Youth Smoking in the 1990s: Why Did it Rise and What are the Long Run Implications?

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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 one-third from its 1991 trough, before declining again somewhat in 1998 and 1999. This trend is particularly striking in light of the continuing steady decline in adult smoking in the U.S.

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 <u>higher</u> than the smoking rate among those who stated that they would be smoking (72%) (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). The notion that this increase in youth smoking will lead to a rise in adult smoking is supported by the fact that 75% of smokers begin before their 19th birthday (Gruber and Zinman, 2000). But this fact does not prove that the current upswing in youth smoking will lead to higher long run adult smoking rates, as 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. In this paper, I first discuss the causes of the rise in youth smoking in the 1990s, then provide some evidence to help causally assess its long run implications for smoking in the U.S. and the health of the U.S. population.

Part I: What Caused the Rise in Youth Smoking?

In this section I consider several candidate causes for the rise in youth smoking. The first is changes in background characteristics. To assess the role of background characteristics, I first use the high quality data on youth smoking from the Monitoring the Future (MTF) survey to estimate cross-sectional models of smoking behavior as a function of individual and family characteristics. The results of these regressions, reported in Gruber and Zinman (2000), are quite interesting, in that there is not the strong correlation of smoking with socioeconomic status that is observed for 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 positively correlated with parental education. On the other hand, youth smoking is much more likely among those with worse academic performance, who miss more school, and who don't plan to go to college. There also appear to be strong income effects on smoking: more hours worked and more income lead to more smoking among seniors.

I then take this cross-sectional model and use the estimated relationships to predict smoking in each year, given the values of the Xs in each year. If changes in background characteristics are explaining the time series pattern, then this predicted series should mimic actual smoking behavior. I present the results from doing so in Figure 1. I use here a cross-sectional model estimated in 1985-86 to predict smoking in each year, so that I can do out of sample predictions on both the steep decline in the

1970s and the steep increase in the 1990s. This model can predict very little of either the decline in the 1970s or the rise in the 1990s. The predicted series does rise very slightly in the 1990s, by 0.7 percentage points, but this is less than 10% of the 7.8 percentage point rise in smoking by high school seniors over this period. Thus, the steep increase in smoking participation of the 1990s is not explained by changes in background characteristics.

One question with an exercise of this nature is whether changes in the coefficients on background characteristics can explain this trend. In fact, it cannot. Indeed, smoking is rising within every measurable group of high school seniors over this period. It is also true that changes in reported attitudes towards smoking do not at all explain this trend (Gruber and Zinman, 2000).

But there is one other natural candidate to explain this rise: prices. Due to a tobacco industry price war, the price of cigarettes declined by 10% in the early 1990s, exactly when youth smoking began to rise. This raises a natural question: is youth smoking sufficiently price sensitive that this price decline can explain its increase? I address this question in Table 1 using data from a restricted use sample of the MTF data that has information on smoking and a limited set of demographic characteristics, as well as state of residence (which is not available on the public use data), for 8^{th}, 10^{th} and 12^{th} graders from 1991 through 1997. I use two measures of smoking: participation (any smoking in past month) and intensity (number of cigarettes per day if smoke). I match to these data information on the price of cigarettes in each student's state and year, as well as the excise tax rate that they face at the time of the MTF interview.

I use these data to estimate models of smoking as a function of cigarette prices and other public policies, controlling for both state and year fixed effects, the limited available demographic characteristics (race, sex, grade, and age), and other measures of state/year public policies towards smoking. Cigarette prices are instrumented by state excise taxes to deal with the potential endogeneity of state-specific tobacco pricing. As Table 1 shows, there is a significant and substantive negative impact of cigarette prices on the decision of high school seniors to smoke. 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; there may, however, be some positive selection bias to this estimate if higher prices reduce smoking participation most among those who are low intensity smokers. This coefficient implies that the decline in prices from 1991 through 1997 can explain 26% of the 8 percentage point rise in smoking for seniors over this time period. Thus, price is playing an important role, but not the dominant one.

The next two rows of Table 1 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.

Gruber and Zinman (2000) report comparable models to these ones with two other large micro-data sets on youth smoking, and the basic results are very similar: large and significant negative effects on price for seniors, with little effect for younger teens. They also find that, for seniors but not for younger teens, there is a much higher elasticity for those in socioeconomically disadvantaged groups such as blacks and those with low parental education. And they estimate little consistent role for other public policy barriers to youth smoking besides price.

The finding of a much smaller elasticity of participation for younger teens suggests that younger teens may view participation as pure experimentation, which is less well described by economists' models of addictive behavior (Becker and Murphy, 1988; Gruber and Koszegi, 2000), 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 fact that demographic correlates of socioeconomic disadvantage lead to higher price sensitivity for seniors, but not for younger teens.

To summarize, then, we know relatively little about what caused the sharp upturn in teen smoking in the 1990s. There is relatively little explanatory role background characteristics, as youth smoking is rising within all demographic groups. There is a more significant explanatory role for the decline in price, which can explain about one-quarter of the trend for seniors. But the majority of trend remains unexplained. One potentially important but difficult to quantify factor may have been increased tobacco industry efforts to target youths, as witnessed by the advent of the "Joe Camel" campaign, but further work is needed to discern any causal role for these efforts.

Part II: Long Run Implications of Rising Youth Smoking

Regardless of the source of the rise in youth smoking, a central question is what it implies for the future of smoking in America. If shifts in youth smoking imply long run increases in adult smoking, then we are headed towards a substantial reversal in the downward trend in smoking in the U.S. But simply asserting that the fact that most smokers started as children does not prove that there is a significant intertemporal correlation. Any model with individual heterogeneity and experimentation at young ages would deliver this fact, even without a causal role for youth smoking per se; after all, just because most drivers started before age 18 does not prove that youth driving causes adult driving.

I therefore take two approaches to trying to assess how smoking by youth will translate into increased adult smoking. The first, and most direct, is to examine whether shifting patterns of smoking across cohorts of youth are reflected in the smoking rates of those cohorts as adults. This approach will yield an estimate of the relationship between rising youth smoking and rising adult smoking that is free of individual heterogeneity bias; this is akin to using cohort dummies as instruments for youth smoking.

To carry out this analysis, I use data from both the National Health Interview Survey (NHIS) and the Current Population Survey (CPS), which in several years (1978-80, 1987-88, 1995, and 1997-98 for NHIS; 1989, 1992-93, and 1995-96 for CPS) asked current and former smokers the age at which they initiated smoking (as well as when they quit, if they are former smokers). This allows me to calculate by cohort not only their current smoking rate in the survey year, but their smoking rate when the cohort were seniors (age 17-18). I restrict the analysis to those persons below age 60 in the survey year, to minimize bias from differential smoker mortality, and examine the impact of youth smoking on smoking at ages 19-45. Thus, in the NHIS, I use data for cohorts born in 1911 or later, so that they are age 45 in 1956-1998; in the CPS, I use data for cohorts born in 1930 or later, so that they are age 45 in 1975-1996.

In each case, I regress the cohort smoking rates at adult ages on the smoking rate at ages 17-18, controlling for a full set of age dummies. I also include controls to capture secular trends in the data; if smoking is declining over time, even in the absence of any within-cohort correlation one will find that cohorts born later have lower smoking both as teens and as adults. I control for these trends by including a cubic time trend, as well as the contemporaneous smoking rate of 49-50 year olds, as a proxy for trends in adult smoking that should not be determined by the youth smoking of those at ages 19-45.

The results of this exercise are shown in Table 2, first for the NHIS, then for the CPS. In fact, despite these detailed time series controls, I find a very strong correlation between youth and adult smoking, with a coefficient of 0.45 (CPS) to 0.55 (NHIS). Thus, the findings from this first exercise suggest that higher smoking rates among youths translates in a significant way to the smoking rates of adults. But the fact that this estimate is significantly smaller than one suggests that there is more to reducing adult smoking than simply stopping youths from smoking.

A weakness of this first approach, however, is that despite my attempts to control for time series factors there may still be shifts in the underlying environment that affect smoking of cohorts as both youths and adults. The second approach I take is motivated by the ideal thought experiment, which would be exogenously induce some teens to smoke and others not to smoke. An approximation to this thought experiment is to assess the implications for *adult* smoking of differential taxes on *youth*. That is, if there are two adults who face the same tax regime today, but who faced different tax regimes as teens, by how much does their smoking differ? This approach has the advantage that it nicely approximates the experiment of interest, since we know that youth are price sensitive in their smoking decisions. But it has the disadvantage that one cannot directly infer the implications of the findings, since we don't know for these cohorts of adults how prices affected their actual smoking as youths; this test is therefore more useful as a confirmation that a significant intertemporal correlation exists than as a method for measuring its magnitude.

I carry out this analysis using data from the Vital Statistics Natality Detail Files. These data are a census of birth certificates for the U.S., with approximately 4 million observations per year. The data contain information, since 1989, on the smoking behavior of the mother during pregnancy, as well as both their state of birth and state of current residence. I can therefore use these data to model smoking as a function of both the current tax rate and the average tax rate in the woman's state of birth during the years when they were 14-17 years old.

Since estimating this model on the 15 million observations in the micro-data is impractical, I first convert the 8 years of natality data into a set of year of birth* year of survey * state of birth * state of residence cells. I then use the means of smoking rates in these cells to estimate models of smoking today on the tax rates in both the current state of residence and the state of birth, including a fixed effects for each of these sets of states (residence and birth), for year of birth, for year of the survey, and for age. I also control for the racial composition of the cell and the share of the cell that are high school dropouts, high school graduates, or have at least some college. All regressions are weighted by the cell counts. The dependent variable is the average number of cigarettes smoked by women giving birth in the cell, incorporating zeros.

Table 3 shows the results that include both the contemporaneous tax and the teen tax, along with the control variables described above. I find an elasticity with respect to current prices of -0.46; even though the key regressor is tax rates, I present price elasticities, assuming a pass-through to prices of one-for-one. There is also a strong negative effect of the tax as a teen; the elasticity is -0.19, which is over 40% as large as the effect of current taxes.

One problem with this analysis is that the tax rate is assigned with some error, since we know only birthplace and not the state of residence as a teen. To mitigate this measurement error, in the second column of Table 3 I use only the sample of non-movers, for whom we can presume that the state of both birth and current residence is the state in which the mother resided as a teen. For this sample, the impact of both current taxes and taxes as a teen are somewhat larger, and their ratio is similar.

These findings clearly provide evidence for the addictive nature of smoking: if you exogenously shift women to non-smoking status early in life with higher taxes, they will smoke less later in life as a result. But youth smoking is by no means the sole, or even the primary, determinant of smoking later in life; indeed, the taxes that smokers face as adults are significantly more important than the taxes that they faced as youths.

Part III: Implications

The 1990s is a decade which has produced a very mixed track record with respect to risky behaviors among youths. While teen births and crime rates are steeply down, rates of substance use, and particularly smoking rates, are rising; Gruber (2000) further discusses the contradictory time trends in risky behaviors among youths. The increase in smoking rates is particularly vexing given the expected, widely postulated intertemporal correlation between the decisions of youths to smoke and their subsequent smoking as adults, with the corresponding costly impacts on health.

Evidence from cohort comparisons suggests an intertemporal correlation coefficient of roughly 0.5; half of any rise in youth smoking is translated into increased smoking by adults. The significant intertemporal correlation is confirmed by the "natural experiment" of examining the impact of youth cigarette taxes on current smoking decisions. Over this period, smoking rose by 8 percentage points for seniors in the MTF. This implies a long run rise in the adult smoking rate of 4 percentage points. Compared to the current adult smoking rate of 25%, this is a rise of 16 percent, a non-trivial increase. Of course, whether this recent rise will persist into adulthood in the manner suggested by past cohort shifts is unclear. The technology for quitting smoking has improved dramatically in recent years, and these youths are moving into workplaces which almost universally ban smoking, raising significantly the hassle costs of maintaining a habit. But the historical record speaks clearly, which should indicate a very significant rise in adult smoking going forward.

The decline in youth smoking in 1998-99, corresponding to significant cigarette price increases, suggests that there may not cause a permanent upward shift in adult smoking, but perhaps a "bulge" in smoking rates across cohorts. Even if the rise from 1991 to 1997 was a transitory one, however, the long run health consequences could be substantial. A 4 percentage point rise in smoking for this seven year cohort, along with a somewhat reduced increase for the 1998 cohort of seniors, implies 954,000 more adult smokers. Of course, some of these adults will then quit in their adult years, and those who quit sufficiently before the age of greatest medical risk from smoking (age 60 onwards) can substantially reduce their mortality risk. Based on the NHIS data for 1987/88 on age of initiation and age of quitting, of those who started smoking as youths and are still smoking at age 35, 45% will quit by age 60. So a conservative estimate is that 525,000 additional persons will have their lives shortened due to increased smoking.

As noted above, smoking throughout one's life shortens life expectancies by 6.5 years for men and 5.7 years for women. Taking a simple average across men and women, this implies that the rise in youth smoking will cause a reduction of 3.2 million life years, even if this rise is totally undone. At a value of $100,000 per life year, and discounted at a real 3% rate from age 69 (typical life expectancy for smokers) to age 19, this is a foregone value of life years in today's dollars of $73 billion. Once again, this is a vast oversimplification, as both quitting technologies and the mortality impacts of smoking are evolving rapidly over time. But it suggests the importance that even a potentially transitory rise in youth smoking for the health of the U.S. population.

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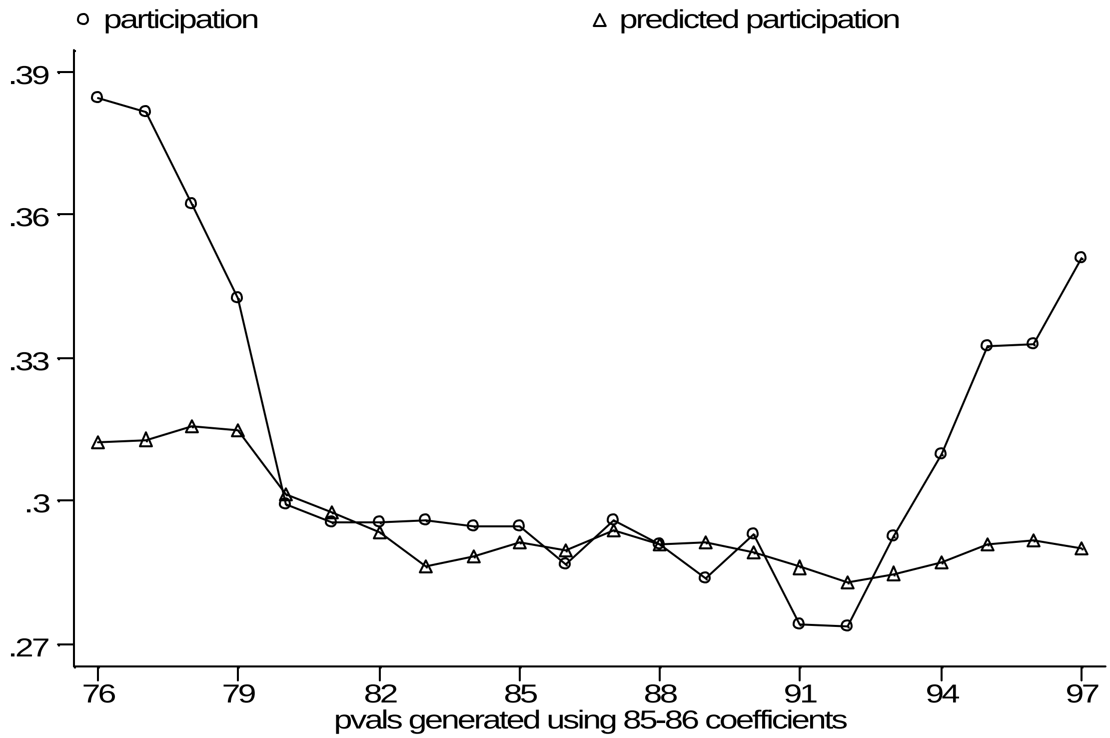

Figure 3. Smoking Participation Predicted v. Actual

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Table 1: The Impact of Price on Youth Smoking

	Participation	Conditional Intensity

12th Graders	-0.148 (0.078) [-0.666]	-0.310 (2.388) [-0.059]
8 - 10th Graders	--0.033 (0.035) [-0.21]	-0.013 (1.243) [-0.0003]
All Youth	-0.055 (0.034) [-0.311]	-0.129 (1.132) [-0.029]

Coefficients on cigarette price from instrumental variables regression (using excise tax as instrument) described in text using MTF data; standard errors in parentheses and elasticities in square brackets. The first column shows impact of price on smoking participation, and the second on conditional intensity of smoking; first row shows results for seniors, second for 8 - 10th graders, and third for the combined sample. Regressions also control for state and year fixed effects, age, race, sex, and grade, and state clean air and youth access restrictions. N = 106539 and 32868 for 12th graders; 230126 and 49227 for 8 - 10th graders.

Table 2: Cohort Correlations in Smoking Rates

	NHIS	CPS
Youth Smoking	0.552 (0.016)	0.451 (0.016)
Smoking Among 49-50 Year Olds	0.212 (0.030)	0.150 (0.082)
Time	-0.0005 (0.0004)	-0.0025 (0.0004)
Time Squared / 100	-0.018 (0.002)	-0.021 (0.005)
Time Cubed / 10000	0.023 (0.003)	0.046 (0.013)
Number of Observations	1161	594

Coefficients from regressions of smoking at ages 19-45 on smoking at ages 17-18 for each cohort described in text; regressions also include full set of age dummies. Standard errors in parentheses. First column from NHIS data; second from CPS data.

Table 3: The Impact of Current and Youth Taxes on Smoking

	Full Sample	Non-Movers Only
Current Tax	-0.810	-0.970
	(0.033)	(0.064)
	[-0.455]	[-0.513]
Youth Tax	-0.480	-0.598
	(0.061)	(0.111)
	[-0.188]	[-0.221]
Number of Observations	337690	9941

Coefficients on cigarette excise tax from regression using grouped Natality data, as described in text; standard errors in parentheses and (price) elasticities in square brackets. The first column shows impact of current and youth taxes on current smoking for full sample; second column shows results for non-movers only. Regressions also control for education, race, and full sets of fixed effects for state of birth, state of residence, year of birth, year of survey, and age.