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Racial Difference in the Determinants of Smoking Onset

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Abstract

The large differences in youth smoking behavior across ethnic and racial groups are often overlooked in debates about prevention. This study examines how the determinants of the onset of smoking vary by race and ethnicity. Academic success is strongly associated with lower smoking rates among white youth, but this is not as true for Hispanics and African-Americans. Cultural assimilation may be an important determinant of smoking for Hispanics. Price increases do not appear to reduce smoking onset among white youth, but the results provide some support that higher prices will reduce smoking among Hispanic and African-American youth.

Key words: health, youth smoking, racial differences, peer behaviors, price responsiveness, cultural assimilation

JEL Classification: J3, I1, D0, Z0

The large differences in youth smoking behavior across different ethnic and racial groups are often overlooked in debates about prevention policies. Data from the Monitoring the Future [MTF] Project indicate that in 1998 about 42 percent of white high school seniors smoked during the 30 days before the survey, compared to about 15 percent of African-American high school seniors. Rates of smoking by Hispanics and other ethnic and racial groups fall in between these two extremes.[1] Moreover, as discussed in more detail in Section 1, time trends in youth smoking rates have been much different across racial and ethnic groups, and youths of different racial and ethnic backgrounds typically choose to smoke different brands of cigarettes. A better understanding of these differences could provide clues to

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more effective policies to reduce smoking onset. The Treasury Department (1998) predicted that the $1.50 per pack price increase and other prevention measures included in the proposed national tobacco settlement could cut youth smoking rates in half. To highlight the potential importance of understanding racial and ethnic differences, it is interesting to observe that reducing the rate of smoking among white youth to that of African-American youth would require an even more dramatic change.

In a recent survey, the Surgeon General's Report (U.S. Department of Health and Human Services [USDHHS] 1998) concludes that 'no single factor determines patterns of tobacco use among racial/ethnic minority groups, these patterns are the result of complex interactions of multiple factors, such as socioeconomic status, cultural characteristics, acculturation, stress, biological elements, targeted advertising, prices of tobacco products, and varying capacities of communities to mount effective tobacco control initiatives." While previous economics research tends to focus on the role of prices, many do not consider the role of peer influences and socioeconomic determinants of smoking. Few studies consider these factors together in one empirical model.

The main objective our study is to examine, together, the importance of prices, peer influences, academic success and other factors in determining youth cigarette consumption and how these factors vary by race. We use data from the National Education Longitudinal Survey of 1988 (NELS:88). NELS:88 surveyed students when they are in 8th grade and re-surveyed them in 1990 and 1992. A key advantage of these data are that most students start smoking between 8th grade and 12th grade. We exploit the longitudinal nature of the data by estimating discrete time hazard models that include state fixed effects. We conduct separate analyses for whites, Hispanics and African-Americans.

Our results indicate that there are important differences in the determinants of smoking onset between the racial/ethnic groups. First, the association between academic success and smoking rates varies by race/ethnicity. Among white youth, those who are more successful academically have significantly lower rates of smoking. This relationship is not as strong for Hispanics and African-Americans. Second, measured aspects of family background are more important predictors of smoking onset rates for white youth than for Hispanic and African-American youth. Third, the results provide some indications that exogenous peer influences are important determinants of youth smoking behavior, and again suggest some racial and ethnic differences in the roles of these determinants. Finally, the results suggest that cigarette price increases will be largely ineffective in reducing smoking onset for the majority of youth in the sample. Controlling for state fixed effects, there is no evidence that cigarette prices deter youth smoking onset for whites. Since whites comprise a majority of the population, these results question the general effectiveness of price policy to stem the rising trend in youth smoking rates. The importance of the state fixed effects also suggests that other studies that fall to include them or similar controls yield potentially biased estimates. The results for Hispanics and African-Americans provide some support that higher prices will reduce smoking in these populations.

Section 1 provides background information on youth smoking behavior across different racial and ethnic groups, and discusses the implications of these differences for economics research on youth smoking. Section 2 describes the data and econometric approach. The results are presented in Section 3, while Section 4 concludes and suggests directions for future work.

1. BACKGROUND

1.1. Differences in youth smoking rates across racial and ethnic groups

From 1965 to 1991, smoking was somewhat more common among African-American adults than among white adults (Hersh, 1998). Currently, about 25 percent of both white and African-American adults smoke, while about 26 percent of Hispanic adults smoke (USDHHS 2000). However, these similarities in adult smoking rates mask important difference in youth smoking behavior across racial and ethnic groups. Figure 1, based on data from the MTF, shows the separate trends in smoking for white, Hispanics, and African-American high school seniors. The late 1970s witnessed a drop in smoking rates among all three groups. However, only among African-American youth did this trend continue through the next decade.

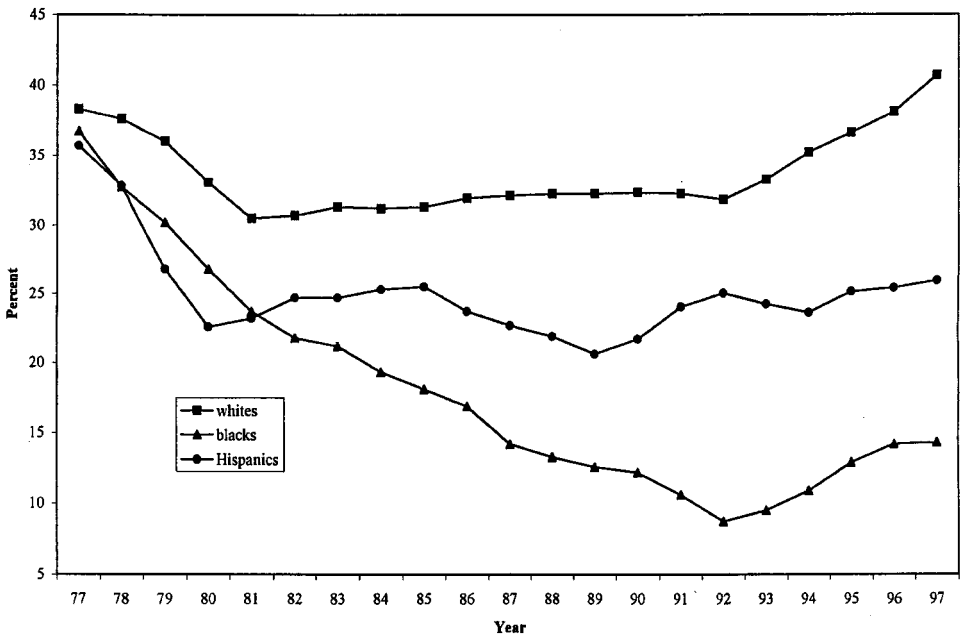

Figure 1. Youth smoking rates by race and ethnicity.

The trends diverge remarkably: in 1977 thirty-day prevalence rates[2] among white, Hispanic, and African-American youth were all between 35 and 40 percent, but by 1992 the thirty-day prevalence rate for African-American youth was below 10 percent, while the rate for white youth was about 32 percent, with the rate for Hispanic youth falling somewhere in between at 25 percent.

Smoking prevalence increased among white and African-American youth during the 1990s. The increase among African-American youth is striking given the earlier steep declines. Previous-month smoking prevalence among African-American high school seniors almost doubled from a low of 8.7 percent in 1992 to 14.9 percent in 1998. This dramatic increase in smoking rates among African-American youth is especially troubling given recent evidence that African-Americans find it harder to quit and experience higher rates of lung cancer than white smokers (Caraballo et al., 1998).

1.2. Differences in cigarette brand choices across racial and ethnic groups

It is well-established that virtually all young smokers choose to smoke premium brands of cigarettes. For example, a survey conducted in 1992 found that over 90 percent of young smokers chose one of the three major premium brands of Marlboro, Camel, or Newport (Cummings et al., 1997). As with smoking prevalence and trends, there are sharp differences in brand choices of young smokers across racial and ethnic groups. The 1998 MTF survey added a new question about cigarette brand choices among current smokers (Johnston et al., 1999).[3] Pooling together respondents in 8th, 10th, and 12th grades, about 66 percent of white youth who smoke say they usually smoke Marlboro, compared to about 8 percent of African-American youth smokers. In contrast, Newport is the brand choice of 75 percent of African-American youth smokers, compared to just 12 percent of white youth who smoke. Again, the brand choices of Hispanic youth smokers fall in between these extremes, with a higher percentage (60 percent) choosing to smoke Marlboros than among African-Americans, but also with a higher percentage (20 percent) choosing to smoke Newports than among whites. The second most popular brand among white youth smokers was Camel, with 8.5 percent, but it was relatively unpopular among Hispanics (chosen by 2.6 percent) and extremely unpopular among African-Americans (chosen by 0.6 percent).

1.3. Economics and differences in youth smoking behavior by race and ethnicity

An economist would be hard-pressed to use a simple consumer demand model to explain the observed differences in youth smoking behavior by race and ethnicity. Most economics studies focus on the role of cigarette taxes or prices on youth smoking.[4] However, the rates and trends of youth smoking and brand choices of smokers vary across racial and ethnic groups even though all groups faced similar

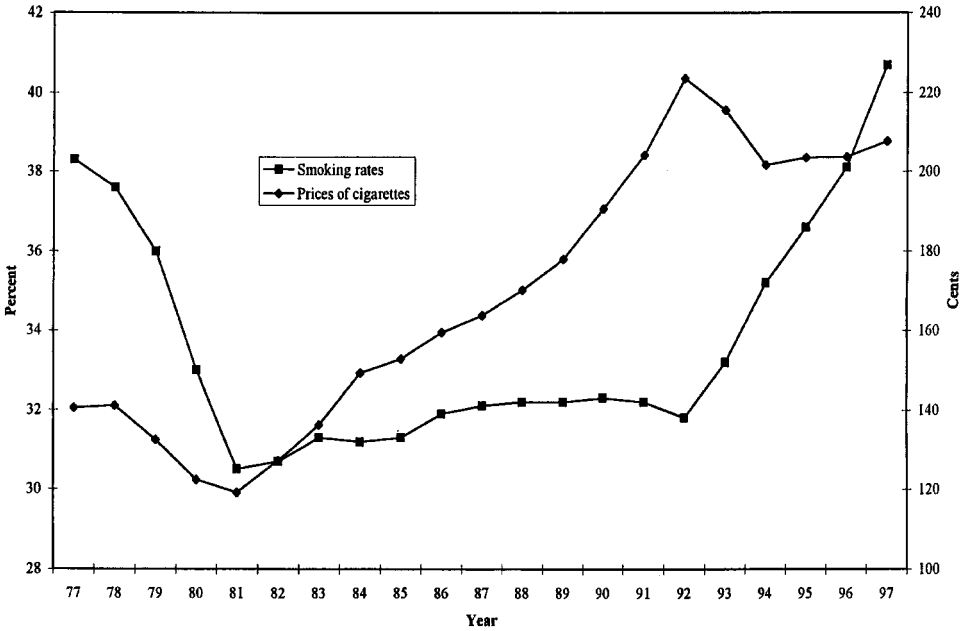

Figure 2. White youth smoking rates and prices of cigarettes.

cigarette prices. To help illustrate this point, the trends in the real price of cigarettes and youth smoking rates are plotted separately for white youth (Fig. 2), Hispanic youth (Fig. 3), and African-American youth (Fig. 4). The real cigarette price is a weighted average of state cigarette prices, where the weights reflect each state's share of the U.S. youth population in the specific racial or ethnic group. These plots of aggregate data provide no support for an argument that differences in the levels or trends of cigarette prices help explain different smoking rates across white, Hispanic, and African-American youth.

The few econometric studies that use micro-data to focus on racial and ethnic differences provide conflicting evidence about the price-responsiveness of cigarette demand across the groups. Based on analysis of data from the 1992–94 MTF surveys, Chaloupka and Pacula (1999) predict that a marginal increase in the price of cigarettes reduces the probability of smoking among whites by 0.14 percentage points among whites but only by 0.08 percentage points among African-Americans.[5] In contrast, the CDC's (1998) results suggest that there is virtually no effect of prices on the smoking participation among white youth but much stronger effects for African-American and especially Hispanic youth (CDC, 1998, Fig. 1, p. 608).[6] Similar to the CDC, in analysis of data from the 1991–97 MTF surveys Gruber (2000) does not find that price has a statistically significant effect on smoking participation among white youth, but finds a strong price response for nonwhites.

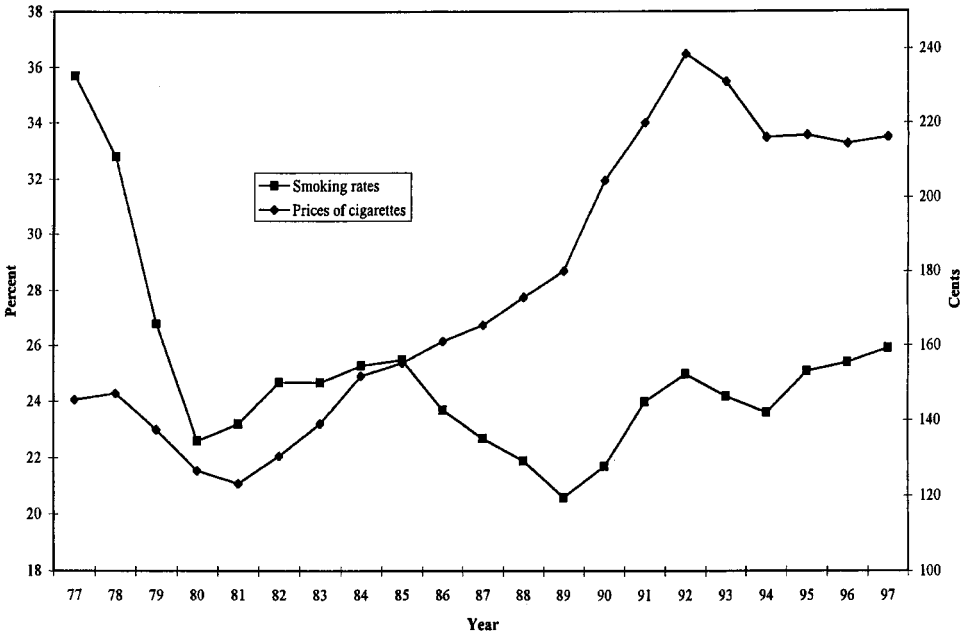

Figure 3. Hispanic youth smoking rates and prices of cigarettes.

Gruber's analysis of data from the Youth Risk Behavior Survey reveals a similar pattern, with a perhaps implausibly large price response for African-Americans (corresponding to a price elasticity of -9.3). However, Gruber's analysis of data on young women's smoking from the Vital Statistics Natality Detail Files suggests the opposite pattern: He finds almost no price responsiveness of smoking participation among African-Americans but a statistically significant price effect for whites. In sum, studies have explored the price-responsiveness of youth smoking participation by race and ethnicity using 5 different data sets. Three sets of results suggest that white youth smoking participation is much less price-responsive than for other groups, while two sets of results suggest the reverse.[7]

Even if consistent empirical evidence accumulates that youth smoking is more price-responsive among one ethnic or racial group than some other group, it would then raise the question of why. Standard economic theory simply does not provide much guidance on the price-responsiveness of consumer demand by race and ethnicity. Rather than focusing narrowly on the role of prices, a more fruitful approach is to consider insights of the economic approach to human behavior more broadly.

More basic to the economic model of human behavior than the "law of demand" is the idea that consumers make choices by comparing the perceived marginal benefits with the perceived marginal costs of each decision. Given other important

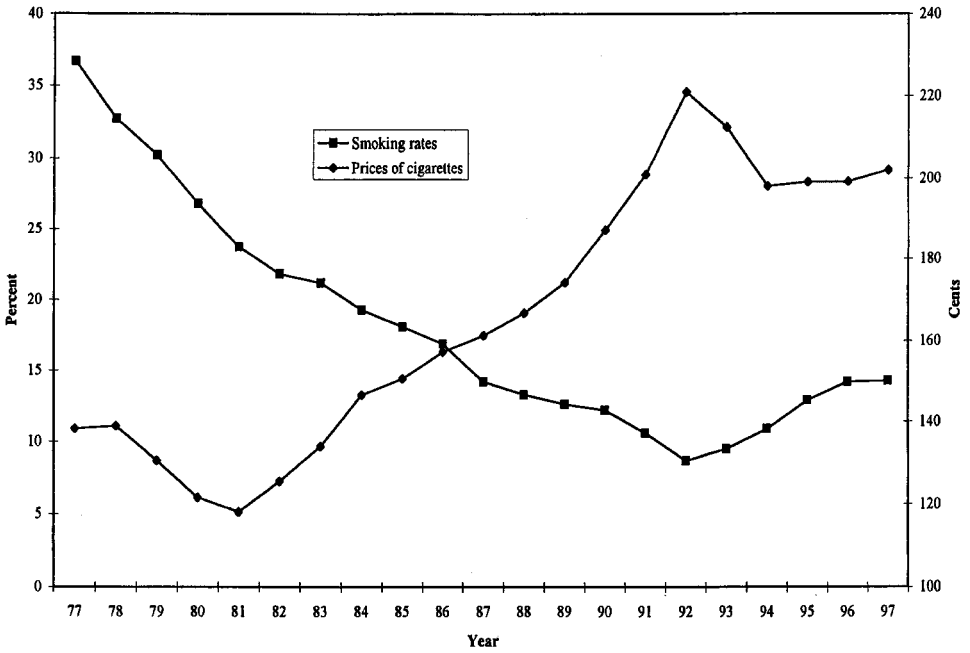

Figure 4. Black youth smoking rates and prices of cigarettes.

influences on the perceived marginal benefits and costs, the monetary price of cigarettes may play a relatively small role in youth smoking decisions. Summarizing research on psychosocial risk factors, the Surgeon General's report on preventing youth smoking concluded that the influence of peers plays a "powerful role," because "[s]moking initiation appears to be a component of peer associations and peer bonding in adolescence, as peer groups establish shared behaviors to differentiate themselves from other adolescents and from adults" (USDHHS, 1994). Tyas and Pederson (1998) extend the Surgeon General's report's analysis of psychosocial risk factors in a comprehensive literature review of studies published from 1984 to 1996. They also conclude that "One of the most consistent findings in the literature is that of the social influence of peers and others on adolescent smoking" (Tyas and Pederson, 1998, p. 416).

If peer influences are the major determinant of youth smoking, then the demand for cigarettes can be viewed as a derived demand. Cigarettes are smoked as one of several means to produce peer acceptance, which in turn, generates utility. Viewing cigarette demand in this fashion suggests that the responsiveness of smoking to the price of cigarettes will depend on a variety of factors not typically considered in the economics literature. More formally, consider a utility function in which individuals receive utility from peer acceptance (PA) and other goods (X). Peer acceptance is

produced by smoking (S) and other methods (Y). The consumer's problem is to maximize

$$U = U(PA(S, Y), X) \tag{1}$$

subject to a standard budget constraint

$$P_1S + P_2Y + P_3X = I$$

where P_1 is the price of cigarettes, P_2 is the price of other methods of producing peer acceptance, P_3 is the price of the consumption good, and I is income. The first order conditions are given by:

$$U_{PA} * PA_S - \lambda P_1 = 0 \tag{2}$$

$$U_{PA} * PA_y - \lambda P_2 = 0 \tag{3}$$

$$U_x - \lambda P_3 = 0 \tag{4}$$

The model provides an explanation for racial and ethnic differences in youth smoking behavior if the technology for producing peer acceptance varies with race and ethnicity. For example, some research suggests that whites are more strongly influenced by peer smoking than African-Americans (Tydas and Pederson, 1998). If smoking is relatively unproductive in producing peer acceptance (a low PA_S) among African-Americans, the model predicts their observed lower smoking rates. Similarly, if smoking the "wrong" brand of cigarettes is unproductive in producing peer acceptance, the model helps to explain the patterns of strong brand preferences among young smokers.

But the responsiveness of youth smoking to the price of cigarettes is complex in this model. Most importantly, the conditions set forth by the equality of (2) and (3) imply that the extent to which increases in the price of cigarettes will result in a decrease in the consumption of cigarettes will depend on PA_S and PA_y, the marginal impacts of smoking and other inputs into producing peer acceptance. If racial differences exist in the factors that produce peer acceptance, we would expect both different levels of smoking and different price elasticities across groups. To predict the precise pattern of price elasticities requires more information than is available about the technology of peer acceptance. In addition, given the obvious differences in the production function of peer acceptance for adults[8] and youth it becomes impossible to predict *a priori* whether youth or adults will be more price elastic.

The role of peer influences must also be considered when aggregating individual behavior (described by the model above) to describe the price responsiveness of group behavior. In Liebenstein's (1950) model of "bandwagon effects" in consumer demand, the demand for a commodity is increased when others are also consuming it. Liebenstein shows that consumer demand is more price elastic when there are

bandwagon effects. However, when there are "snob effects," where the demand for a commodity is decreased when others are consuming it, Liebenstein shows that consumer demand is less price elastic. Bandwagon and snob effects in youth smoking could be captured in the model by allowing the marginal productivity of smoking in producing peer acceptance (PA_S) to depend on the prevalence of smoking among peers and other adolescents. If higher prices reduce smoking in a peer group, there will tend to be a bandwagon effect (lower PA_S) with less peer pressure on any individual member of that group. But continuing to smoke at higher prices might make smoking a more effective way for members of one peer group to differentiate themselves from other adolescents. That is, a snob effect (higher PA_S) could operate making demand less price elastic. Without knowing whether bandwagon effects or snob effects are more powerful, it is impossible to predict whether peer influences make youth smoking more or less price elastic.

To our knowledge, economics does not have a complete theory of the formation of peer groups and their influence on youth consumer behavior. Development of such a theory is not the goal of this paper. Instead, our empirical study of racial and ethnic differences in youth smoking is informed by two simpler lessons we draw from the above discussion. First, peer effects appear to be more promising than price effects as a route to explain the striking differences in smoking behavior across racial and ethnic groups. Peer influences are widely recognized as key factors in youth smoking decisions, and race and ethnicity are often key factors in the formation of peer groups. The second lesson is that a focus on peer effects does not require abandoning the economic approach. Although we lack a complete model and a set of unambiguous predictions, the empirical analysis below is guided by the general argument that peer effects are usefully thought of as part of the reason youth onset into smoking.

2. Data and empirical approach

The main objective our study is to use panel data from the NELS:88 survey to examine the determinants of youth cigarette consumption and how these vary by race. Following a brief description of the NELS:88 data set, we describe the econometric specification and the main sets of explanatory variables that measure potential determinants of youth smoking.

2.1. Data

The National Education Longitudinal Study of 1988 (NELS:88) is a large-scale study which provides a variety of data regarding American 8th graders as they move through the school system and into early adulthood. The study administered questionnaires and subject-specific achievement tests to 24,599 eighth graders in more than 1,000 public and private schools in the spring of 1988. At that time, data

were also collected from the student respondents' parents, teachers, and school principals. Students are from diverse racial, sex, and ethnic backgrounds, with oversampling of certain groups.

NELS:88 continued with a second collection of information from these students in the spring of 1990 when most were high school sophomores, as well as a third collection when most were seniors. By design, NELS:88 staff re-sampled a subset of 21,474 members of the original 8th grade (1988) sample. Of the potential re-sample, 17,424 or 81.1 percent were successfully reinterviewed in 1990. In 1992, 16,489 individuals or 94.6 percent of those in both the 8th (1988) and 10th grade (1990) surveys were successfully re-interviewed. This last number represents the potential sample of students available in all three surveys. By focusing on individuals present in all three cross-sections we can estimate a discrete time hazard model of the determinants of the hazard of starting smoking.

There are several additional sample restrictions. Limiting the sample to white, Hispanic and African-American students reduces the sample size to 14,779. Restricting the sample to those to whom we can assign state of residence (so that they can be matched to state level prices and taxes) and to those with smoking information reduces the sample to 12,459. Additional restrictions due to missing data on other control variables reduces the sample to 10,893, with 8,546 observations on white students, 1,180 observations on Hispanic students, and 912 observations on African-American students.[9]

2.2. Discrete time hazard model of smoking onset

A discrete time hazard model focuses on the probability of starting to smoke. In this approach the sample consists of each individual who is at risk of the event occurrence (beginning to smoke) at each point in time (Allison, 1984). The dependent variable for the discrete time hazard model is based on the responses to the question: *How many cigarettes do you currently smoke in a day*? The possible response categories were 0, 1–5, 6–10, 11–40, and 40 or more.[10] Responses other than 0 are coded as a smoking participant. This measure tends to capture at least somewhat regular smoking, to the extent that youth who smoke experimentally or occasionally may answer that they currently smoke 0 cigarettes in a day.

In the NELS:88 sample, all 8th graders are assumed to be at risk of starting to smoke in 1988. The approximately 5 percent of the sample that started to smoke in 8th grade are by definition no longer at risk of starting to smoke in subsequent years.[11] All others are still at risk in the 10th grade and thus are included as another observation in the sample. Finally, all those who did not start to smoke in the 10th grade are still at risk in the 12th grade and continue to contribute to the sample. At the end of each wave of data the risk set is diminished by the number who experienced the event during that period. The dependent variable is the hazard rate, which is the probability that an event will occur at a particular time to a particular individual, given that the individual is still at risk at that time.

Separate hazard models are estimated for whites, Hispanics and African-American youth. Recalling that each youth remains in the sample as long as he or she is still at risk of starting to smoke, the sample sizes for the discrete time hazard models are 23,442 whites, 3,297 Hispanics, and 2,671 African-Americans.

The hazard model described by Eq. (1) can be thought of as a demand function for an addictive good at the beginning of the addiction.[12]

$$\begin{aligned}\text{Hazard}_i = {} & \alpha_0 + \alpha_1 \textit{Grade}_i + \alpha_2 \text{Cigarette Price}_i + \alpha_3 \textit{Youth Control Variables}_i \\ & + \alpha_4 \text{Eventual Dropout}_i + \alpha_5 \textit{Older Kid Peer Exposure}_i \\ & + \alpha_6 \text{Acculturation Variable}_i, \\ & + \alpha_7 \textit{State Fixed Effects}_i + c_i \end{aligned} \tag{1}$$

Standard maximum likelihood techniques (probit) are used to estimate Eq. (1) separately for whites, African-Americans, and Hispanics. The right-hand side of Eq. (1) includes measurable demand influences that are likely to affect the probability that the youth will start smoking. Variables including grade and the cigarette tax rate are time varying and take different values when the youth is in 8th grade, 10th grade, and 12th grade. Most of the demographic variables are time invariant and measured when the youth is in the 8th grade. As discussed below we use the state of residence of the respondent to merge state level prices to each individual. Since youth residing in the same state are assigned identical prices we utilize a robust estimation technique that accounts for the potential state level clustering of the errors.

2.3. Cigarette prices and state of residence

With restricted use data (attained through special licensure with the National Center for Education Statistics) we are able to link individual NELS:88 respondents to the states in which they reside. This allows us to examine the impact of cigarette prices and the youth's state of residence on the probability of starting to smoke. We merged data on prices in 1988, 1990, and 1992 from the Tobacco Institute (1993) with the NELS:88 data.[13] When states changed tax rates during the year, the Tobacco Institute price data will be different from the price faced by individuals in that state when the NELS:88 survey was administered. Prices reported from the Tobacco Institute are from November but the NELS:88 surveys were conducted over several months prior to the summer. In 1990 and 1992 the NELS:88 data set includes information on the interview month. All tax increases that occurred between the interview date and November of that year are subtracted from the Tobacco Institute price measure. In 1988 the interview month was not available, so tax increases that occurred after the summer (when the interview process was essentially over) and November are subtracted from the 1988 Tobacco

Institute price measure. These adjustments provide better measures of the prices faced by NELS:88 respondents, assuming that all tax increases are passed through to higher prices on a one-to-one basis. The results are not particularly sensitive to these adjustments, probably because there were only a few states that passed tax increases between the interview dates and November of the respective years. We also merged state taxes to the NELS:88 data and re-estimated the models replacing cigarette taxes with cigarette prices. The results (available upon request) are similar to those reported below.[14]

A potential problem is that residents of states with high cigarette prices may be able to purchase cigarettes from nearby states with lower prices (Saba et al., 1995). If this avenue is open to youths, our estimated elasticities will be biased towards zero. However, although cross-border purchases of cigarettes appear to be significant for adults, they should be much less common for youths, many of whom will not be licensed drivers, have access to a car, or make regular trips out of state. The empirical results of Lewit, Coate and Grossman (1981) lend additional support to the argument that border crossing can be neglected when estimating youth smoking demand.[15]

Equation (1) describes a discrete time hazard model with state fixed effects.[16] The state fixed effects are included to capture the influence of unobserved differences across states in tobacco control policies and anti-smoking sentiment. Since we have panel data there are three observations on prices for individuals (the prices they faced in 8th, 10th, and 12th grade) within a state. This allows us to examine the impact of prices on smoking onset within states rather than across states thereby providing some control for unobserved state heterogeneity. The use of state fixed effects, however, require sufficient within state variation in order to identify the impact of prices on behavior. The time period covered by the NELS:88 panel, 1988 to 1992, is particularly useful in this regard. There was within state price variation due to natural market forces, and in 28 states this price variation was reinforced by increases, of various size, in state cigarette excise taxes.

Most previous studies rely on cross-sectional variation in cigarette taxes or prices to identify the price-responsiveness of youth smoking demand. One problem with utilizing cross-sectional data is the possibility that some of the right hand side variables, such as prices and taxes, are correlated with the unobservable heterogeneity across states. This heterogeneity can result in biased estimates. For example, cigarette taxes and prices may be high in states with strong anti-smoking sentiment, so the estimated effects of taxes or prices reflect the influence of anti-smoking sentiment on youth smoking decisions, rather than the true impact of prices and taxes. To explore the importance of this potential bias, for comparison purposes we estimate and report a second specification (Model 2) of the discrete time hazard models of starting smoking that omits state fixed effects or other controls for state-level influences. As will be seen when we describe the results the inclusion of state fixed effects has an important impact on the size of the estimated coefficient and does not simply inflate the standard error of the coefficient This suggests that it is useful and important to include these fixed effects in the model.

The number of African-American youth in our sample is small, making it infeasible to include state fixed effects. As an alternative to state fixed effects, for the African-American sub-sample we include variables that more fully capture the state- specific policy environment. Model (1) for the African-American sub-sample includes a set of three measures of smoking-related state legislation as explanatory variables in the smoking demand functions. These variables are based on information from Jacobson and Wasserman (1997). The first is an index of restrictions on smoking in public places such as workplaces and restaurants. The second is an index of restrictions specific to youth smoking, including limitations on cigarette vending machines and licensing requirements for cigarette vendors. The third variable indicates if the state had passed legislation banning discrimination against smokers. Similar variables have been used in some recent studies (e.g. Wasserman et al., 1991; Chaloupka and Grossman, 1996) but not in others (e.g. Evans and Farrelly, 1995; Evans and Huang, 1998).[17] In addition, we include the region variables in the equation for African-Americans to capture unobserved heterogeneity by region.

2.4. Academic success

The NELS:88 data provide several valuable measures related to high school students' success in academics. Previous studies establish a strong link between schooling and smoking by adults (e.g. Farrell and Fuchs, 1983; Kenkel, 1991). The NELS:88 data on smoking by provides an opportunity to further explore whether this relationship is already apparent among youth in 8th, 10th and 12th grades. The first measure of academic success is the student's composite score on a math/reading ability test.[18] The second measure is the student's status as a high school dropout. The panel nature of the data allow us to specify, even when students are in the 8th grade, whether they eventually dropout of high school.[19] Thus the hazard rate equation includes a dummy variable for whether the individual eventually drops out of high school. The last measure related to academic success is the youth's birth year, because controlling for grade school different birth years may indicate delayed or accelerated academic progression.

2.5. Family background

The vector *youth control variables* includes a number of factors including family income, whether the mother's and father's occupation is professional, whether the youth is from an intact family, urban or suburban residence, religion, and the number of individuals in the family.[20]

If cultural factors account for some of the differences between the smoking behavior of whites and Hispanics, the degree to which Hispanic youth assimilate into the white culture can be an important determinant of the hazard of starting to

smoke. To incorporate a measure of degree of acculturation for Hispanic youth, the hazard model includes a variable indicating whether Spanish is spoken in the home. We would expect that students from families where Spanish is spoken to have retained more of their specific Hispanic cultural identity and to behave less like their white counterparts. In this case we would expect Hispanic youth where Spanish is spoken in the home to smoke less than other Hispanic youth.[21]

2.6. Peer influences

As discussed above, the influence of peers is widely recognized as playing a powerful role in youth smoking behavior (USDHHS, 1994; Tyas and Pederson, 1998). However, identifying causality is extremely difficult. Peer groups may be endogenous, for example if youth choose peers with smoking habits like their own (Norton, Lindrooth and Ennett, 1998). Or in an even more complex model, youth may choose peers with preferences like their own (e.g. for rebellion against authority), with the peer group cooperatively establishing shared behaviors such as smoking or not smoking that reflect the preferences of typical members of the group. Lacking a structural model of peer group formation and behavior to provide an identification strategy, we focus instead on identifying factors that may provide exogenous variation in peer influences.

Two variables measure exposure to older students, which can influence cigarette consumption through both peer influences on the demand side and availability influences on the supply side. On the demand side, adolescents may seek to become more like their older counterparts. On the supply side, older students can be a source of supply for younger students, especially since 12th graders who are 18 years of age can legally purchase cigarettes in many states. The first variable included in the analysis is the number of older siblings the student has in their family. The second exogenous variable measures the number of older kids that the student goes to school with. Within the NELS:88 data there are a variety of school structures. Some 8th graders are in schools where they are the oldest kids in their school while other 8th graders are the youngest kids in the school. The second variable included in the analysis is whether there are older kids in the school when the student was in 8th grade.

3. Results

Table 1 provides descriptive statistics of the data used in analysis, while Table 2 provides the estimated hazard models for whites, Hispanics, and African-American. Table 2 presents the results of two models for each group. Model (1) includes state fixed effects or other state-level controls to account for state-level influences on youth smoking such as prevailing anti-smoking sentiment, while Model (2) omits these variables. As will be discussed in more detail below, the results of Model (1)

Table 1. Descriptive statistics

	White youth		Hispanic youth		African-American youth	
	Mean	S.D	Mean	S.D	Mean	S.D
Smoke	0.1148	0.319	0.0925	0.290	0.0352	0.184
Cig. price	146.254	20.633	153.8015	22.0025	143.2527	20.912
Grade 12	0.2900	0.454	0.2991	0.458	0.3209	0.467
Grade 10	0.3454	0.476	0.3430	0.475	0.3377	0.473
Born 1972	0.0231	0.150	0.0573	0.232	0.0895	0.286
Born 1973	0.2723	0.445	0.2824	0.450	0.2984	0.458
Born 1974	0.6960	0.460	0.6518	0.476	0.6009	0.490
Male	0.485	0.500	0.4443	0.497	0.4354	0.496
Rural	0.2054	0.404	0.3812	0.486	0.3531	0.478
Suburb	0.4346	0.496	0.4046	0.491	0.3006	0.459
Northeast	0.2085	0.406	0.0983	0.298	0.1239	0.330
Midwest	0.3375	0.473	0.1253	0.3310	0.1516	0.359
West	0.1416	0.349	0.4286	0.495	0.0487	0.215
Test score	54.2723	9.440	47.8504	8.947	45.9332	8.755
Catholic	0.3209	0.467	0.7040	0.456	0.0884	0.284
Protestant	0.5736	0.495	0.1823	0.386	0.8237	0.381
Eventual drop out	0.0353	0.184	0.0925	0.290	0.0786	0.269
Income	49,619.7	40,182.91	29,587.28	26,167.98	25,442.16	23,176.19
Mom professional	0.1764	0.381	0.0813	0.273	0.1235	0.329
Dad professional	0.2020	0.4015	0.0974	0.296	0.0970	0.296
Family size	4.0331	1.478	4.6676	1.649	4.6765	1.779
Number of older sibs	1.2480	1.478	1.5839	1.725	1.8083	1.944
Intact family	0.8464	0.361	0.7756	0.4173	0.5447	0.498
Older kids in 8th grade school	0.3695	0.483	0.1920	0.394	0.2572	0.437
Spanish in home			0.4992	0.500		
Number of observations	23,442		3,297		2,671	

Data source: NELS88 sample—8th, 10th and 12th grade surveys.

that include controls for anti-smoking sentiment are seen as more reliable; the results of Model (2) that excludes state fixed effects or other controls are presented for comparison purposes only.

In order to better understand the relative importance of different factors in explaining the hazard rate of smoking for each racial/ethnic group, Table 3 presents the predicted hazard rates from the discrete time hazard model under a variety of scenarios. The baseline hazard reported in Table 3 is the hazard rate

Table 2. Discrete time hazard models of smoking onset

	White youth		Hispanic youth		African-American youth	
Variable	Model (1) coefficient (t-value)	Model (2) coefficient (t-value)	Model (1) coefficient (t-value)	Model (2) coefficient (t-value)	Model (1) coefficient (t-value)	Model (2) coefficient (t-value)
Intercept	−1.4965	−1.1280	−1.4088	−1.0458	−0.9252	−0.8335
	(−4.78)**	(−5.76)**	(2.91)**	(−2.38)**	(−1.23)	(−1.36)
Cigarette price	0.000053	−0.0016	−0.0086	−0.0096	−0.0059	−0.0066
	(0.01)	(−1.48)	(−1.98)**	(−3.07)**	(−1.18)	(−1.54)
Year 12	0.6112	0.6681	1.0148	1.0056	0.8628	0.8822
	(6.25)**	(11.91)**	(4.70)**	(5.97)**	(3.83)**	(4.23)**
Year 10	0.6813	0.6995	0.8493	0.8257	0.7630	0.7679
	(13.66)**	(18.65)**	(8.90)**	(7.85)**	(5.11)**	(5.29)**
Born 1972	0.5179	0.5055	−0.0112	0.1308	NA	NA
	(2.49)**	(2.44)**	(−0.04)	(0.37)		
Born 1973	0.5706	0.5455	−0.1212	−0.028	−0.0884	−0.0989
	(3.39)**	(3.29)**	(−0.40)	(−0.09)	(−0.47)	(−0.55)
Born 1974	0.5298	0.5097	−0.1681	−0.0770	−0.1295	−0.1208
	(3.16)**	(3.07)**	(−0.61)	(−0.24)	(−0.84)	(−0.79)
Male	−0.0227	−0.0239	0.0600	0.0620	0.2086	0.2003
	(−0.97)	(−1.00)	(0.83)	(0.96)	(1.87)*	(1.81)*
Rural	0.0855	0.0729	0.0787	−0.0490	−0.0640	−0.0756
	(1.63)	(1.47)	(0.46)	(−0.51)	(−0.41)	(−0.48)
Suburb	0.0723	0.0568	0.0152	−0.1083	−0.0139	−0.0138
	(2.25)**	(1.79)*	(−0.19)	(−1.16)	(−0.12)	(−0.11)
Northeast	NA	−0.0122	NA	0.2556	0.2935	0.4160
		(−0.30)		(2.21)*	(1.59)	(2.46)**
Midwest	NA	−0.0039	NA	0.0519	0.1543	0.2415
		(−0.11)		(0.48)	(0.90)	(1.35)
West	NA	−0.1642	NA	0.0432	−0.0380	0.1388
		(−2.70)**		(0.52)	(−0.17)	(0.97)
Test score	−0.0153	−0.0156	−0.0089	−0.0078	−0.0100	−0.0102
	(−11.62)**	(−11.80)**	(−3.00)**	(1.95)*	(−1.50)	(−1.51)

Catholic	0.0186	0.0394	0.0096	0.0367	−0.0798	−0.0800
	(0.42)	(0.92)	(0.12)	(0.43)	(−0.36)	(−0.39)
Protestant	0.0488	0.0596	0.1291	0.1436	−0.3036	−0.3121
	(1.37)	(1.75)*	(1.08)	(1.49)	(−1.96)**	(2.06)**
Drop out	0.6172	0.6177	0.4789	0.4040	0.2702	0.2744
	(10.46)**	(10.52)**	(5.54)**	(3.94)**	(1.60)	(1.61)*
Income	0.0000005	0.0000005	0.0000017	0.0000025	0.0000010	0.0000012
	(1.41)	(1.53)	(1.43)	(1.86)*	(0.40)	(0.46)
Mom profess.	−0.0067	−0.0083	0.0044	−0.0665	−0.1399	−0.1467
	(−0.19)	(−0.23)	(0.03)	(−0.53)	(−0.88)	(−0.91)
Dad profess.	0.0522	0.0499	0.0438	−0.0365	0.0696	0.0635
	(1.52)	(1.46)	(0.28)	(−0.32)	(0.42)	(0.38)
Family size	−0.0110	−0.0131	−0.0387	−0.0267	0.0038	0.0045
	(−0.95)	(−1.14)	(−2.03)**	(−1.03)	(0.10)	(0.12)
Number of older sibs	0.0485	0.0478	0.0446	0.0412	0.0227	0.0233
	(4.79)**	(4.81)**	(2.89)**	(1.74)*	(0.62)	(0.65)
Intact family	−0.1804	−0.1805	0.02071	−0.0338	−0.1926	−0.1949
	(−5.55)**	(−5.81)**	(0.77)	(−0.41)	(−1.93)*	(1.96)**
Older kids in 8th grade	0.0232	0.0331	0.0788	0.0415	−0.1724	−0.1576
	(0.78)	(1.16)	(1.19)	(0.50)	(−1.62)	(−1.56)
Spanish in home			−0.1335	−0.1476	NA	NA
			(1.70)*	(−2.13)**		
Youth restriction					−0.0838	
					(−0.95)	
Adult restriction					0.0933	
					(1.84)*	
Non-discrimination					0.0116	
					(0.11)	

Note: For whites and Hispanics Model (1) includes state fixed effects. In the case of whites 4 observations were eliminated from the fixed effect model because there was no variation in smoking behavior within a state. For the Hispanics fixed effect model there were 53 observations eliminated for this reason. The results of Model (2), which omits state fixed effects, are presented for comparison purposes. Because of the limited sample size and the limited number of smokers in the African-American equation state-fixed effect modeling was not possible. Instead the region variables are included as well as state tobacco regulation variables.

Table 3. Predicted smoking hazard rates under various scenarios

Scenario	White	Hispanic	African-American
Baseline hazard[a]	.1651	.1727	.0784
Price increase of $0.20	.1654	.1322	.0625
Price increase of $1.10	.1665	.0291	.0195
Price increase of $1.50	.1671	.0126	.0107
High school dropout	.3607	.3216	.1259
Intact family	.1242	.1781	.0539
Utah	.0779	not available	(west) .0403
North Carolina	.1821	not available	(south) .0437
Virginia	.2110	.5152	(south) .0437
Tennessee	.1599	.1408	(south) .0437
Poor academic performance[b]	.4194	.3537	.1489
12th grade	.1483	.2183	.0940
8th grade	.0490	.0370	.0147
Spanish in home	not available	.14083	not available
Average[c]	.115	.094	.035

[a] Baseline hazard is the predicted hazard rate of starting to smoke based on a particular set of values for the independent variables and the coefficient estimates from the models with fixed effects (or in the case of the African-American equation the state regulation variables). The values for the independent variables assume a price of 1.46 per pack of cigarettes, an non-intact family, in the 10th grade, from the city, a math/reading score of 54, New York State (for African-American equation—students living in the northeast), high school graduate, neither parent being a professional worker, from a school where there were no older kids in their 8th grade school, were born in 1974, family size of 4 with one older sibling, and family income of $40,000. The rows below the baseline hazard are the predictions when the baseline values are changed on that particular dimension.

[b] Poor academic performance is when high school dropout is set equal to 1 and 10 (approximately one standard deviation) points are taken away from the standardized test score on reading/math.

[c] Average is the average of each sample members' predicted hazard based on their values of the independent variables.

predicted given a particular set of values for the independent variables and the coefficient estimates from Model (1) for each sub-group. In effect, this provides a case study of the predicted hazard rate for a youth with the specified characteristics. Table 3 also reports the predicted hazard rate under different scenarios, when certain of the baseline characteristics are changed. Comparing the predicted hazard rates for different scenarios illustrates the magnitude of the effects of different characteristics on youth smoking probabilities. The last row of Table 3 also reports the average hazard rate, which is the average of sample members' predicted hazard rates based on their values of the independent variables. This essentially duplicates the average hazard rate for the sample, and is provided as a check of the performance of the estimated models.

3.1. Broad patterns

Before turning to more complicated patterns in the results, the descriptive statistics and econometric results document some broad patterns. The descriptive statistics provide an overview of the smoking behavior and other characteristics of whites, Hispanics and African-American youth in the NELS:88 sample. The mean of the dependent variable, ANYSMOKE, is the average hazard rate, which by definition is lower than the smoking prevalence rate used in many other studies. However, comparing hazard rates across groups reveals a pattern similar to the results from other national data sets, namely that white youth smoke more than Hispanic, who in turn smoke more than African-Americans. The average hazard rate for whites is almost three times that of African-Americans.

There are other differences across the sub-samples of youth. White youth are from smaller families with higher incomes and with a higher percentage of parents in professional occupations. There are also differences in reading/math scores across the race/ethnic groups, with whites having higher scores on average. The distribution of the students across the states results in average cigarette prices differing across the sub-samples. Interestingly, although African-American students have the lowest hazard of starting to smoke, they also live in states with the lowest prices.

Some broad patterns results also emerge from the econometric results. Comparing the baseline hazard rates reported in Table 3 across white, Hispanics, and African-Americans shows the importance of observable characteristics in explaining differences in youth smoking. For example, whether Hispanics or whites are predicted to have higher hazard rates depends on the particular set of observable characteristics. Under the set of characteristics used in the baseline hazard (the first row of Table 3) the differences across the groups' average hazard rates are more pronounced than the differences in the predicted baseline hazards. As noted above, on average white, Hispanic, and African-American youth in the sample are different in observable ways, which is reflected in their different average hazard rates of starting to smoke. The case study represented in the baseline hazard rate eliminates this effect and reduces the differences across the groups. Most strikingly, while the average hazard rate for Hispanic students is below that of whites the baseline hazard is actually higher for Hispanic students. In other words, the predicted hazard of starting to smoke for a Hispanic youth and a white youth with this particular set of identical characteristics is higher for the Hispanic. The average hazard rate for Hispanics is lower because, among other differences, Hispanics tend to live in different states than whites, face different prices, and face potentially different attitudes toward smoking. Each row of Table 3 represents a different case study in that the set of common observable characteristics is altered on an important dimension.

Another broad pattern from the econometric results is that for all three race groups the hazard rate is lowest for 8th grade students. As reported in Table 2, the coefficients on YEAR10 and YEAR12 are large and statistically significant. The

progression in hazard rates differ across groups, however. From Table 3 the predicted hazard rate in 8th grade (.049) is less than one-third as high as in 10th grade (.1651—the baseline case) for whites. The results largely reflect the fact that smoking onset initially increases with age. However, it should be recognized that while the *prevalence* of smoking increases over the life cycle until quitting behavior becomes important at much older ages, the *hazard of starting* to smoke follows a different pattern. Youth who start to smoke at younger ages are no longer in the sample of those at-risk of starting to smoke, which explains why the predicted hazard rates for whites is smaller for youth in 12th grade (.1483) than in 10th grade. For Hispanics and African-American youth the predicted 12th grade hazard is higher than the predicted 10th grade hazard (the baseline).

The last broad pattern to be noted from the estimated hazard models is that gender differences in the hazard of starting to smoke are only apparent among African-Americans, where males are more likely to start smoking than females. The estimated coefficients on MALE in the hazard models for whites and Hispanics are not statistically significant.

3.2. Cigarette prices and state of residence

The results presented in Tables 2 and 3 suggest that higher cigarette prices do not reduce the hazard rate of starting to smoke among white youth. From Table 2, for the white sub-sample controlling for state fixed effects the estimated coefficient on the price variable is positive but very close to zero and statistically insignificant. Because of the positive coefficient, in Table 3 increases in cigarette prices are predicted to increase the hazard rate of starting to smoke among white youth trivially. However, this result probably should not be taken seriously because the predictions are based on a statistically insignificant coefficient.

As reported in Table 2, the estimated relationships in model (1) for Hispanics and African-Americans between cigarette prices and the hazard of starting to smoke is statistically significant only for the Hispanic sample. However, although the coefficients are estimated imprecisely in the African-American equation, they are negative and large. As a result, in Table 3 increases in cigarette prices are predicted to dramatically reduce the hazard rates for both Hispanic and African-American youth smoking. For Hispanic students, a 20 cent increase in the price reduces the hazard rate from 17.3 percent to 13.2 percent. Tax increases like those proposed by the Clinton administration in 1998 and 1999 are predicted to virtually eliminate smoking among Hispanic youth. The results for African-American youth also indicate a potentially large effect though the coefficient that drives these results is not statistically significant.

For all three racial/ethnic groups, comparing the results for models (1) and (2) demonstrates the importance of controlling for hard-to-observe state effects when estimating the effect of cigarette prices on youth smoking. For all three groups, in model (2) the estimated coefficient on the price variable is always negative, and while it is statistically significant at conventional levels only for the Hispanic

sub-sample it could be considered on or near the borderline for whites and Hispanics.[22] The estimated coefficients on the price variable in model (1) are less precise than in model (1), but also move closer to zero (and in the white subsample actually becomes positive). Comparing to model (1), estimates from model (2) are subject to bias if cross-sectional variation in cigarette prices reflects unobserved heterogeneity that is correlated with smoking onset.

Examining the coefficients on the state fixed effects provides clues as to the nature of unobservable heterogeneity across states. In the white equation, the dummy variables for each of the tobacco producing states (Virginia, North Carolina, Kentucky, West Virginia, and South Carolina) have positive coefficients, indicating that hazard rates in these states are higher than would otherwise be predicted. The estimated coefficients on the dummy variables for these states are among the largest estimated state fixed effects.[23] These large coefficients probably reflect the fact that in tobacco-producing states there is weaker anti-smoking sentiment, which in turn results in higher than predicted smoking rates for youth in these states. These states also have some of the lowest cigarette taxes and cigarette prices. Thus, if state fixed effects are not controlled for, these differences are attributed to the impact of cigarette prices on smoking onset. More generally, the states with positive coefficients have significantly lower cigarette taxes and prices, which shows the importance of including state fixed effects or some alternative measure of unobserved heterogeneity across states into the model.[24]

The importance of unobserved heterogeneity across states is further illustrated through predicted hazard rates reported in Table 3. The baseline hazard rate corresponds to a youth living in the state of New York. For a white youth with identical characteristics but living in the tobacco-producing state of Virginia, the predicted hazard rate increases by almost 5 percentage points, from 16.5 percent to 21.1 percent. For a youth with identical characteristics residing in Mormon-influenced Utah, the smoking hazard rate drops to 7.8 percent. Another interesting aspect of these results is the difference in the state effects for Hispanic and white youth. For a Hispanic youth, the difference between New York state residence and Virginia residence is an almost 34 percentage point increase in the smoking hazard rate, from 17.3 percent to 51.5 percent.[25] In terms of the magnitude of the differences in predicted hazard rates, the youth's state of residence emerges as one of the most powerful determinants of the hazard of starting to smoke. It is worth re-iterating that these predictions shed light on the marginal effect of changing state of residence holding other observed determinants, including cigarette prices, constant.

3.3. Academic success

Overall academic success is strongly associated with lower smoking onset for white youth, but less so for African-Americans and Hispanics, at least with respect to the measures used in this analysis. White youth with lower scores on the standardized

tests for Math/Reading are statistically significantly more likely to start to smoke. Among whites, youth who drop out of high school between the 8th and 12th grade also have significantly higher smoking rates than students who graduate high school. In addition, controlling for grade in school, among whites older youth have higher hazard rates of starting to smoke. This partly reflects the impact of age on the probability of starting to smoke, but may also reflect the impact of unobserved academic performance on smoking onset rates. Most students in 8th grade in 1988 were born in 1974, suggesting that those 8th graders born in 1975 (the omitted category) may have skipped a grade while those born in 1972 or 1973 may have been held back. Unlike the results for whites, for Hispanics and African-Americans the estimated relationships between smoking onset and the various measures of academic success are weaker and not as consistently statistically significant.

The predictions reported in Table 3 illustrate the magnitude of the relationship between academic success and smoking onset among whites, and further support the argument that the relationship between academic success and youth smoking behavior appears to be different across the different racial/ethnic groups. Poor academic performance is measured by assuming a student is a high school dropout and scores 10 points less (approximately one standard deviation) on the standardized math/reading score than in the baseline hazard prediction. Poor academic performance is predicted to lead to a 25.4 percentage point increase in the hazard rate for white youth, from a baseline of 16.5 percent to 41.9 percent. Poor academic performance is predicted to lead to a 18.1 percentage point increase in the hazard rate for Hispanic youth (from 17.3 percent to 35.4 percent), and a 7.1 percentage point increase among African-American youth (from 7.8 percent to 14.9 percent). The predicted effects of poor academic performance on smoking onset among Hispanics and African-Americans are smaller than for whites but still dramatic: expressed as a percentage of the baseline hazard rate, poor academic performance is predicted to increase the hazard rate of beginning to smoke by over 150 percent for whites, about 100 percent for Hispanics, and about 90 percent for African-Americans.

The relationship between academic success and the hazard of starting to smoke is open to several interpretations. One possibility is that higher ability students smoke less because they have a better understanding of the eventual health consequences (Kenkel, 1991; Viscusi, 1992). An alternative explanation is that both academic success and smoking behavior reflect an unmeasured factor like the individual rate of time preference that leads some individuals to invest more in the future through both health and human capital. However, neither of these interpretations provides an obvious reason to expect that the relationship between academic success and smoking should be different across racial and ethnic groups. An empirical pattern noted by Hersh (1998) may provide a clue. Nonwhite youth appear to be less likely than white youth to consider smoking an addiction (Hersh, 1998, Table 5). This suggests that nonwhite youth are more likely to view smoking as a current consumption good with fewer long-term health consequences because quitting is seen as easier. In this scenario, the rate of time preference, as proxied

by academic success, could be expected to have a weaker influence on smoking decisions. Obviously, this explanation for the weaker relationship between academic success and smoking for nonwhites is highly speculative.

The estimated relationships between smoking hazard rates and the variables related to academic success might be different across groups because the variables have different meanings for whites, Hispanics, and African-Americans. Most obviously, the usefulness of using test scores to measure academic ability across different racial/ethnic groups is often questioned. In the educational testing literature there is some consensus that standardized tests are reasonably good predictors of future academic success. Much of this literature has focused on the type of multiple choice standardized tests that were administered to NELS:88 participants. For example, the SAT has been found to be a good predictor of future academic success (Shepard, 1993) and even better than high school grades in explaining future academic success (Stricker, 1991; Morgan, 1989; Donlon, 1984; Wilson, 1983). However, while there is some agreement that standardized tests like those administered by NELS:88 are reasonably good predictors of future academic success, there is less evidence when validity is examined by race. In general, the SAT seems to predict future academic outcomes better for whites relative to African-Americans and Hispanics (Shepard, 1993). However, the extent of this relationship is subject to some debate. Some studies suggest that there are differences in predictive validity between whites and various minority groups (Pennock-Roman, 1988; Duran, 1989; Nettles et al., 1986; Duran, 1983) while others refute this (Pennock-Roman, 1990; Wilson, 1978; Goldman and Hewitt, 1976).

While no clear pattern has emerged, these racial differences in predictive validity tend to occur more often with respect to the verbal section of the SAT relative to the mathematics section. Recent evidence, in fact, cautions that the SAT may not be a particularly good predictor of verbal ability of Hispanics, especially those whose primary language is not English (Pearson, 1993; Pennock-Roman, 1990; Schmitt, 1988). Given these results we re-estimated the Hispanic equation using only the math score from the standardized test instead of the math/reading composite score. However, the coefficient on the math score is about the same as the coefficient on the composite math/reading score, still suggestive of a weaker relationship between academic success and smoking among Hispanics than whites.

The other measures of academic success—eventual drop-out status and birth year (controlling for grade in school)—are not subject to precisely the same concerns about reliability and validity across racial and ethnic groups. However, given different rates of high school attrition and progression through grades across the groups, these variables may not be as good proxies for variables like health knowledge or individual time preference among Hispanics and African-Americans. Another interpretation is that these variables more generally signal somewhat different experiences, peer groups, and so on across the different racial and ethnic groups.

3.4. Family background

The estimated hazard models also reveal some differences in the importance of family background in explaining the hazard of starting to smoke across racial and ethnic groups. In general, measured aspects of family background are more important predictors of the hazard rate for white youth than for Hispanic and African-American youth. Among whites, the following factors are estimated to increase the hazard rate of starting to smoke: residence in a suburban area rather than an urban area; and a non-intact family. Of these factors, only family income emerges as a possibly important determinant of Hispanic smoking. The only one of these factors that emerges as an important determinant of African-American smoking is the measure of a non intact family environment.

Interestingly, religious affiliation is estimated to have a different impact across the groups. Among African-American youth, affiliation with a Protestant religion has a strong association with lower smoking hazard rates, but the results suggest that a Protestant affiliation increases the probability that white youth start to smoke though this latter result is not statistically significant.

For Hispanic youth, a marginally statistically significant negative coefficient on the variable that indicates whether Spanish is spoken in the home indicates a lower hazard rate of starting to smoke for youth in such homes. This variable was included to proxy for the degree of acculturation. Children of families who speak Spanish in the home may be less influenced by their white peers since they may associate more with the Hispanic culture. Given the different rates of smoking between whites and Hispanics, those who associate more with Hispanic culture are hypothesized to be less likely to start smoking, but this hypothesis is only modestly supported in the data.

Hersh (1998) reports that smoking rates are much lower among both white and nonwhite youth who live in households where smoking is not permitted. While NELS:88 does not contain a measure of whether smoking is permitted in the household, some of the patterns discussed above may be related to this effect. However, this effect does not necessarily help explain the differences across racial and ethnic groups in the importance of the family background variables as determinants of youth smoking.

3.5. Peer influences

The results provide some indications that exogenous peer influences are important determinants of youth smoking behavior, and again suggest some racial and ethnic differences in the roles of these determinants. The number of older siblings increases the hazard of starting to smoke for all three groups. This result is statistically significant for Hispanics and white youth but not so for African-Americans. There are no statistically significant results suggesting that smoking

hazard rates are increased due to school structures that expose 8th graders to older kids.

4. Conclusions

In this paper we use a rich panel data on adolescent smoking to develop estimates of the determinants of smoking onset and how these vary by race and ethnicity. There are several conclusions that emerge from this analysis.

First, the association between academic success and smoking rates varies by race. Among white youth, those who are more successful academically have significantly lower rates of smoking compared with other whites. This relationship is not as strong for Hispanics and African-Americans. It is not clear why these results emerge and future research may focus on why this association differs across groups. One speculation is that when there are a very few members of a minority group in a school, minority status becomes the main social identifier and the members do not sort themselves socially based on academic success. If this is true, we would expect a weak link between academic success and smoking when students are minorities within a school rather than simply a student from a minority group. Schools that are segregated are likely to create social sorting mechanisms that are not based on race since the schools are homogeneous on this dimension. This is an important avenue for future research.

Second, the evidence from the NELS:88 data suggests that increases in taxes will be largely ineffective in reducing smoking onset for the majority of students in the sample. Controlling for state fixed effects, there is no evidence that higher cigarette prices deter youth smoking onset for whites. Because whites comprise a majority of the population, these results question the general effectiveness of tax policy to stem the rising trend in youth smoking rates. The importance of the state fixed effects also suggests that other studies that fail to include them or similar controls yield potentially biased estimates. DeCicca, Kenkel and Mathios (2000) and Kenkel and Mathios (2000) address this in more detail. The results for Hispanics and African-Americans provide some support that higher taxes will reduce smoking in these populations, because the imprecisely estimated effects are suggestive of a potentially high degree of price-responsiveness. However, previous studies provide conflicting evidence on how price-responsiveness varies across race and ethnicity, suggesting we are far from understanding these patterns. Future research could explore the patterns of price-responsiveness across racial and ethnic groups using a model based on the role of peer influences.

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Notes

1. Data on smoking by racial and ethnic groups other than whites, African-Americans, and Hispanics are not available from the MTF surveys because of small sample sizes. Estimates from larger data sets suggest that Asian Americans and Pacific Islanders smoke at much lower rates than American Indians and Alaska Natives (USDHHS, 1998).
2. Thirty day prevalence rates indicate the percentage of individuals who reported smoking at least one cigarette in the last 30 days. The general trends are similar when other measures of smoking are used.
3. Current smokers are defined as those respondents who report smoking one or more cigarettes in the prior 30 days.
4. Summarizing 41 studies of the price-elasticity of cigarette demand, Viscusi (1992, p. 105) notes that "Despite the diversity of approaches in the studies . . . most of the demand elasticities are clustered in the range from [− 0.4 to − 1.0]." He goes on to note that the evidence (as of 1992) was somewhat mixed on the price-responsiveness of teen smoking. Kenkel and Mathios (2000) provide a critical review of research on the price-responsiveness of youth smoking, and argue that the evidence is still inconclusive.
5. Because smoking is so much less common among African-American youth the smaller absolute change is a larger percentage change in the smoking participation rate of African-Americans. As a result, the estimated price elasticity of smoking participation is larger for African-American youth than for white youth, leading Chaloupka and Pacula (1999) to conclude that the smoking rates of African-Americans are more sensitive to price. However, the absolute change in smoking behavior seems more relevant both in terms of economic theory (which usually focuses on derivatives of levels not derivatives of rates) and public policy.
6. Unfortunately, the published Fig. 1 in the CDC report also reports the percentage change in smoking estimated to follow a price increase instead of the absolute change in smoking behavior. However, it appears that the empirical models predict that a price increase leads to a decrease in Hispanic youth smoking that is greater than the predicted decrease for white youth smoking whether measured in absolute or percentage terms.
7. To further complicate matters, some of the studies also explore the price-responsiveness of the intensity (number of cigarettes) smoked conditional on participation.
8. It might be the case that for adults peer acceptance becomes a minor or nonexistent reason to smoke and that smoking directly enters the utility function, as in the rational addiction model of Becker and Murphy (1988).
9. In other work, we show that the main results are not sensitive to the way in which observations with missing data are handled (DeCicca, Kenkel and Mathios, 1998, 2000).
10. In the 10th and 12th grade surveys, < 1 cigarette a day was a possible response. For the purposes of analysis this category was combined with the 1–5 category, to be consistent with the 8th grade survey.
11. Quitting behavior is not considered in this model in part because it is such a rare event in the NELS88 data. Conceptually it is possible for an 8th grade smoker to quit by the 10th grade and be at risk again for starting to smoke in the 12th grade.
12. Chaloupka (1991) and Becker, Murphy and Grossman (1994) estimate empirical demand functions for cigarettes consistent with the model of rational addiction developed by Becker and Murphy (1988). Those studies are concerned with the steady-state behavior of on-going addictions. To our knowledge, the rational addiction model has not been used to derive an equation like (1) that describes the determinants of beginning a new addiction. Intuitively, because it lacks a measure of future consumption or future cigarette prices, Eq. (1) is consistent with a standard or myopic model of addiction.
13. Prices are adjusted for inflation to put 1988, 1990 and 1992 values on a comparable basis.
14. For 1990 and 1992 we use the average prices calculated exclusive of generic brand cigarettes, because almost all youth smokers purchase premium brands (96 percent of youth in the sample of

Cummings et al., 1997). For 1988 only the average price inclusive of generics is available from the Tobacco Institute. However, Cummings et al. (1997) report that only 6.6 percent of adult smokers in their sample purchased generic brands in 1988, compared to 24.5 percent in 1992. With such a low market share for generics, the average price data for 1988 are probably not seriously distorted by their inclusion.

15. Lewit, Coate and Grossman (1981) include the difference between own-state price and low price in a bordering state as an explanatory variable. This variable is estimated to have a statistically insignificant effect on youth smoking, and the estimated effect of own-state price is not altered by its inclusion.
16. There are some states that have no observations on Hispanic and/or African-American students. Obviously, in these cases, there is no dummy variable included for that state. Moreover, in some states there is no variation in the dependent variable. In these cases the observations are eliminated and that state is not included in the analysis. There were only a small number of observations eliminated for this reason.
17. When attempting to replicate earlier studies, Wasserman et al. (1991) find that results can be quite sensitive to the inclusion of an index of restrictions on smoking in public places. As Grossman (1991) points out, this index takes its highest value when worksite smoking is restricted, so it should not have a direct causal impact on youth smoking. Similarly, anti-discrimination or "smokers' rights" statutes also apply to employment opportunities and should not have a direct causal impact on youth smoking. Instead, we include these variables as proxies for anti-smoking sentiment in the state, an interpretation consistent with the discussion of both Wasserman et al. (1991) and Grossman (1991).
18. To avoid losing observations with missing test scores, we mainly rely on the 8th grade cognitive test scores, which are available for most NELS:88 respondents. Filling in missing information on 8th grade test scores with information on 10th grade test scores further increases the available sample for analysis.
19. A unique aspect of the NELS:88 sample is the attention paid to following high school dropouts. First, NELS:88 staff contacted the sampled schools to verify the enrollment status of every original sample member. If the school identified a student as having dropped out, NELS:88 staff attempted to confirm this information directly with the sample member. If the sample member could not be contacted, staff attempted to corroborate this information with an adult member of the sampled student's household. When successful in reaching these dropouts, staff administered dropout questionnaires and cognitive tests during off-campus administrative sessions. Dropouts attending these sessions were reimbursed for travel expenses at the end of the sessions. Overall, 88 percent of these identified as dropouts completed a questionnaire, providing well over a thousand observations on high school dropouts.
20. For family income we use the midpoint of the ranges of each category. For the category $> \$200{,}000$ we assign the value \$200,000.
21. We experimented with several other measures of acculturation including whether the student speaks Spanish as well as whether Spanish is spoken in the home. We also used the school-based data to examine school-wide variables such as whether school administrators believe that there is problem with English at the school.
22. We have also modeled the onset of smoking between 8th and 12th grade. In this model the dependent variable is whether a student who was not smoking in 8th grade is smoking by 12th grade. When modeled as a function of the level and changes in taxes between 8th and 12th grade, taxes also have an insignificant positive effect.
23. Overall, 36 states had positive coefficients on their respective dummy variables. Virginia, West Virginia and South Carolina were among the ten states with the most positive coefficients.
24. It is also interesting to note that the most negative coefficient on any of the state dummy variables is on the state of Utah. This is probably the result of unobserved anti-smoking sentiment generated by the high proportion of Mormons in Utah.

25. Small cell sizes preclude predicting the hazard rate for Hispanics in Utah, and hazard rates can only be predicted on the basis of region, not state, of residence for African-American youth.

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