(0.772)
Age	1.337	(1.329)	4.112*	(2.110)
Age2	-0.013	(0.044)	-0.111	(0.070)
Male	1.368***	(0.323)	2.366***	(0.383)
Hispanic	-1.905***	(0.405)	-1.340**	(0.632)
White	0.485	(0.464)	0.635	(0.588)
Black	-2.854***	(0.867)	-4.075***	(0.737)
Religion	-1.181***	(0.427)	-0.715	(0.728)
Pmarried	-1.193***	(0.420)	0.157	(0.383)
Mothered1	1.552***	(0.510)	2.232***	(0.712)
Mothered2	1.202**	(0.482)	2.156***	(0.503)
Mothered3	4.592***	(1.421)	2.908***	(0.909)
Mothered4	0.885**	(0.344)	1.771***	(0.434)
Workmom	0.482	(0.391)	-0.318	(0.537)
County Characteristics[a]	Yes		Yes	
State-Level Smoking sentiment variables [b]	Yes		Yes	
N	1,924		1,131	

Notes: ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively. Robust standard errors, clustered at the state-level, are in parentheses.

[a] They include the county-level variables as described in Section 3.

[b] These include the state-level variables as described in Section 3.

Table 5
OLS Results--Consumption Equations for Smoking
(Behavioral Problems)

	Without Behavioral Problems (Bottom 75 %)		**With Behavioral Problems (Top 25 %)**	
Variables	Coefficient	Standard Error	Coefficient	Standard Error
Price	-1.656**	(0.770)	-2.200	(1.355)
Salary	0.004	(0.003)	0.009**	(0.004)
Allowance	0.010	(0.015)	-0.001	(0.018)
BMI	-0.073*	(0.037)	0.051	(0.045)
Psmoke	1.329***	(0.360)	1.950***	(0.409)
Health1	-2.470***	(0.528)	-2.752***	(0.565)
Health2	-0.824	(0.643)	-1.804***	(0.634)
Age	1.249	(1.549)	3.297**	(1.605)
Age2	-0.009	(0.050)	-0.080	(0.054)
Male	1.245***	(0.287)	1.197***	(0.414)
Hispanic	-0.927	(0.572)	-2.755***	(0.665)
White	0.680	(0.534)	0.612	(0.503)
Black	-2.866***	(0.544)	-4.305***	(1.073)
Religion	-1.145**	(0.560)	-0.710	(0.442)
Pmarried	-0.595**	(0.293)	-0.702	(0.521)
Mothered1	2.286***	(0.521)	1.418**	(0.596)
Mothered2	1.455***	(0.436)	1.676***	(0.438)
Mothered3	2.923***	(0.993)	4.874***	(1.213)
Mothered4	1.441***	(0.405)	0.985**	(0.474)
Workmom	-0.240	(0.489)	0.408*	(0.236)
County Characteristics [a]	Yes		Yes	
State-level smoking sentiment variables [b]	Yes		Yes	
N	1,595		1,460	

Notes: ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively. Robust standard errors, clustered at the state-level, are in parentheses.

[a] They include the county-level variables as described in Section 3.

[b] These include the state-level variables as described in Section 3.

Table 6
Estimated Elasticities

	First Measure			
	75%-25% Classification		90%-10% Classification	
	With Emotional Problems	Without Emotional Problems	With Emotional Problems	Without Emotional Problems
Participation	-1.04	-0.33	-0.66	-0.53
Consumption	-0.53	-0.89	-0.24	-0.95
Total Elasticity	-1.57	-1.22	-0.90	-1.48
	With Behavioral Problems	Without Behavioral Problems	With Behavioral Problems	Without Behavioral Problems
Participation	-0.93	-0.05	-1.16	-0.27
Consumption	-0.65	-0.67	-0.53	-0.69
Total Elasticity	-1.58	-0.72	-1.69	-0.95

	Second Measure			
	75%-25% Classification		90%-10% Classification	
	With Emotional Problems	Without Emotional Problems	With Emotional Problems	Without Emotional Problems
Participation	-1.16	-0.29	-0.91	-0.49
Consumption	-0.58	-0.89	-0.64	-0.84
Total Elasticity	-1.74	-1.18	-1.55	-1.34
	With Behavioral Problems	Without Behavioral Problems	With Behavioral Problems	Without Behavioral Problems
Participation	-1.10	0.03	-1.48	-0.19
Consumption	-0.73	-0.59	-0.27	-0.90
Total Elasticity	-1.83	-0.56	-1.75	-1.09

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Endnotes

[1] Cigarette smoking triples the risk of dying from heart disease (CDC 2006).

[2] Additional references can be found in the detailed survey paper by Chaloupka and Warner (2000).

[3] For example, a person's cigarette consumption may decrease in response to a rise in cigarette prices. But cigarette consumption may also decrease because the person may have fewer opportunities to obtain cigarettes from a peer as the peer's quantity demanded goes down in response to rising cigarette prices. Rather than identifying these channels separately, our empirical model yields the overall effect of cigarette prices on one's cigarette consumption.

[4] Add Health is a program project designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris, and funded by a grant P01-HD31921 from the National Institute of Child Health and Human Development, with cooperative funding from 17 other agencies. Special acknowledgment is due Ronald R. Rindfuss and Barbara Entwisle for assistance in the original design. Persons interested in obtaining data files from Add Health should contact Add Health, Carolina Population Center, 123 W. Franklin Street, Chapel Hill, NC 27516-2524 (addhealth@unc.edu).

[5] Participating high schools were asked to identify junior high or middle schools that were expected to provide at least five students to the entering class of the high school. These schools are called feeder schools. Their probability of selection was proportional to the percentage of the high school's entering class that came from that feeder.

[6] Lloyd-Richardson et al (2002) find that for the Add Health respondents, being in a higher quartile of the depression and delinquency scales is associated with higher odds of being an experimental smoker as compared to being a nonsmoker, being an intermittent smoker as

compared to being a nonsmoker or being a experimental smoker, and being a regular smoker as compared to being in all the earlier stages of smoking uptake.

[7] In case of behavioral problems, there are other potential ways individuals can be classified. For example, we employed a third classification scheme, where an adolescent was classified as being delinquent if he/she ever committed theft or burglary, or sold illicit drugs, regardless of his/her responses to the other questions. Results from this classification were consistent with the ones reported based on other classifications of behavioral problems.

[8] The average price for the calendar year is computed by subtracting state and federal excise taxes from the current year's price and the previous year's price and weighting the pre-tax prices accordingly (4/12 previous year and 8/12 current year). We then add the current federal and state excise tax back to the average pre-tax price calculated above.

[9] See Chaloupka and Warner (2000) for a review of some of the relevant literature.

[10] One potential caveat is that in the sample of adolescents with behavioral problems, although the coefficient of cigarette price was always highly statistically significant, it was not always significant in the consumption equation at conventional significance levels.

[11] This is because we do not have random or quasi-random assignment of peers; nor do we have