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YOUTH SMOKING IN THE U.S.: PRICES AND POLICES

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ABSTRACT

After steadily declining over the previous 15 years, youth smoking began to rise precipitously in 1992, and by 1997 had risen by roughly one-third from its 1991 trough. We know very little about what caused this time trend and what public policy can do to reverse it. This paper therefore provides a comprehensive analysis of the impact of prices and other public policies on youth smoking in the 1990s, drawing on three separate data sets. I find that the most important policy determinant of youth smoking, particularly among older teens, is prices. Prices are a significant and sizeable determinant of smoking by older teens in all tree data sets, although the estimated price elasticity varies significantly. On the other hand, price does not appear to be an important determinant of smoking by younger teens. There is little consistent evidence of robust effect of other public policies targeted to reducing youth smoking, although there is some suggestion that restrictions on youth purchase of cigarettes reduce the quantity of cigarettes reduce the quantity of cigarettes smoked. And I find that black youth and those with less educated parents are much more responsive to cigarette price than are white teens and those with more educated parents, suggesting a strong correlation between price sensitivity and socioeconomic status.

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One of the most striking trends in the behavior of youth in the U.S. during the 1990s has been the increased incidence of smoking. After steadily declining over the previous 15 years, youth smoking began to rise precipitously in 1992. By 1997, smoking by teenagers in the U.S. had risen by roughly one-third from its 1991 trough. This trend is particularly striking in light of the continuing steady decline in adult smoking in the U.S. Indeed, today we are in the unprecedented position of having a youth smoking rate that is at least 50% higher than the smoking rate of adults. It is also intriguing in light of the well publicized declines in other risky behavior among youth, notably teen pregnancy (Levine, forthcoming), and crime (Levitt and Lochner, forthcoming).

This striking time trend has motivated substantial public policy interest in youth smoking, highlighted by the recent unsuccessful attempt of the Clinton Administration to pass a comprehensive tobacco regulation bill that had the ostensible main purpose of reducing youth smoking. This public policy interest arises out of concern that youth are not appropriately recognizing the long run implications of their smoking decisions. Indeed, young smokers clearly underestimate the likelihood that they will still be smoking in their early 20s and beyond. For example, among high school seniors who smoke, 56% say that they won't be smoking 5 years later, but only 31% of them have in fact quit five years hence. Moreover, among those who smoke more than 1 pack/day, the smoking rate five years later among those who stated that they would not be smoking (74%) is actually higher than the smoking rate among those who stated that they would be smoking (72%) (U.S. Department of Health and Human Services, 1994).

If youth smoking leads to adult smoking, particularly in a manner that is underappreciated

by the youth smokers themselves, it can have drastic implications for the health of the U.S. population. Smoking-related illness is the leading preventable cause of death in the U.S., and smokers on average live 6.5 (males) to 5.7 (females) fewer years, relative to never smokers (Cutler et al., 1999). Thus, it is critical to understand the role that public policy can play in deterring youth smoking.

Yet, despite this concern both among public health advocates and legislators, there is little consensus about the impact of public policy on youth smoking. There are a number of studies which assess the responsiveness of youth smoking to prices (and thereby to taxes), but most of the work has been cross-sectional in nature and therefore unable to disentangle price effects from other fixed differences in smoking propensities across areas. More recent work which has addressed this issue with repeated cross-sections or longitudinal data has produced very mixed conclusions. There is much less work that has integrated a study of prices and other policies. And there is no work which has explored the critical period of the 1990s, nor which has distinguished the price responsiveness of older and younger teens.

This paper provides a comprehensive analysis of the impact of prices and other public policies on youth smoking in the 1990s. This period is of particular interest both because it is the period of rapidly rising youth smoking, and because there is substantial variation in both state excise taxation and other policy variables that can be exploited to study responsiveness to policy. I do so using three different data sets with information on youth smoking: the Monitoring the Future (MTF) survey, an in-school survey of 8th, 10th, and 12th graders; the Youth Behavior Risk Survey (YRBS), an in-school survey of 9-12th graders; and the Vital Statistics Natality Data, which has data on smoking for a census of all teen mothers giving birth. By using these three

different data sets, with complementary strengths and weaknesses, I am able to assess which relationships with teen smoking are most robust.

The findings of this analysis are clear: the most important policy determinant of youth smoking, particularly among older teens, is prices. Prices are a significant and sizeable determinant of smoking by older teens in all three data sets, although the estimated price elasticity varies significantly. On the other hand, price does not appear to be an important determinant of smoking by younger teens. There is little consistent evidence of robust effect of other public policies targeted to reducing youth smoking, although there is some suggestion that restrictions on youth purchase of cigarettes reduce the quantity of cigarettes smoked. And I find that black youth and those with less educated parents are much more responsive to cigarette price than are white teens and those with more educated parents, suggesting a strong correlation between price sensitivity and socioeconomic status.

The paper proceeds as follows. Part I provides background on trends in youth smoking and on previous work in this area. Part II discusses the data and empirical framework. Part III presents the basic findings, and explores their sensitivity to specification variation. Part IV considers heterogeneity of impacts by race and parental education. Part V concludes.

Part I: Background

Youth Smoking: Where It's Been, Where It's Going, and Why We Should Care

The time series trends in youth smoking are depicted in Figures 1 and 2. Figure 1 shows the trend since the 1970s for the three available surveys of seniors: the MTF data, which has surveyed seniors since 1976 but 8th and 10th graders only since 1991; the National Health

Interview Survey (NHIS); and the National Survey of Household Drug Abuse (NHSDA). The latter two surveys are household surveys, for which we use data on older teens.[1] There is considerable uncertainty over the relative value of in-school vs. household surveys for collecting smoking information; the latter have the advantage of collecting information on dropouts, but the disadvantage that youths may be less willing to give honest answers when their parents may overhear. Despite these differences in sources, however, all three surveys show the same basic trend: large declines over the late 1970s, flattening and slow declines in the 1980s, and a steep rise in the 1990s.

Figure 2 focused on the trend for the 1990s for all high school youths, using data from the MTF and YRBS data sets that will be used for the regression analysis below. For both data sets, there are dramatic increases in the 1990s. In the MTF data, there is an increase of 7.2 percentage points, or 35 percent; in the YRBS, the increase starts from a higher base, but the increase is larger at 8.7 percentage points, so that the percentage increase is also about one-third.

We know remarkably little about the determinants of this increase in youth smoking over the 1990s. Gruber and Zinman (1999) note that changes in the background characteristics of teen smokers can explain less than 10% of the time series trend. But it is worth noting that the time series trend in cigarette prices is negatively correlated with youth smoking over the early part of this period at least. As Figure 3 shows, after rising slowly for a number of years, prices fell precipitously in the early 1990s, the result of a price war among premium brands battling a growing generic share of the cigarette market. This corresponds in a negative way to the uptick

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[1]In particular, for the NHIS, we use 18-19 year olds, and for the NHSDA we use 17-19 year olds through 1991, and 18-29 year olds for 1996-97.

in smoking by high school seniors that begins in that time period. Moreover, prices rose by the largest amount in many years in 1998 (10%), and youth smoking fell for the first time since the beginning of the decade (by 1.4 percentage points, or 3.8%, for seniors).[2] Thus, the time series evidence is suggestive of a role of prices, but it is important to assess more carefully what role prices are playing in driving these movements.

This dramatic upswing in youth smoking is a concern because smoking as a youth is strongly correlated, at least in the past, with smoking as an adult. Tabulations from the 1992 and 1995 National Health Interview Surveys reveal that 42% of current or former adult smokers started before their 16th birthday, and 75% started before their 19th birthday (Gruber and Zinman, 1999). Conversely, of those smoking a pack a day as high school seniors in the Monitoring the Future survey, 87% are smoking five years later. Even among those smoking 1-5 cigarettes per day, 70% are smoking 5 years later (U.S. Department of Health and Human Services, 1994). If youth smoking is a strong determinant of adult smoking, then the long run secular decline in adult smoking may be reversed.

Of course, these facts do not prove that the current upswing in youth smoking will lead to higher long run adult smoking rates, for two reasons. First, it is difficult to distinguish causality from these intertemporal correlations; smoking later in life may not be a consequence of youth smoking for adults in the past, but rather smoking at both points in life may simply arise from intertemporal correlation in tastes for this activity. Evidence on this point is provided by Gruber and Zinman (1999), which investigates the implications of taxes on cigarettes when individuals

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[2]Price data from Tobacco Institute (1998). Youth smoking data from U.S. Department of Health and Human Services (1999).

are youths on their current smoking patterns as adults. That paper finds that higher taxes on youths lower smoking when those youths are grown as well, suggesting that exogenous shifts in youth smoking can have long run impacts.

Second, however, there may also have been a structural shift in the nature of youth smoking. Those youths who are newly taking up smoking today may be different from those in the past, and in particular more resolved to quit, and therefore this intertemporal correlation may be broken. Once again, however, the evidence for this view does not look promising. Gruber and Zinman (1999) examines repeated cross-sectional models of youth smoking. They do find that smoking has become more of a "yuppie" activity among high school seniors, with smoking increases the largest among the most advantaged groups. But these relative shifts are swamped by the dramatic secular increases in smoking among all groups over this period: males and females, blacks and whites, suburban and urban dwellers, and high and low GPA students are all seeing their smoking rates rising substantially in the 1990s. Thus, unless smokers in the 1990s are different only in unobservable ways, it seems likely that the rise in youth smoking will have long run implications for the smoking rate of the adult population. It therefore becomes very important to understand what is driving the rise in smoking in the 1990s, and what role policy can play in reversing it.

Previous Literature on Youth Smoking

There is a substantial literature on the background characteristics of youths that are most closely correlated with smoking decisions. This literature is reviewed in the Surgeon General's Report of 1994, which provides a comprehensive overview of the state of knowledge to that

point. More recent evidence on demographic correlates of smoking is provided by Gruber and Zinman (1999). The key findings of that research are that smoking is not as purely concentrated in disadvantaged youths as it is concentrated on low socioeconomic status adults: smoking is much lower among minorities than among whites; it is more likely in the suburbs than in either the city or rural areas; and it is essentially uncorrelated with parental education. On the other hand, youth smoking is much more likely among those with worse academic performance, those who have their own children, and those who work.

There is also a sizeable literature on the responsiveness of youth smoking to prices and other public policies. The early work on the price elasticity of youth smoking was cross-sectional in nature. This work generally found quite strong impacts of prices on youth smoking. While there is some variation, a representative estimate that is frequently cited is Chaloupka and Grossman's (1996) estimate of a participation elasticity of -0.675 and a total smoking elasticity of -1.313. Similar estimates are found in Lewit, Coate and Grossman (1981) and Lewit and Coate (1982), although the result is disputed by Wasserman et al. (1991).

This literature has been strongly criticized, however, by DeCicca et al. (1998) and Evans and Huang (1998), who point out that in cross-sectional data it is impossible to disentangle price and policy impacts from other underlying long-run determinants of smoking attitudes. For example, as they note, taxes are traditionally the lowest in the tobacco producing states, where smoking is also the highest, and it is difficult to disentangle causality in that relationship. These two papers take different approaches to solving this problem. DeCicca et al. pursue a strategy of focusing on smoking initiation, which compares changes in smoking rates to changes in price within a cohort, and they find no significant price impact. Evans and Huang, on the other hand,

use repeated cross-sections of youth and include state fixed effects to control for fixed state tastes towards smoking, and they find a significant participation price elasticity of -0.5 over the 1985-1992 period (using repeated cross-sections of the restricted MTF data discussed below).

Both of these approaches have weaknesses. The DeCicca et al. methodology excludes the responsiveness of quitting to price increases; ultimately, it is the level of youth smoking that is the concern, not just initiation. Evans and Huang do consider the overall level of smoking, but they do not include the other controls for state smoking regulations that are deemed quite important by DeCicca et al. Moreover, neither paper focuses on the period of most interest, the 1990s, and neither paper assesses whether their finding is robust to alternative data sets, which I consider in detail below.

There is a smaller literature which has studied the impact of other anti-smoking policies on youth smoking. DeCicca et al. (1998) include in their model measures of state access restrictions on youth tobacco purchase and of restrictions on smoking in public places, and find no effect on smoking. Chaloupka and Grossman (1996) include a variety of measures of access restrictions and clean air regulations; they find no (actually wrong-signed) impacts of the former, but fairly strong negative impacts of the latter in their cross-sectional study. Another cross-sectional study by Chaloupka and Pacula (1998) focusing on youth access restriction enforcement does find some evidence that more tightly enforced youth access restrictions lowers youth smoking. But these cross-sectional studies once again suffer from the fact that the legislation and enforcement of youth access restrictions may be correlated with fixed underlying attitudes towards smoking. Two interesting case studies of communities that implemented tough youth access restrictions found mixed results, with Jason et al. (1991) finding substantial (50%)

declines in youth smoking in Woodridge, Illinois, while Rigotti et al. (1997) finding very limited impacts on sales to youth and youth smoking in several Massachusetts communities.

To summarize, the literature on both prices and policies has produced somewhat mixed conclusions, particularly the limited literature that has attempted to control for unobserved state characteristics. Moreover, another limitation of most of the work on price responsiveness is that it has focused on either only one cohort or one age group of teens. In fact, as I document at length below, there is considerable heterogeneity among the teen population in their responsiveness to policy variables.

Part II: Data and Empirical Strategy

Data Sources

The key criteria that was used in selecting data for the analysis was that information had to be available for repeated cross-sections of teens of all ages over the 1990s. Three data sources meet this criteria, and all three are used.[3] The first, and (I argue) best, source is the Monitoring the Future data collected through the University of Michigan. The public use version of these data do not identify the state of residence of teens, nor are they are available for teens other than high school seniors. I therefore purchased a restricted use sample of the data which includes information on smoking behavior, race, age, sex, and state of residence, for 8th, 10th, and 12th

[3]A fourth data set that could have been used here is the National Survey of Household Drug Abuse data, but this was excluded for two reasons. First, the quality of these data before the mid 1990s is quite suspect, due to the use of in-home surveys without computer assistance that could suffer from bias due to parental observation; indeed, these data do not appear to show an increase in smoking among teens through the mid-1990s, while the more respected MTF and YRBS surveys both do. Second, there is no public use or even private use version of the NSHDA data available with state identifiers; only selected researchers can access these data.

graders, from 1991 through 1997. I focus on 1991 as the starting point for the analysis for three reasons: first, this is the last year before teen smoking began to rise; second, this is the year in which the 8th and 10th grade MTF data become available; and third, this is the year that the YRBS data described next became available.

The second data source is the Youth Behavior Risk Survey data collected by the Centers for Disease Control. A public use version of these data were newly created for this project, and they provide information on smoking and a limited set of background characteristics for 1991, 1993, 1995 and 1997 for a sample of 9–12th graders.

The MTF and YRBS data are comparable, in that they provide nationally-representative, in-school surveys of youth. As noted earlier with reference to Figure 2, they suggest different levels of smoking among teens, but similar trends. The sample sizes of these surveys are also comparable. But the MTF data has the strong advantage of being a more complete survey over this sample period; the survey includes data on 35 states in every year from 1991 to 1997, and a total of 277 state/year pairs over this time period. On the other hand, the YRBS is a survey that is phasing into coverage of the entire nation, with only 10 states in the survey in every year, and only 102 state/year pairs over this time period.[4] As a result, while from 1991 to 1997 there are 59 tax changes to be studied in the MTF data, there are only 14 in the YRBS data. Thus, the results that we obtain in the MTF are more robust to the specification check we pursue below, and we will rely on them as our primary estimates.

The third data source is the Vital Statistics Natality Detail Files. These data are a census

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[4]All of our YRBS means and estimates are weighted using weights designed to reproduce national representativeness.

of birth certificates for the U.S., with approximately 4 million observations per year. These data contain information, since 1989, on the smoking behavior of the mother during pregnancy. These smoking data appear to be of high quality; for all women, the smoking participation rate in these data is almost exactly the same as that from a National Health Interview Survey supplement in 1991 which provides a retrospective survey of women on their smoking while pregnant (Gruber and Koszegi, 1999). Moreover, these data are available for virtually every state in every year from 1991 onwards, providing even more variation than the MTF (73 tax changes over this time period).[5] But these have the disadvantage of being focused solely on one particularly select group of teens, those having children before their 19th birthday. Due to the enormous size of the Natality data (over 300,000 teen mothers per year for our seven years of analysis), we do not analyze micro-data on smoking rates by mothers. Rather, we group these data into state*year*age cells, and analyze cell mean rates of smoking and conditional smoking intensity, where the regressions are weighted by cell size.

The means for all three data sets are presented in Table 1. We consider two measures of smoking: participation, defined as any smoking over the past month, and conditional intensity.[6] The latter measure has the difficulty as a dependent variable that if there are policy impacts on participation, there could be sample selection bias to the effects on conditional intensity; for

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[5]Smoking data are not available for California, Indiana, and South Dakota in any year and for New York for 1991-93.

[6]In the MTF and YRBS data, conditional intensity is asked in intervals, and we use the midpoint of each interval for intensity. In the natality data, the intensity question is continuous, but the time frame to which the smoking question refers is unclear, as it asks about smoking during the pregnancy. But the smoking rate for all women matches very closely the National Health Interview Survey smoking rate calculated throughout the pregnancy, suggesting that this question refers to the end of the pregnancy, as argued by Gruber and Koszegi (1999).

example, if higher prices reduce smoking participation, and those who quit are low intensity smokers, then higher prices could be associated with higher intensity among those who remain smokers through this compositional effect.

As noted above, smoking rates are somewhat higher in the YRBS than in the MTF data sets; for seniors over this time period, participation rates in the MTF are 31% while they are 36% in the YRBS. Smoking rates are much lower for teen mothers; for 17-18 year old teen mothers, the smoking rate is only 18%. However, smoking intensity is higher in the MTF survey, averaging 7.2 cigarettes per day for seniors as compared to 6.1 cigarettes per day in the YRBS. Intensity is even higher for teen mothers, averaging over 10 cigarettes per day for 17-18 year old mothers. Thus, smoking among teen mothers appears less frequent, but more intense when these women are participating. Note that this is not just a male/female difference; smoking participation among males and females are very similar in the YRBS and MTF surveys, and intensity is actually somewhat higher for males.

Smoking is less frequent, and smoking intensity is lower, for younger teens in all three surveys. In the MTF and YRBS surveys, the full sample results are weighted more closely to the results for younger teens, since the samples of younger teens are much larger; in the Natality data, they are weighted towards older teens, since there are so many more births to older teens in the data.

The key independent variables to be used in the analysis are state-level measures of prices, taxes, and other policies. Prices as of November of each year for each state are provided in the Tobacco Institute (1998), and a monthly series of information on taxes can be constructed from information in that volume as well. The MTF and YRBS surveys are both conducted in the

spring, so we use an average of the prices from November of year t-1 and November of year t as our price measure, and the tax rate as of February as our tax measure. For the natality data, I know the actual month of the birth, so I use the tax rate from that month of birth.

The two dimensions of anti-smoking policy that I explore are clean air regulations and youth access restrictions. Clean air regulations, which are described in substantial detail in Jacobson and Wasserman (1997), are laws which restrict smoking from certain public areas. I constructed a comprehensive data base of such laws using information from the state legislative records, Coalition on Smoking OR Health (various years) , and the Centers for Disease Control web site http://www2.cdc.gov/nccdphp/osh/state/ . While there are a panoply of such laws, we categorize them into five categories: private workplace restrictions; public (e.g. state and local government) workplace restrictions; restaurants; schools; and other (e.g. elevators, public transportation, theaters).

Youth access restrictions are laws designed to limit youth purchases of tobacco products, since, while youth smoking is legal, selling cigarettes to youth is not. As reviewed in Jacobson and Wasserman (1997), states have therefore endeavored along various dimensions to implement barriers to youth access to cigarette purchase. Categorizing these state efforts is difficult, as there are a large number of different regulatory tools, and states enforce them with differential rigor. I therefore rely on the expert opinion of a panel convened by the National Cancer Institute (NCI) to evaluate state laws limiting youth access to cigarettes (Alciati, et al., 1998) This panel considered a wide variety of state laws in this area and formed an index to capture their overall "bite" in limiting youth access. They consider nine categories of state regulation, and provide a score within each, which is aggregated into a total index. Their index is

available for 1993-1996; I have followed their rules, in consultation with them, to use state laws to extend the data back to 1991 and forward to 1997. I did augment their index by adding some finer disaggregation of categories, and by correcting some inconsistencies with actual legislation. I also added three additional categories that they did not consider: advertising restrictions; licensing of retailers; and penalties on minors themselves for tobacco purchase.

I describe in more detail how this index was created in the Appendix. Appendix Table A1 also shows means for the MTF of the clean air and youth access index variable. The average value of our access index is roughly 12 (where the maximum possible value is 26); about half of students were subject to restrictions on smoking in private workplaces, whereas restrictions in restaurants, government worksites, schools, and other sites were more common.

The other frequently discussed public policy intervention to reduce youth smoking is counteradvertising. While this is a major focus of very recent discussions, over the time period studied in this paper (ending in 1997) there was very little counteradvertising in most states.[7]

Empirical Strategy

For all three data sets, we pursue a similar estimation strategy, considering the impact of prices and public policies on smoking in the following regression framework:

$$(1) \quad SMOK_{ijt} = \alpha + \beta PRICE_{jt} + \delta ACCESS_{jt} + \gamma CLNAIR_{jt} + \eta X_{ijt} + \lambda S_j + \nu T_t + \varepsilon_{ijt}$$

where i indexes individuals; j indexes states; and t indexes years
SMOK is a measure of smoking (participation or conditional intensity)
PRICE is the price per pack of cigarettes (inclusive of taxation)

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[7]Based on conversations with experts at the Office on Smoking and Health at the Centers for Disease Control. The available data suggests that only a few states have major programs by 1997, and that the spending on those programs was fairly constant over our time period.

ACCESS is the index of access restrictions
CLNAIR is a set of dummy variables for clean air regulations
X is a set of individual control variables (which varies by data set)
S is a set of state dummies
T is a set of year dummies

By including a complete set of state fixed effects, this regression surmounts any problems with fixed differences across states in both their level of prices and the propensity to smoke, e.g. due to tobacco production intensity. However, two potential concerns remain with the interpretation of the price coefficient in this specification. First, if tobacco companies are doing any state-specific pricing, then prices may be endogenous to smoking levels. While 80% of the variation in prices within states over time are driven by tax changes (Gruber and Koszegi, 1999), there remains 20% that is possibly demand driven. We therefore instrument prices with the tax rate in the state, to provide identification solely from tax-induced price movements. All estimates presented below are from such instrumental variables models.

Second, the identifying assumption of this estimator is that within-state changes in taxation (and other public policies) are not themselves determined by youth smoking behavior. It is plausible that tax policy is set as a function of smoking in a state, with revenue maximizing legislators and an inelastically demanded good. Since youths smoke only about 2% of the total number of cigarette packs smoked annually, it is doubtful that youth smoking per se is driving tax policy. But it is possible that youth smoking is correlated with some of the same factors that drive adult smoking, and possibly therefore with tax setting. It is difficult with this short panel to address this concern definitively, but we attempt to do so below.

Another important estimation issue is that we are using a large number of observations in each of these data sets, but we really only have variation in our key variables across state and

year cells. As a result, all regressions are estimated with the standard errors corrected for within state-year cell correlations in the error terms.

Part III: Results

MTF Data - Seniors

I begin the analysis by focusing on the MTF data, which as discussed above is the highest quality source of nationally representative data. I also start with seniors, to parallel most previous work in this area.

The results of estimating equation (1) for high school seniors are presented in the first two columns of Table 2. The most important finding is that there is a negative and statistically significant impact of prices on smoking participation. The implied elasticity at the sample mean is -0.67. The impact on conditional intensity is negative, but insignificant, implying a small elasticity of conditional intensity of -0.06. As noted earlier, it is difficult to interpret these estimates as the pool of smokers is changing. In particular, it seems likely that those who quit smoking as the price rises have the lowest ex-ante intensity, which would lead to a positive compositional bias to the estimates.

I obtain much less convincing evidence for the role of other policies, however. There is a negative impact of access restrictions on the quantity of cigarettes smoked, but the coefficient is not significant. The only clean air restrictions for which there are significant negative effects are for restrictions on government workplaces (in terms of conditional quantity smoked) and for restrictions on other sites (for both participation and quantity smoked). It seems highly unlikely that there is a true causal impact of restrictions in government worksites on youth; it is perhaps

more plausible that restrictions on other sites such as public transportation might matter.

Does this significant price impact suggest that we can explain the time series movements by the price decline of the early 1990s? From 1991 through 1997, the price of cigarettes fell by 14 cents. At our estimated coefficient on participation, this explains 30% of the 7.2 percentage point rise in smoking over this time period. Thus, price is playing an important role, but not the dominant one.

MTF Data - Younger Teens

The next four columns of Table 2 investigate the impact of prices and policies on younger smokers (8^{th} and 10^{th} graders). Interestingly, there is little impact of price on the smoking of younger teens. The coefficients on both participation and intensity are insignificant for 8-10th graders, and as a result for the full sample of 8-12th graders. Over the full sample, the price elasticity for participation is only -0.31, with a conditional intensity elasticity of -0.03. This casts further doubt on the role of price as the primary determinant of the time series trend, since the trends in smoking are quite similar for 8-10th graders and for seniors.

The impacts of other policies on the smoking of 8-10th graders is more interesting than for seniors. We now estimate a highly significant impact of youth access restrictions on the conditional quantity of cigarettes consumed by younger teens, which is not subject to selection bias due to the insignificant impacts on participation. This coefficient suggests that moving from the lowest to the highest value of this index would lower smoking intensity by 1.38 cigarettes per day, or 25%. This is interesting because it is indeed possible that access restrictions, by raising the hassle costs of obtaining cigarettes, do not deter youths from smoking

at all, but rather limit the extent to which they do smoke. We also again obtain negative impacts of government worksite restrictions on smoking intensity, and negative impacts of other clean air restrictions on both intensity and participation.

There is a paucity of control variables available in these restricted MTF data. We do find that smoking rises with grade. The age variables are defined only conditional on grade (due to data restrictions in these MTF data), but they have the expected pattern: older children within each grade smoke more. Non-white youths are much less likely to smoke, and there is a positive effect of being male among seniors, but a negative effect among 8th and 10th graders, so that for the full sample the effect is insignificant. Gruber and Zinman (1999) find that the positive impact of being male for the seniors becomes negative when other covariates available in the public use data are included.

YRBS and Natality Data

As emphasized above, a key advantage of my analytic strategy is that I have brought several data sets to bear on this question, in order to analyze the most consistent patterns of impacts of public policy on smoking. In this spirit, Tables 3 and 4 replicate the results for the MTF data in the YRBS and Natality data, once again for older teens (seniors in the YRBS; 17-18 year olds in the Natality data), younger teens (9-11th graders in YRBS; 13-16 year olds in Natality data), and overall.

The most strikingly consistent finding across all three data sets is the negative impact of prices on smoking by older teens. In the YRBS, the elasticities are enormous: there is an elasticity of -1.5 on participation, and an elasticity of -1.5 on conditional intensity. In the

Natality data, the elasticities are more modest, with an elasticity of participation of -0.38 and an elasticity of conditional intensity of -0.15. It is perhaps not surprising that the elasticity is smaller for teen mothers than for other groups, given that the very fact that these women are smoking reveals their insensitivity of the smoking decision to information about the hazards for newborns. This smaller elasticity is not due to the gender composition of the sample. In both the MTF and YRBS data, we estimate very similar elasticities for males and females; the elasticities are somewhat higher for males in the MTF and somewhat higher for females in the YRBS.

Moreover, there is a consistent finding of a much smaller impact of prices on young smokers. In the YRBS data, the elasticity of participation is wrong-signed, and the elasticity of conditional intensity is insignificant, for 9-11th graders. In the Natality data, both coefficients are right-signed, but insignificant.

Why might we be finding that older teens are more price sensitive? There are several possible explanations. One is that smoking means different things at different ages. Younger teens may view participation as pure experimentation, which is less well described by economists models of addictions, such as Becker and Murphy (1988), and which is as a result less sensitive to economic factors such as price. But by the time these youths have become seniors they have completed their experimentation phase, and smoking follows expected relationships with price and other economic factors. This type of story is consistent with the fact that younger teens who smoke consume a smaller quantity of cigarettes, and with the evidence below that the demographic correlates of socioeconomic disadvantage (race and parental education) lead to higher price sensitivity for seniors, but not for younger teens.

Alternatively, younger teens may be pursuing smoking as a mode of acceptance into a

peer group, and by the time they are seniors they have been accepted into the group. If smoking as a younger teen regardless of price is required to gain acceptance to a peer group, but once within the group peer effects have their usual multiplier impact on price elasticities, then this would yield low price elasticities on younger teens and higher ones on older teens. Finally, it may simply be that teens using their own money are more price elastic than are those who rely on money from parents (obtained either complicitly or illicitly).

In contrast to the robust and significant impact of prices on youth smoking, however, we obtain much more mixed evidence on a role for other public policies. There is no public policy variable other than price which is significant for either age group in all three data sets, or even in both the data sets representing the full teen population (MTF and YRBS). The most robust finding appears to be for the impact of youth access restrictions on the quantity of cigarettes smoked, which is negative for both younger teens and seniors, and significant for the latter, in the Natality data; the magnitudes of the effects for teen mothers are much smaller than for all teens in the MTF. We also find negative impacts of clean air regulations for restaurants (which are significant for participation by seniors in the Natality and YRBS data), and of clean air regulations for other sites such as public transportation (which are highly significant in the MTF, and are negative and marginally significant for younger teen participation in the Natality data).

The coefficients on the covariates in the YRBS generally conform to expectations. There is little impact of sex, and an enormous negative impact of race, on smoking rates. Smoking rates fall with grade, conditional on age, but rise strongly with age, so that on average smoking is rising with grade as well. Echoing the findings of Gruber and Zinman (1999) using MTF microdata, there is little impact of parental education on smoking, at least for seniors; there is

some evidence that having more educated parents leads to less smoking for 8th and 10th graders.[8] There are very few covariates in the Natality data, but they do confirm that smoking rises with age and is much higher for whites.[9] One interesting difference between the Natality and YRBS data sets is that smoking among hispanics is much lower in the Natality data, but is only marginally lower in the YRBS. Unfortunately, due to the restricted nature of the MTF data, we can't bring that evidence to bear on racial distinctions; we only know whether the youth is white or non-white in those data.

In summary, there are four conclusions from these basic results. First, there is a sizeable and significant negative impact of price on smoking by seniors, particularly for the decision to participate. This finding is robust to all three data sets. I estimate elasticities that range from -0.38 (Natality) to -1.5 (YRBS), but the most reliable estimate is probably the elasticity of -0.66 from the MTF data. Second, however, I find that there is no impact of price on younger teens, so that in aggregate the price impacts on teen smoking are weak, with overall price elasticities for teens ranging from -0.13 (YRBS) to -0.35 (Natality). Third, there is some suggestion that laws which restrict youth access to tobacco products reduce the intensity of youth smoking, but not smoking participation. Finally, there is little consistent evidence that clean air restrictions matter for youth smoking decisions.

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[8]Parental education is not available in the 1991 YRBS, and is missing for a number of respondents in other years, so the omitted category here is parents who are either high school dropouts or for whom education is missing.

[9]Note that the covariates here are cell means, e.g. percent white in the age/year/state cell.

Specification Tests

There are two potential concerns about this exercise that must be addressed. The first is that, for two of our three data sets, we only have data on students, and not high school dropouts. This may lead to a biased estimate of the aggregate teen elasticity, if dropouts are differentially price sensitive; but since the quoted statistics on teen smoking come from the in-school surveys used here, these are the relevant data for trying to explain time trends. More perniciously, however, if high school dropout rates are somehow correlated with tobacco taxation, then there could be a sample selection bias to our estimates. For example, it is plausible that increased tobacco taxes may be associated with more dropping out of high quantity smokers, leading to a fall in the in-school measured participation rate and smoking intensity. While the price of cigarettes is unlikely to be a major determinant of the dropout decision, some relationship of this type could bias our estimates.

We addressed this concern by collecting data on state by year dropout rates and controlling for them in our regression framework. These data were computed from the October CPS, as the share of students who are enrolled in school at age 17 or 18 but were not enrolled when they were age 16 or 17 in the previous year; we use three year rolling averages for each state and year to increase precision.[10] The results of including these controls are shown in the first panel of Table 5, for the MTF and YRBS samples; we show the coefficients on price and on these controls. In no case does including these control variables change much our coefficient on price, nor did the variables themselves enter significantly in our regressions. So this suggests no

[10]We have also experimented with using the share of 19 and 20 year olds who are not high school graduates in a state/year; the results were similar. We are grateful to Thomas Lemeiux for compiling these data for us.

bias from selection on who remains in school as taxes change.

Another more serious concern, mentioned earlier, is that excise taxes may be endogenous, if not directly to youth smoking, then to aggregate cigarette consumption, which may in turn be correlated with youth smoking decisions (either positively, through adult peer effects, or negatively, through teen contrariness). This general endogeneity concern is impossible to address perfectly, in particular given the very short panel of data with which we are working. But we can address the specific concern that our finding is driven by an omitted correlation of youth and adult smoking by including directly in the regression a control for aggregate cigarette consumption in that state in the previous year. If taxes are responding negatively to aggregate cigarette demand, and this demand is in turn positively correlated with youth smoking, then including lagged packs will remove our finding of a sizeable price elasticity.

The results of this specification test are shown in Table 6, where we present the results from regressions that include in our basic specification (1) the lagged value of packs per capita in that state, from Tobacco Institute (1998). We show the coefficient on price and on lagged packs. In the MTF, the coefficient for seniors is virtually unchanged, and the coefficient for younger teens rises. The YRBS results are more sensitive, perhaps reflecting the fact that there so many fewer tax change "events" in these data, and the price term is now only statistically significant at the 8% level for seniors, but the elasticity remains quite large (-1.194). The Natality coefficients are unchanged. We have also experimented with including not just lagged aggregate sales, but also current sales, twice lagged sales, and thrice lagged sales. We find once again that these expanded controls lead to a weakening of the YRBS result similar to that shown in Table 6, and actually to a modest increase in the estimated MTF elasticity. The coefficients on lagged

packs/capita themselves are generally insignificant. Thus, it appears that correlations between aggregate consumption and both tax setting and youth smoking cannot explain our findings.

Part IV: Heterogeneity

The analysis thus far has considered youth smoking as a simple aggregate, and has not explored the heterogeneity in policy impacts across different groups of youth. But there are considerable differences across youth in their underlying propensity to smoke. Most noticeable is racial differences, and the YRBS suggests some differences by parental education as well, at least for younger teens. In this section we explore the heterogeneity in the price responsiveness of youth smokers. In particular, we assess whether socioeconomically disadvantaged youth are more responsive to prices, suggesting a cross-elasticity between price and income.

The results for a racial decomposition of smoking responsiveness are presented in Table 7. For the MTF sample, we can only compare white and non-white youths, since this is the only racial distinction available in these restricted data. In the YRBS and Natality data, we can compare white and black youths more specifically. When we have estimated models for whites and all non-whites in these other data sets, they are similar but more muted than the results for whites and blacks.

The results for the MTF and YRBS data for seniors are striking: there is much higher price responsiveness among blacks than among whites. In the MTF, the price elasticity of participation for white seniors is only -0.35, and is insignificant, and there is a positive coefficient on conditional intensity. But for black seniors the elasticity of participation is an enormous and statistically significant -2.32, and there is a significant elasticity of conditional

intensity of -2.03 as well. In the YRBS, the results are even more extreme, with an elasticity of -0.63 for white smoking participation and an unreasonable elasticity of -9.3 for blacks. In the Natality data, on the other hand, the results are reversed: the price elasticity for whites is slightly larger than for the full sample, and there is no price responsiveness of participation among blacks (although there is a large negative impact on conditional intensity).

For younger teens, there is a much less clear racial pattern. There are no significant elasticities for either whites or blacks in the MTF or YRBS data. For the natality data, the elasticities are once again significant for whites and wrong-signed for blacks.

One explanation for this higher price sensitivity among black youths is lower incomes. A number of articles have found for adult smokers price elasticities that fall with income (e.g. Evans et al. 1999). If the same is true for teens, then the lower incomes of black seniors may explain their increased responsiveness. Unfortunately, none of these data sets contain information on income. But the YRBS data do have an excellent proxy for permanent income: parental education.

In the final panel of Table 7 I therefore present results which divide the YRBS sample into those whose mother and father are high school dropouts or graduates, and those whose mother and father have some college or are college graduates. There is a striking difference across these groups for seniors: the elasticity of participation is -4.4 for the low education group, and is only -0.2 for the high education group (and is highly insignificant for the latter). This is offset to some extent by a very large conditional intensity elasticity for the high education group. But, overall, there is a clear negative correlation of price responsiveness and socioeconomic status measured this way. Once again, however, there is no clear relationship for younger teens;

the elasticity of participation is actually positive and significant for younger teens with less educated parents, and is positive and insignificant for younger teens with more highly educated parents.

Taken together, the results in Table 7 suggest two important conclusions. First, for seniors, there is a strong cross-elasticity between price and incomes. Lower income groups, either racially or by parental education, are much more price sensitive. Moreover, the fact that the results by race for teen mothers are reversed is consistent with the fact that, while white teens are much more advantaged than black teens as a whole, among teen mothers blacks actually have a higher median income.[11]

Second, there continues to be evidence that the smoking decisions of younger teens are determined primarily by non-economic factors. Not only are younger teens not price sensitive, there is no pattern of increased relative sensitivity with income, as proxied by either race or parental education.

Part V: Conclusions

The 1990s is a decade that has seen remarkable progress on important indicators of risky teen behavior, such as teen births and crime by youths. But a striking countervailing trend is the increased incidence of smoking by teenagers, which rose by a third from 1991 through 1997. This trend has potentially troubling public health implications if youth smoking leads to adult smoking. Yet we know very little about what caused this dramatic shift, and what role public

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[11]Specifically, in 1997, median family income for white teens was $47,000, while it was only $25,000 for black teens. At the same time, among white teen mothers median income was $3000, while it was $4300 among black teen mothers.

policy can play in reversing it.

The results in this paper suggest that the single greatest policy determinant of youth smoking is the price of cigarettes. I consistently find across several data sets that older teens are very sensitive to the price of cigarettes, with a central price elasticity estimate of -0.67. This estimate implies that the sharp reduction in cigarette prices in the early 1990s can explain roughly 30% of the increase in smoking over the subsequent six years. Moreover, this price sensitivity rises for more socioeconomically disadvantaged groups such as blacks or those with less educated parents.

At the same time, I find that younger teens are not sensitive to prices on average, nor is there any relationship between price sensitivity and socioeconomic status for younger teens. These findings suggest important heterogeneity in the teen population. Younger teens appear to be price insensitive experimenters who evolve into more price sensitive smokers by their older teen years. An important priority for future work in this area is to understand the evolution of smoking between the younger teen and older teenage years.

These findings also hold out little hope for other policies as a means of reducing youth smoking. I do find some evidence that policies that restrict the access of youth to cigarettes reduce the quantity of cigarettes smoked by those youth, but this finding is not nearly as robust as the price relationship. There is no consistent evidence that restrictions on smoking in public places lowers smoking.

Overall, these results imply that policy makers concerned about the rise in youth smoking should look to raising cigarette taxes as the most effective means of reducing that smoking. Of course, with youths only smoking about 2% of cigarette packs, taxes are a very blunt instrument

to address youth smoking issues. Thus, there are a host of additional issues that must be considered in deriving the optimal cigarette tax beyond considerations of youth smoking; Chaloupka and Warner (1999), Evans et al. (1999) and Gruber and Koszegi (1999) provide further discussions of these factors. But the results here suggest that consideration of optimal cigarette tax policy must include the very strong effect that taxes have on smoking by older teens.

Appendix: Youth Access Index

Our Youth Access Index (YAI) is based upon the National Cancer Institute's (NCI) Decision Criteria For Rating State Youth Access Laws. The NCI's Criteria include nine categories: minimum age of purchase; packaging; clerk intervention; photo identification; vending machine availability; free distribution; graduated penalties; random inspections; and statewide enforcement. For each category, a score is granted on a scale of 1-4 or 1-5 as a function of the stringency of state regulation in that area. For example, states get a score of 0 if the minimum age is below 18; a score of 3 if the minimum age is 18 but there is no requirement of sign posting and/or there is no specific penalty for failure to post a sign; a score of 4 if the minimum age is 18 with specific sign posting requirements and penalties for failure to post; and a score of 5 if there is a minimum age above age 18 and there are posting/penalty provisions. These points are then summed across categories to get a total access index score. Then, states points are reduced by two points (to a minimum of zero) if they allow their state regulation to preempt a stricter local ordinance.

While the general framework of the two indexes is the same, the YAI contains several variations in order to describe state tobacco laws in more detail. The largest difference is the inclusion of three categories in addition to the nine utilized by the NCI. These were Advertising, Licensing, and Restrictions on Minors. Points are awarded for advertising restrictions on a scale between one and four. A state earns one point for minimal limitations (no advertising on school buses, etc.) and four points for a ban on all tobacco advertisements. Including licensing in the YAI captures the extent to which retailers, vendors, and wholesalers are regulated by state agencies. Maximum licensing requirements (applicable to retailers, vendors, and wholesalers)

received four points while states mandating only wholesale licenses received one point. The Restrictions on Minors category encompasses laws relating to underage purchase, possession, and use of tobacco. Those states outlawing these actions, but implementing no penalties for violating the laws received between zero and one point. The highest possible score, four points, is given to states outlawing purchase, possession, and use and implementing graduated penalties.

The YAI also allows for more point levels under each category than the NCI index, to create a finer gradation between the stringency of various laws. For example, one problem with the minimum age categorization noted above is that some states mandate signage at the point of purchase, while others mandate signage but not at the point of purchase; we awarded the latter group of states 3.5 points instead of 4. This affected twenty-one states overall. Similar half point steps were added to each the nine original NCI categories. The purpose of this variation from the NCI index was to distinguish more clearly between the stringency of varying state requirements.

We also in several instances altered scoring decisions made by the NCI in the final computation of state scores. After extensive investigation of state laws and statutes, several inconsistencies were discovered between the laws and the NCI point allotment. For example, upon consultation with NCI representatives, it was revealed that Connecticut received two points for the vending machine category in 1996. The justification for this score was that a 1996 law added new restrictions. However, certain sections were not effective until after the time period of the NCI study. Since the law had already passed, though, NCI awarded points to reflect it in their study. For this project, however, this point assignment was inappropriate. Credit for laws was only awarded after the law came into effect. Therefore, the YAI contains several

modifications to the factual basis of the NCI index.

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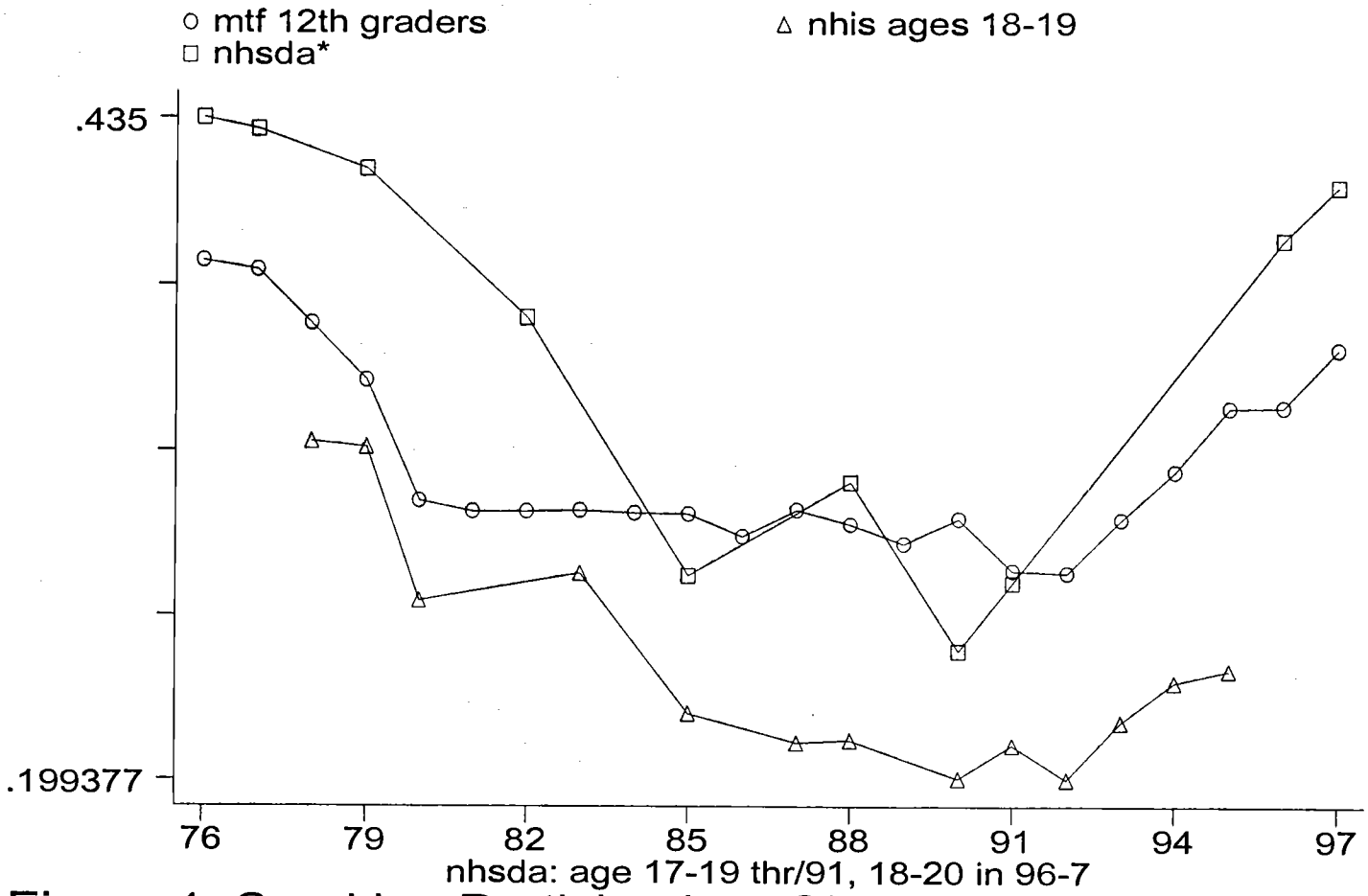

Figure 1. Smoking Participation: Older Youth Time Series

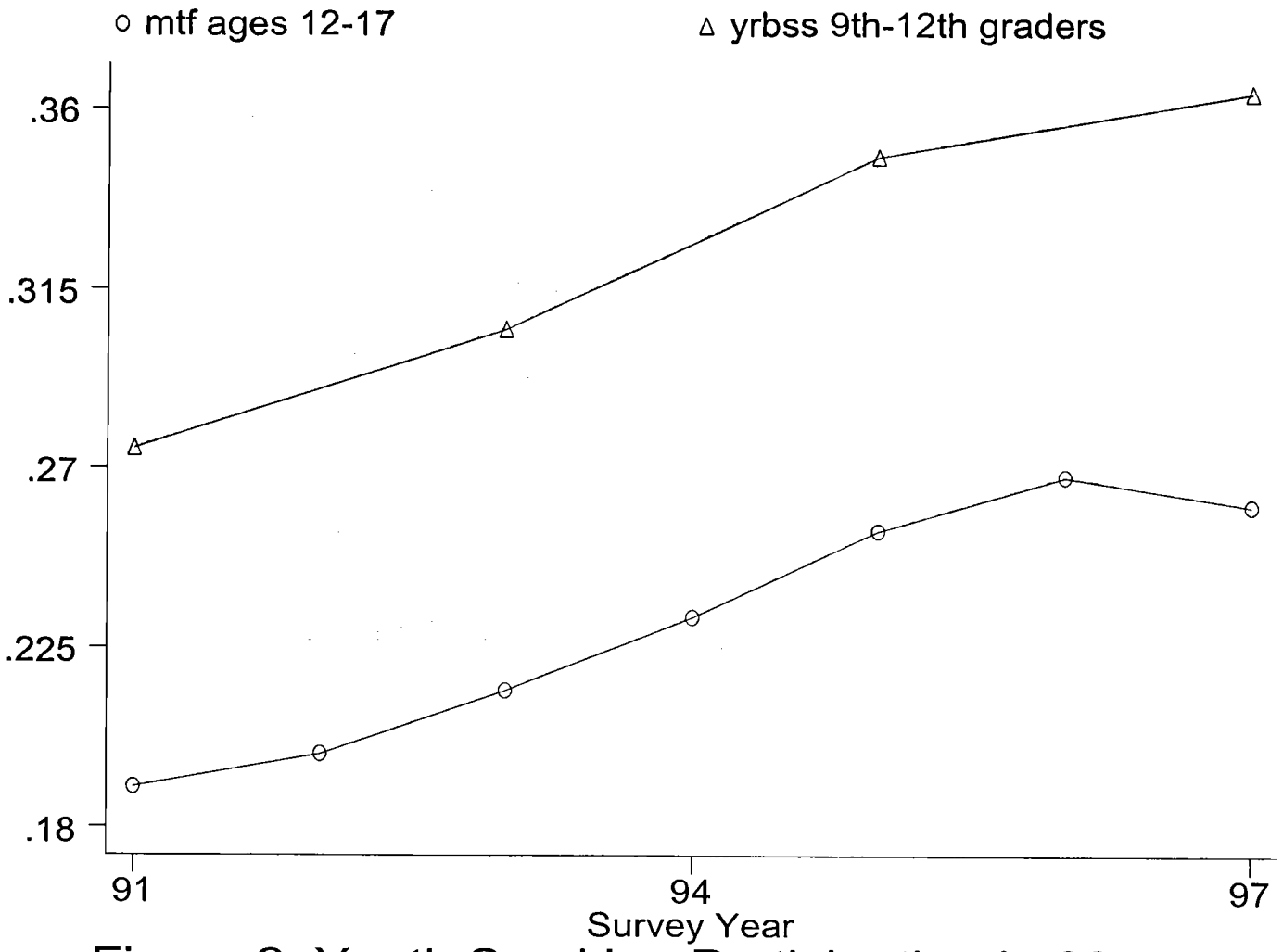

Figure 2. Youth Smoking Participation in 90s

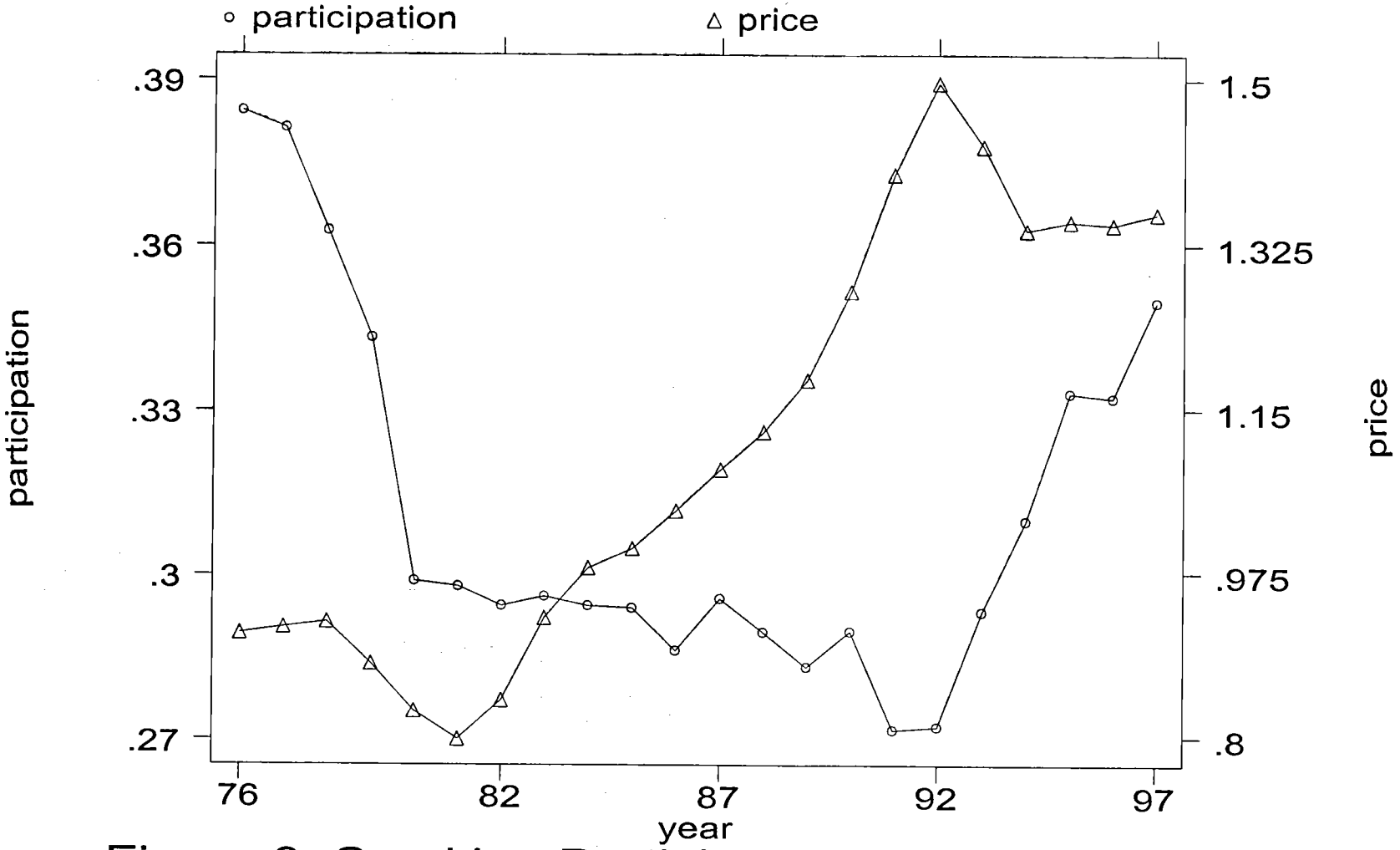

Figure 3: Smoking Participation v. Cigarette Price

Table 1: Means of MTF, YRBS, and Natality Price Regression Samples

	Any Smoking	Cigs/Day when smoke	Real Price ($1982)	Real Excise Tax ($1982)
Monitoring the Future Data - 1991-97				
12th Grade	0.309	7.21	1.39	0.21
(N=91,567)	(0.462)	(8.87)	(0.17)	(0.10)
8-10th grade	0.217	5.42	1.38	0.21
(N=213,527)	(0.412)	(8.38)	(0.17)	(0.10)
8-12th Grade	0.246	6.13	1.39	0.21
(N=336,665)	(0.431)	(8.63)	(0.17)	(0.10)
Youth Risk Behavior Survey Data - 1991,1993,1995,1997				
12th Grade	0.358	6.06	1.28	0.21
(N=14,346)	(0.479)	(6.13)	(0.15)	(0.10)
9-11th Grade	0.315	5.15	1.28	0.21
(N=38,932)	(0.464)	(5.70)	(0.15)	(0.10)
9-12th Grade	0.326	5.42	1.28	0.21
(N=53,278)	(0.469)	(5.85)	(0.15)	(0.10)
Natality Data - 1991-1997				
17-18 Years Old	0.180	10.23	1.23	0.19
(N = 666)	(0.075)	(1.31)	(0.14)	(0.10)
13-16 Years Old	0.127	9.21	1.22	0.19
(N =1319)	(0.071)	(1.70)	(0.14)	(0.10)
13-18 Years Old	0.164	9.93	1.22	0.19
(N = 1985)	(0.078)	(1.51)	(0.14)	(0.10)

Notes: Author's tabulations of MTF, YRBS, and Natality data. All prices and taxes in 1982 dollars. Micro-data for MTF and YRBS; cell-level data for Natality, as described in text, with means weighted by cell count. Cigs/day when smoke is cigarettes per day smoked on days when smoking. Standard deviations in parentheses.

Table 2: Impact of Price and Regulations on Youth Smoking in MTF Data

	12th Graders		8th & 10th Graders		8th - 12th Graders	
	Partic.	Cigs/Day	Partic.	Cigs/Day	Partic.	Cigs/Day
Price	-0.148	-0.310	-0.033	-0.013	-0.055	-0.129
	(0.078)	(2.388)	(0.035)	(1.243)	(0.034)	(1.132)
	[-0.666]	[-0.059]	[-0.21]	[-0.003]	[-0.311]	[-0.029]
Access Index/100	0.084	-3.48	0.033	-5.520	0.066	-5.22
	(0.106)	(2.76)	(0.060)	(1.640)	(0.056)	(1.49)
Private Work	-0.041	0.462	-0.006	1.464	-0.021	1.045
	(0.028)	(0.589)	(0.017)	(0.489)	(0.017)	(0.348)
Gov't Work	0.022	-1.128	-0.019	-0.813	-0.001	-0.834
	(0.026)	(0.517)	(0.015)	(0.394)	(0.013)	(0.251)
Rest.	0.032	2.166	0.012	0.868	0.016	1.318
	(0.030)	(0.783)	(0.017)	(0.615)	(0.015)	(0.483)
Schools	0.050	0.931	0.044	0.788	0.040	0.645
	(0.030)	(0.915)	(0.018)	(0.553)	(0.015)	(0.392)
Other	-0.080	-2.791	-0.032	-1.424	-0.038	-1.617
	(0.041)	(1.234)	(0.020)	(0.775)	(0.019)	(0.621)
Male	0.016	1.235	-0.009	0.926	-0.001	1.041
	(0.004)	(0.115)	(0.003)	(0.085)	(0.003)	(0.069)
Non-White	-0.153	-1.908	-0.076	-0.436	-0.1	-0.962
	(0.007)	(0.171)	(0.004)	(0.119)	(0.005)	(0.115)
Grade 8			-0.088	-2.746	-0.185	-3.815
			(0.018)	(0.576)	(0.014)	(0.538)
Grade 10					-0.098	-1.055
					(0.019)	(0.632)
Grade 8, Age<=13			-0.027	0.217	0.03	0.181
			(0.018)	(0.573)	(0.014)	(0.519)
Grade 8, Age>=14			0.026	1.829	0.083	1.8
			(0.018)	(0.572)	(0.014)	(0.515)
Grade 10, Age<=15			-0.037	-1.211	0.019	-1.334
			(0.003)	(0.104)	(0.019)	(0.625)
Grade 10, Age>=16					0.055	-0.119
					(0.019)	(0.627)
Grade 12, Age <=17	-0.013	-0.546			-0.012	-0.512
	(0.003)	(0.113)			(0.003)	(0.112)
Number of Obs	106539	32868	230126	49927	336665	82795

Notes: Estimates from regressions in MTF data, as described in text. Standard errors (corrected for state/year clustering) in parentheses. All regressions also include full set of state and year fixed effects.

Table 3: Impact of Price and Regulations on Youth Smoking in YRBS Data

	12th Graders		9th - 11th Graders		9th - 12th Graders	
	Partic.	Cigs/Day	Partic.	Cigs/Day	Partic.	Cigs/Day
Price	-0.429 (0.200) [-1.534]	-7.462 (3.461) [-1.576]	0.103 (0.134) [0.419]	-0.912 (1.847) [-0.227]	-0.032 (0.103) [-0.126]	-2.228 (1.937) [-0.526]
Access Index/100	-0.060 (0.169)	0.461 (3.985)	-0.098 (0.092)	-0.804 (2.223)	-0.098 (0.088)	-0.316 (2.308)
Private Work	0.006 (0.047)	-2.723 (1.742)	0.064 (0.046)	1.146 (0.552)	0.051 (0.042)	0.905 (0.476)
Gov't Work	-0.075 (0.032)	-0.168 (1.459)	-0.088 (0.037)	-1.800 (0.473)	-0.087 (0.034)	-1.971 (0.396)
Rest.	-0.162 (0.028)	-1.435 (1.466)	-0.006 (0.025)	0.383 (0.627)	-0.050 (0.025)	-0.447 (0.783)
Schools	0.006 (0.060)	-0.578 (1.161)	0.008 (0.045)	0.517 (0.567)	0.008 (0.034)	0.578 (0.533)
Other	0.012 (0.065)	6.164 (2.260)	-0.015 (0.054)	0.775 (0.813)	0.002 (0.048)	1.842 (0.950)
Male	0.002 (0.014)	1.283 (0.268)	-0.001 (0.010)	0.846 (0.164)	0.000 (0.008)	0.984 (0.146)
White	0.048 (0.028)	0.585 (0.634)	0.046 (0.014)	-0.148 (0.506)	0.044 (0.012)	0.071 (0.382)
Black	-0.206 (0.033)	-3.16 (0.621)	-0.128 (0.018)	-2.69 (0.541)	-0.149 (0.015)	-2.73 (0.417)
Hispanic	-0.013 (0.030)	-2.10 (0.627)	0.003 (0.016)	-2.09 (0.448)	-0.002 (0.014)	-2.02 (0.354)
Grade 10			-0.055 (0.010)	0.261 (0.366)	-0.055 (0.011)	0.266 (0.363)
Grade 11			-0.076 (0.017)	0.289 (0.455)	-0.075 (0.017)	0.379 (0.452)
Grade 12					-0.092 (0.022)	0.103 (0.551)
Age 15	-0.052 (0.211)	-12.28 (6.70)	0.079 (0.013)	1.04 (0.369)	0.079 (0.013)	1.00 (0.370)
Age 16	-0.044 (0.161)	-14.86 (4.93)	0.146 (0.016)	1.39 (0.443)	0.146 (0.016)	1.36 (0.444)

Age 17	-0.106	-15.50	0.191	2.28	0.191	2.13
	(0.145)	(4.62)	(0.020)	(0.542)	(0.020)	(0.544)
Age 18	-0.086	-14.95	0.244	2.71	0.218	2.53
	(0.144)	(4.66)	(0.035)	(0.772)	(0.023)	(0.618)
Dad Educ HS Grad	0.014	-0.349	-0.007	-0.384	-0.002	-0.362
	(0.022)	(0.431)	(0.015)	(0.252)	(0.012)	(0.215)
Dad Educ Some Coll	0.008	-1.07	-0.035	-0.488	-0.025	-0.660
	(0.027)	(0.549)	(0.018)	(0.410)	(0.014)	(0.332)
Dad Educ Coll Grad	-0.004	-1.26	-0.055	-0.905	-0.042	-0.971
	(0.024)	(0.493)	(0.019)	(0.305)	(0.015)	(0.232)
Mom Ed HS Grad	-0.058	-0.701	-0.014	-0.640	-0.027	-0.686
	(0.024)	(0.403)	(0.017)	(0.416)	(0.015)	(0.339)
Mom Ed Some Coll	-0.031	-0.382	-0.030	-0.935	-0.030	-0.751
	(0.030)	(0.508)	(0.013)	(0.429)	(0.015)	(0.326)
Mom Ed Coll Grad	-0.044	-0.785	-0.038	-0.908	-0.041	-0.891
	(0.027)	(0.446)	(0.017)	(0.423)	(0.015)	(0.338)
Number Obs	14346	4429	38932	11368	53278	15797

Notes: Estimates from regressions in YRBS data, as described in text. Standard errors (corrected for state/year clustering) in parentheses. All regressions also include full set of state and year fixed effects.

Table 4: Impact of Price and Regulations on Youth Smoking in Natality Data

	17-18 Year Olds		13-16 Year Olds		13-18 Year Olds	
	Partic.	Cigs/Day	Partic.	Cigs/Day	Partic.	Cigs/Day
Price	-0.055	-1.209	-0.025	-0.436	-0.047	-1.003
	(0.018)	(0.527)	(0.018)	(0.638)	(0.016)	(0.440)
	[-0.376]	[-0.145]	[-0.240]	[-0.058]	[-0.353]	[-0.124]
Access Index/100	0.023	-1.771	-0.006	-1.010	0.013	-1.485
	(0.026)	(0.718)	(0.024)	(1.106)	(0.023)	(0.651)
Private Work	0.009	0.037	0.013	0.555	0.011	0.134
	(0.007)	(0.329)	(0.007)	(0.466)	(0.005)	(0.254)
Gov't Work	0.000	0.014	-0.005	0.180	-0.002	0.021
	(0.003)	(0.109)	(0.004)	(0.160)	(0.003)	(0.089)
Rest.	-0.012	-0.493	0.002	-0.972	-0.007	-0.597
	(0.004)	(0.233)	(0.005)	(0.355)	(0.004)	(0.193)
Schools	0.002	-0.195	0.006	-0.613	0.004	-0.316
	(0.004)	(0.175)	(0.005)	(0.220)	(0.004)	(0.148)
Other	-0.003	0.231	-0.011	0.299	-0.006	0.300
	(0.005)	(0.238)	(0.006)	(0.327)	(0.004)	(0.205)
% White	0.179	2.16	0.131	-0.839	0.171	-0.016
	(0.093)	(2.67)	(0.056)	(2.59)	(0.046)	(1.61)
% Black	-0.263	2.09	-0.139	-2.40	-0.203	-2.42
	(0.096)	(2.80)	(0.052)	(2.39)	(0.044)	(1.49)
% Hispanic	-0.255	-1.90	-0.238	0.34	-0.238	-1.15
	(0.044)	(1.64)	(0.028)	(1.13)	(0.025)	(0.896)
Age 14			0.017	-0.158	0.009	-0.187
			(0.004)	(0.366)	(0.004)	(0.363)
Age 15			0.024	0.317	0.009	0.213
			(0.005)	(0.354)	(0.005)	(0.349)
Age 16			0.033	0.734	0.011	0.557
			(0.007)	(0.375)	(0.006)	(0.354)
Age 17					0.014	0.912
					(0.007)	(0.368)
Age 18	0.003	0.502			0.019	1.362
	(0.002)	(0.055)			(0.007)	(0.376)
Number Obs	1319	1189	666	666	1985	1855

Notes: Estimates from regressions in Natality data, as described in text. Standard errors (corrected for state/year clustering) in parentheses. All regressions also include full set of state and year fixed effects.

Table 5: Impact of Price and Regulations with Dropout Control - Seniors Only

	MTF Data		YRBS Data	
	Partic.	Cigs/Day	Partic.	Cigs/Day
Price	-0.136 (0.082) [-0.612]	-0.894 (2.512) [-0.172]	-0.446 (0.199) [-1.534]	-7.736 (3.673) [-1.634]
Access Index/100	0.077 (0.106)	-3.12 (2.71)	-0.037 (0.172)	1.360 (3.765)
Private Work	-0.040 (0.028)	0.380 (0.584)	0.006 (0.047)	-2.615 (1.768)
Gov't Work	0.022 (0.026)	-1.138 (0.508)	-0.077 (0.031)	-0.265 (1.465)
Rest.	0.039 (0.030)	1.896 (0.807)	-0.176 (0.030)	-1.718 (1.184)
Schools	0.047 (0.031)	1.106 (0.940)	0.012 (0.061)	-0.451 (1.171)
Other	-0.087 (0.039)	-2.502 (1.245)	0.033 (0.069)	6.557 (1.967)
Dropout Rate	0.135 (0.115)	-6.570 (4.431)	-0.447 (0.454)	-13.27 (7.282)

Notes: Estimates from regressions in MTF data (first two columns) and YRBS data (last two columns). Standard errors (corrected for state/year clustering) in parentheses; price elasticity in square brackets. All regressions include full set of state and year fixed effects, as well as control variables shown in Tables 2 and 3.

Table 6: Price Coefficient with Lagged Packs/Capita

	Older Teens		Younger Teens		All Teens	
	Partic.	Cigs/Day	Partic.	Cigs/Day	Partic.	Cigs/Day
			MTF Data			
Price	-0.143	0.551	-0.047	0.105	-0.065	0.208
	(0.089)	(2.493)	(0.035)	(1.316)	(0.035)	(1.134)
	[-0.644]	[0.106]	[-0.300]	[0.027]	[-0.364]	[0.047]
Packs/ Capita	0.138	22.43	-0.436	3.196	-0.274	9.238
	(0.832)	(19.52)	(0.303)	(10.99)	(0.358)	(9.166)
			YRBS Data			
Price	-0.334	-7.480	0.121	-0.599	0.008	-1.732
	(0.191)	(3.714)	(0.130)	(1.892)	(0.097)	(1.847)
	[-1.194]	[-1.576]	[0.419]	[-0.227]		[-0.526]
Packs/ Capita	3.415	-0.589	0.786	13.48	1.597	19.81
	(2.243)	(37.59)	(0.998)	(17.13)	(0.843)	(16.33)
			Natality Data			
Price	-0.048	-1.030	-0.027	-0.257	-0.043	-0.804
	(0.017)	(0.526)	(0.018)	(0.689)	(0.016)	(0.453)
	[-0.376]	[-0.145]	[-0.240]	[-0.058]	[-0.353]	[-0.124]
Packs/ Capita	0.331	7.265	-0.100	7.083	0.195	7.945
	(0.143)	(5.521)	(0.146)	(6.964)	(0.128)	(5.193)

Notes: Coefficient on price and lagged packs/capita from regressions in MTF (first panel), YRBS (second panel), and Natality data (third panel). Regressions include all of the controls shown in Tables 2, 3, and 4, including full set of state and year fixed effects. Standard errors (corrected for state/year clustering) in parentheses; price elasticity in square brackets.

Table 7: Price Coefficient Heterogeneity by Race

	Older Teens		Younger Teens		All Teens	
	Partic.	Cigs/Day	Partic.	Cigs/Day	Partic.	Cigs/Day
			MTF Data			
Whites	-0.091	0.721	-0.054	-1.611	-0.057	-0.848
	(0.010)	(2.637)	(0.047)	(1.214)	(0.041)	(1.225)
	[-0.350]	[0.130]	[-0.300]	[-0.393]	[-0.277]	[-0.181]
Non-Whites	-0.323	-7.690	0.025	4.962	-0.039	2.417
	(0.163)	(3.749)	(0.050)	(2.843)	(0.045)	(2.395)
	[-2.324]	[-2.03]	[0.226]	[1.488]	[-0.327]	[0.691]
			YRBS Data			
Whites	-0.198	-13.70	0.083	0.470	0.026	-3.563
	(0.271)	(4.554)	(0.177)	(2.326)	(0.123)	(2.344)
	[-0.628]	[-2.662]	[0.303]	[0.106]	[0.092]	[-0.775]
Blacks	-1.187	-22.78	-0.132	12.48	-0.369	11.24
	(0.485)	(20.50)	(0.372)	(12.44)	(0.351)	(10.81)
	[-9.259]	[-8.248]	[-0.874]	[4.958]	[-2.530]	[4.393]
			Natality Data			
Whites	-0.079	-0.934	-0.060	0.307	-0.079	-0.639
	(0.023)	(0.556)	(0.023)	(0.682)	(0.021)	(0.453)
	[-0.412]	[-0.109]	[-0.385]	[0.040]	[-0.433]	[-0.076]
Blacks	0.026	-3.357	0.033	-2.809	0.028	-3.256
	(0.017)	(1.286)	(0.019)	(2.113)	(0.015)	(1.144)
	[0.534]	[-0.539]	[1.115]	[-0.494]	[0.671]	[-0.539]
			YRBS Data - Parental Education			
Mom&Dad HS Drop or Grad	-1.266	-2.036	0.79	10.806	0.207	4.464
	(0.583)	(8.497)	(0.369)	(5.889)	(0.206)	(5.4)
	[-4.387]	[-0.401]	[2.721]	[2.514]	[0.715]	[0.103]
Mom&Dad Some or Grad Coll	-0.067	-10.068	0.228	-1.432	0.157	-3.285
	(0.238)	(4.159)	(0.231)	(3.144)	(0.188)	(2.353)
	[-0.236]	[-2.393]	[0.956]	[-0.390]	[0.645]	[-0.874]

Notes: Coefficient on price from regressions in MTF (first panel), YRBS (second and fourth panels), and Natality data (third panel). Regressions include all of the controls shown in Tables 2, 3, and 4, including full set of state and year fixed effects. Standard errors (corrected for state/year clustering) in parentheses; price elasticity in square brackets.

Appendix Table 1: Means of Regulatory Variables in MTF

	12th Graders	8th & 10th Graders	8th - 12th Graders
Access Index	11.91	11.69	11.76
	(5.29)	(5.46)	(5.41)
Clean Air: Private Workplace	0.44	0.44	0.44
	(0.50)	(0.50)	(0.50)
Clean Air: Government Work	0.73	0.71	0.72
	(0.44)	(0.45)	(0.45)
Clean Air: Restaurants	0.64	0.61	0.62
	(0.48)	(0.49)	(0.49)
Clean Air: Schools	0.90	0.85	0.87
	(0.30)	(0.36)	(0.34)
Clean Air: Other	0.93	0.91	0.92
	(0.25)	(0.29)	(0.28)
Number of Obs	106,539	230,126	336,665

Notes: From authors' tabulations of 1991-1997 MTF restricted sample data desribed in text. Standard deviations in parentheses.