



# Public policy and smoking cessation among young adults in the United States

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## Abstract

In the wake of significant budget shortfalls, numerous states have increased cigarette excise taxes to boost revenues. This study examines whether or not increasing the price of cigarettes, which will occur as a consequence of cigarette excise tax increases, and implementing stronger restrictions on smoking in private worksites and other public places have an impact on smoking cessation decisions of young adults, thereby influencing public health in the United States (US). This paper employs longitudinal data on young adults from the Monitoring the Future Surveys matched with information on site-specific prices and measures of clean indoor air restrictions. A Cox regression is employed to estimate the smoking cessation equations. The estimates clearly indicate that increasing the price of cigarettes increases the number of young adults who quit smoking. The average price elasticity of cessation is 0.35. In addition, stronger restrictions on smoking in private worksites and public places other than restaurants increase the probability of young adult smoking cessation. Given the well-documented benefits of smoking cessation, a significant increase in cigarette excises taxes may be one of the most effective means to reduce premature death and disease in the United States.

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## 1. Introduction

Cigarette smoking is the single most preventable cause of death and disability in the United States (US), responsible for more than 400,000 premature deaths each year [1]. On average healthy male and female adults who smoke a pack or more of cigarettes each day live 7.1 and 4.1 fewer years, respectively, than their healthy counterparts who never smoked [2].

Notwithstanding the reduced life expectancy, smokers incur significantly higher lifetime medical expenditures than do never-smokers [3]. Despite the deleterious health effects of cigarette smoking, approximately 46.5 million adults in the United States aged 18 and over were current smokers in 2000, representing nearly one quarter (23.3%) of the total United States adult population [4].

According to the 1990 Surgeon General's report, smoking cessation represents the single most important step that smokers can take to enhance the quality and length of their lives. Relatively small increases in

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smoking cessation have been found to yield substantial gains in quality-adjusted life-years among individuals aged 20–69 [5].

While the likely health benefits of smoking cessation are quite substantial, only 2.5% of smokers in the US quit smoking permanently each year [6]. The inability of smokers to quit is not due to a lack of desire, but rather, it is due in large part to the addictive properties of nicotine [7]. The Centers for Disease Control and Prevention estimated that more than two thirds of current smokers in the United States wanted to quit smoking completely in 1995 and just under half (45%) of everyday smokers quit smoking for at least 1 day during the preceding 12 months in an effort to stop stoking [8].

While unassisted smoking cessation is the most common approach used by smokers to quit, the existing medical literature suggests that pharmacotherapies such as nicotine replacement products and sustained release bupropion, physician advice, and non-physician counseling increase the likelihood of successful smoking cessation [9–11]. A substantial body of evidence from the discipline of economics suggests that cigarette prices are inversely related to smoking propensity and intensity.<sup>1</sup> A preponderance of the studies concluded that the total price elasticity of adult cigarette demand falls in the range of  $-0.3$  to  $-0.5$  [12]. Consistent with economic theory, several studies have found adolescents and young adults to be substantially more responsive to cigarette prices than adults [13–17]. Studies based on survey data suggest that approximately half of the effect of price on cigarette demand is through its impact on smoking prevalence with the remainder of the effect on average smoking by smokers. While a significant number of studies have concluded that cigarette prices and smoking prevalence are inversely related, very few have been able to distinguish whether or not a decrease in prevalence, due to a price increase, is a result of decreased smoking initiation or increased smoking cessation. Several studies of adults and young adults have concluded that cigarette price increases have a positive impact on smokers' decisions to quit smoking [18–20]. In addition, several studies have found

a negative relationship between cigarette prices and adolescent smoking initiation [21–23].

This research adds to the very small body of evidence on the impact of cigarette prices on smoking cessation and distinguishes itself from previous studies by modeling multiple quit attempts of young adults. In addition, this research examines the impact of laws restricting smoking in private worksites and public places on young adult smoking cessation decisions. The public health findings from this research should be particularly important to many state policymakers who are contemplating the use of cigarette excise taxes to generate additional revenues in an attempt to compensate for fiscal shortages associated with the recent downturn in the economy.

## 2. Data

The empirical models that are estimated in this study employ panels formed from the nationally representative cross-sectional surveys of high school seniors conducted by the Institute for Social Research (ISR) at the University of Michigan. Each year since 1975, ISR has conducted a nationally representative random sample of between 15,000 and 19,000 high school seniors as part of a national research program titled *Monitoring the Future: A Continuing Study of American Youth (MTF)*.<sup>2</sup> These surveys focus on the use of cigarettes, alcohol, and illegal drugs and provide an accurate cross-sectional representation of United States high school seniors.

The senior year of high school is an extremely interesting and relevant point in time to start tracking individuals. According to the 1994 Surgeon General's report, nearly all first use of cigarettes occurs before high school graduation, and most adults who regularly smoke are addicted to cigarettes by the time they are 20 years old. In addition, the completion of high school, for many, means the end of living under parental supervision and undergoing a transition into a different social environment.

Starting with the class of 1976, approximately 2400 individuals from each senior class are chosen to participate in follow-up surveys. The 2400 selected re-

<sup>1</sup> For a comprehensive review of these studies see [28] and the various Surgeon General's reports (USDHHS, 1989, 1994, and 2000).

<sup>2</sup> In the past, the Monitoring the Future Study was sometimes called the National High School Senior Survey.

spondents are divided into two groups of 1200 individuals each. One group is surveyed on even-numbered calendar years, while the other group is surveyed on odd-numbered calendar years. As a result, one group is resurveyed for the first time 1 year after baseline (senior year in high school), while the other group is resurveyed for the first time 2 years after the baseline year. Subsequent follow-ups are conducted at 2-year intervals for both groups for up to seven follow-ups and then less frequently.

The questionnaires used in the follow-up surveys are very similar to those used in the baseline. Many of the questions that were asked in the baseline are also asked in all subsequent follow-ups so that changes in behaviors and experiences can be measured. High school specific questions are dropped from the follow-ups and relevant post-high school questions are added such as college education, employment status, marital status, etc.

The most prominent advantage of using the MTF data is that it is the only longitudinal data set that tracks individual's smoking habits as they age from teenagers through early adulthood. This is an extremely important time to analyze, because for many, a transition from regular smoking to cessation takes place during this period.

A variety of cigarette consumption, socioeconomic, and demographic variables was constructed from the survey data for all respondents. Of particular importance to this research was the information collected on each individual's monthly cigarette consumption. In the baseline year and all subsequent follow-ups, all respondents were asked the frequency with which they smoked cigarettes during the past 30 days. The response to this question was used to construct a dichotomous smoking participation indicator equal to one if the respondent indicated that they had used cigarettes in the 30 days prior to the survey, and equal to zero otherwise. Tracked over time, the participation variable maps out each individual's smoking trajectory for up to 14 years or until loss due to censoring occurs.

In addition to the cigarette consumption variables, numerous independent variables were constructed from the surveys to control for other factors affecting cigarette demand. These include: the age of the respondent, in years; average real yearly income from employment (deflated by national consumer price

index (CPI) 1982–1984 = 100); number of years of formal schooling, in years; average number of hours worked weekly; race/ethnicity (white and black: reference category); gender (male and female: reference category); indicators of college student status (full-time, half-time, less than half-time, and no college: reference category); indicators of frequency of participation in religious services (infrequent participation, moderate participation, frequent participation and never: reference category); indicators of marital status (married, engaged, separated or divorced, and single: reference category); indicators of family structure (live alone, live with parents, live with spouse, live with child); and indicators of type of city/town (suburban, rural, and urban: reference category).

In addition, indicators of census division according to the Bureau of Labor Statistics (New England, East, South East, Midwest, South, Plains, Mountain, North West, New York/New Jersey, and West: reference category) and dichotomous indicators of variables capturing the year the questionnaires were administered were constructed from the surveys to control for region and time trends.

Based on the site identifiers, cigarette prices were added to the surveys. The price data were obtained from Tobacco Institute's *Tax Burden on Tobacco* [24]. For each year of the survey, the Tobacco Institute published state level cigarette prices as of 1 November. These prices are weighted averages for a pack of 20 cigarettes based on the prices of single packs, cartons, and vending machine sales where the weights are the national proportions of each type of sale. These prices are inclusive of state level sales taxes applied to cigarettes, but are exclusive of local cigarette taxes. Since the price published is as of 1 November and the survey is conducted between mid February and early June and the dependent variables are based on past month smoking, a weighted average price for the first 6 months of the year is computed. The average price for the first 6 months of every year is calculated by subtracting state and federal excise taxes from the current year's price and the previous year's price and weighting the pre-tax prices accordingly (7/12 previous year and 5/12 current year). Then the average federal tax and average state tax for the first 6 months of the year are added to the first 6 month's average pre-tax price. To account for changes in the relative price of cigarettes over time, all cigarette prices are deflated

by the national Consumer Price Index published by the Bureau of Labor Statistics (1982–1984 = 100).

Based on state identifiers, a set of variables reflecting the presence of state level clean indoor air laws was added to the data. These data were obtained through special agreement with the Centers for Disease Control from an unpublished database. The data were used to construct three dichotomous indicators for state level restrictions on smoking in private worksites, restaurants, and any other public place.

Finally, with the exception of gender, race/ethnicity, and parental education, which are time-invariant across individual specific observations, all other covariates enter the models as time varying regressors. Table 1 provides variable definitions and basic descriptive statistics.

### 3. Methods

In the case of cigarette smoking, an individual can occupy one of two discrete states: smoking and non-smoking. As the costs of smoking increase, economic theory predicts that smokers would be more likely to move from the smoking state to the no-smoking state. Hazard modeling is the appropriate statistical technique to examine the structural determinants of the decision to make a transition from one discrete state to another. This paper employs a Cox regression to examine the impact economic factors have on individual's decisions to quit cigarette smoking. The semi-parametric model takes the form of a stratified Cox regression in which the hazard at time  $t$  for a subject in group  $i$  is assumed to be:

$$h_i(t, x(t)) = h_{0i}(t) \exp(x(t)B_i)$$

where  $h_{0i}(t)$  is the baseline hazard at time  $t$ , which is unknown,  $x(t)$  is a vector of time-varying explanatory variables, and  $B_i$  is a vector of parameters, which is unknown. Group stratification is conditional on the number of previous quit attempts. That is, each subject is assumed not to be at risk for a subsequent event (quit attempt) until a prior event has occurred.

To account for the correlation among observations on an individual subject and the correlation due to observing multiple quit attempts within the same subject, a robust method of calculating the variance-covariance matrix proposed by Lin and Wei [25] is used.

### 4. Results

Estimates from the cessation equations are presented in Table 2. Eight alternative models are estimated. The model presented in the first column (model 1) contains estimates from a specification which includes real average price, three dichotomous clean indoor air indicators reflecting state level restrictions on smoking in private worksites, restaurants, and any other public place, and a variety of socio-economic variables including: race, gender, income, type of community, marital status, family structure, parental education, mother's work status while growing up, religious participation, hours worked, formal years of schooling, college enrollment status, and dummy year variables to control for year fixed effects. In addition, with the exception of price, clean indoor air indicators, year and census division indicators, and indicators of family structure, indicators for respondents with missing data for all the above variables are included in the models. These missing value indicators were created to prevent the loss of a large number of observations. For example, if mother's work status while growing up is unknown, each of the mother's work status variables take on a value of zero, while an additional indicator, unknown mother's work status takes on a value of one. This missing value indicator takes on a value of zero for all respondents whose mother's work status is known.

The models estimated in the second, third, and fourth columns of each table are identical to the first column, except the three dichotomous clean indoor air indicators are replaced by at most one clean indoor air indicator (model 2 contains private worksite restrictions, model 3 contains restaurant restrictions, and model 4 contains any other clean indoor air restrictions). These models are specifically designed to minimize the collinearity of included state-level variables reflecting tobacco control efforts that may be correlated over time. The inclusion of highly correlated state-level controls may result in misleading estimates of the correlated covariates. Models 5–8 are identical to models 1 through 4, except models 5–8 contain nine dichotomous census division indicators to control for regional fixed effects.

The real price of cigarettes is found to have a positive and significant impact on the quitting hazard in all the models estimated. These estimates clearly

Table 1

Variables	Definition	Mean ( $\mu$ )	Standard deviation ( $\sigma$ )
Real cigarette price	Average price of a pack of twenty cigarettes for the first two quarters of the year, deflated by the national consumer price index, 1982–1984 = 100	1.01	0.214
Private workplace Restriction	Dichotomous indicator equal to one if respondent resides in a state that restricts cigarette smoking in private worksites and zero otherwise	0.173	0.379
Restaurant restriction	Dichotomous indicator equal to one if respondent resides in a state that restricts cigarette smoking in restaurants and zero otherwise	0.261	0.439
Other clean indoor air restriction	Dichotomous indicator equal to one if respondent resides in a state that restricts cigarette smoking in government worksites, health care facilities, grocery stores, or any other public place	0.389	0.488
Male	Dichotomous indicator equal to one if respondent is a male, and zero otherwise	0.444	0.497
White	Dichotomous indicator equal to one if White or Caucasian and zero otherwise	0.859	0.348
Real yearly income	Average real yearly income from employment sources only (in US\$), deflated by the national consumer price index, 1982–1984 = 100	67.072	68.336
Infrequent religion	Dichotomous indicator equal to one for individuals who attend religious services infrequently and zero otherwise	0.517	0.500
Moderate religion	Dichotomous indicator equal to one for individuals who attend religious services occasionally and zero otherwise	0.163	0.370
Frequent religion	Dichotomous indicator equal to one for individuals who attend religious services frequently and zero otherwise	0.151	0.358
Suburban	Dichotomous indicator equal to one for individuals who live in a suburban community and zero otherwise	0.656	0.475
Rural	Dichotomous indicator equal to one for individuals who live in a rural community and zero otherwise	0.150	0.357
Work hours	Number of hours worked per week in the past 30 days	26.51	18.41
Married	Dichotomous indicator equal to one for individuals who are married, and zero otherwise	0.203	0.402
Engaged	Dichotomous indicator equal to one for individuals who are engaged, and zero otherwise	0.085	0.279
Separated/divorced	Dichotomous indicator equal to one for individuals who are separated or divorced, and zero otherwise	0.040	0.197
Live alone	Dichotomous indicator equal to one for individuals who live alone, and zero otherwise	0.062	0.241
Live parents	Dichotomous indicator equal to one for individuals who live with their parents, and zero otherwise	0.489	0.500
Live spouse	Dichotomous indicator equal to one for individuals who live with their spouse, and zero otherwise	0.192	0.394
Live child	Dichotomous indicator equal to one for individuals who live with their child or children, and zero otherwise	0.140	0.347
School years	Number of formal school years completed	12.513	1.755
College less than half time	Dichotomous indicator equal to one for individuals who are attending college less than half-time, and zero otherwise	0.040	0.196
College half time	Dichotomous indicator equal to one for individuals who are attending college half-time, and zero otherwise	0.026	0.160
College full time	Dichotomous indicator equal to one for individuals who are attending college full-time, and zero otherwise	0.152	0.359
Father some high school	Dichotomous indicator equal to one if father attended high school, but did not graduate, and zero otherwise	0.149	0.356
Father high school graduate	Dichotomous indicator equal to one if father graduated from high school, but did not attend college, and zero otherwise	0.307	0.461
Father some college	Dichotomous indicator equal to one if father attended college, but did not graduate, and zero otherwise	0.136	0.343
Father college graduate	Dichotomous indicator equal to one if father graduated from college, but pursued no further education, and zero otherwise	0.162	0.368
Father professional	Dichotomous indicator equal to one if father earned a graduate degree in a professional occupation, and zero otherwise	0.112	0.316

Table 1 (Continued)

Variables	Definition	Mean ( $\mu$ )	Standard deviation ( $\sigma$ )
Father education unknown	Dichotomous indicator equal to one if father's education is unknown, and zero otherwise	0.042	0.202
Mother some high school	Dichotomous indicator equal to one if mother attended high school, but did not graduate, and zero otherwise	0.144	0.351
Mother high school graduate	Dichotomous indicator equal to one if mother graduated from high school, but did not attend college, and zero otherwise	0.423	0.494
Mother some college	Dichotomous indicator equal to one if mother attended college, but did not graduate, and zero otherwise	0.152	0.359
Mother college graduate	Dichotomous indicator equal to one if mother graduated from college, but pursued no further education, and zero otherwise	0.137	0.344
Mother professional	Dichotomous indicator equal to one if mother earned a graduate degree in a professional occupation, and zero otherwise	0.064	0.244
Mother education unknown	Dichotomous indicator equal to one if mother's education is unknown, and zero otherwise	0.021	0.144
Mother occasionally worked	Dichotomous indicator equal to one if mother occasionally worked while individual was growing up, and zero otherwise	0.287	0.452
Mother usually worked	Dichotomous indicator equal to one if mother usually worked while individual was growing up, and zero otherwise	0.177	0.381
Mother always worked	Dichotomous indicator equal to one if mother worked full-time while individual was growing up, and zero otherwise	0.229	0.420
D77–D93	Dichotomous indicators equal to one if survey was administered in that year, and zero otherwise		
New England	Dichotomous indicator equal to one if individual resides in Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, or Vermont and zero otherwise	0.074	0.261
New York/New Jersey	Dichotomous indicator equal to one if individual resides in New Jersey or New York and zero otherwise	0.102	0.302
East	Dichotomous indicator equal to one if individual resides in Pennsylvania, Delaware, District of Columbia, Maryland, Virginia, or West Virginia and zero otherwise	0.129	0.335
South East	Dichotomous indicator equal to one if individual resides in Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, or Tennessee and zero otherwise	0.139	0.346
Midwest	Dichotomous indicator equal to one if individual resides in Illinois, Indiana, Michigan, Minnesota, Ohio, or Wisconsin and zero otherwise	0.256	0.436
South	Dichotomous indicator equal to one if individual resides in Arkansas, Louisiana, New Mexico, Oklahoma, or Texas and zero otherwise	0.086	0.280
Plains	Dichotomous indicator equal to one if individual resides in Nebraska, Iowa, Kansas, or Missouri and zero otherwise	0.063	0.243
Mountain	Dichotomous indicator equal to one if individual resides in Colorado, Montana, North Dakota, South Dakota, Utah, or Wyoming and zero otherwise	0.029	0.167
Northwest	Dichotomous indicator equal to one if individual resides in Washington, Oregon, Idaho, or Alaska and zero otherwise	0.032	0.176

indicate that increases in the real price of cigarettes increase the probability smoking cessation among young adults. Table 3 contains the estimated price elasticities of cessation based on the estimates presented in Table 2. The estimated price elasticities range from 0.269 to 0.466 and have an average elasticity of 0.350. The average price elasticity across the alternative specifications implies that a 10% increase in the real price

of cigarettes will increase the probability of cessation among young adults by approximately 3.5%.

Mixed results are found for the impact of clean indoor air laws on smoking cessation decisions of young adults. Policies restricting smoking in private worksites are found to have a positive impact on smoking cessation in all of the models that were estimated. However, when census division fixed effects

Table 2  
Estimates from stratified Cox models

Independent variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Real cigarette price	0.316 (3.03)	0.343 (3.30)	0.378 (3.69)	0.345 (3.35)	0.235 (1.85)	0.239 (1.88)	0.254 (2.01)	0.253 (2.01)
Private worksite Restrictions	0.068 (1.98)	0.056 (2.15)			0.037 (0.93)	0.017 (0.54)		
Restaurant restrictions	-0.081 (-2.24)		0.019 (0.84)		-0.008 (-0.19)		-0.009 (-0.35)	
Other clean indoor Air laws	0.084 (2.90)			0.058 (2.70)	-0.026 (-0.72)			-0.019 (-0.73)
White	0.058 (1.33)	0.055 (1.26)	0.055 (1.26)	0.055 (1.26)	0.057 (1.30)	0.057 (1.30)	0.057 (1.30)	0.057 (1.30)
Male	-0.060 (-2.98)	-0.058 (-2.88)	-0.058 (-2.90)	-0.060 (-2.97)	-0.061 (-3.04)	-0.062 (-3.06)	-0.062 (-3.07)	-0.061 (-3.06)
Real income	0.000 (1.88)	0.000 (1.91)	0.000 (1.91)	0.000 (1.91)	0.000 (1.70)	0.000 (1.71)	0.000 (1.71)	0.000 (1.70)
Suburb	-0.012 (-0.49)	-0.016 (-0.62)	-0.017 (-0.67)	-0.014 (-0.57)	-0.006 (-0.23)	-0.006 (-0.23)	-0.006 (-0.22)	-0.006 (-0.23)
Rural	-0.019 (-0.54)	-0.022 (-0.63)	-0.024 (-0.70)	-0.021 (-0.62)	-0.015 (-0.42)	-0.015 (-0.42)	-0.014 (-0.41)	-0.014 (-0.41)
Married	-0.067 (-0.94)	-0.065 (-0.92)	-0.065 (-0.93)	-0.067 (-0.94)	-0.071 (-1.01)	-0.071 (-1.01)	-0.072 (-1.02)	-0.072 (-1.01)
Engaged	-0.070 (-2.10)	-0.069 (-2.08)	-0.070 (-2.09)	-0.070 (-2.11)	-0.072 (-2.15)	-0.072 (-2.15)	-0.072 (-2.16)	-0.072 (-2.16)
Separated/divorced	-0.266 (-4.84)	-0.262 (-4.76)	-0.262 (-4.76)	-0.264 (-4.80)	-0.273 (-4.97)	-0.273 (-4.97)	-0.273 (-4.98)	-0.273 (-4.97)
Live alone	-0.009 (-0.22)	-0.006 (-0.16)	-0.007 (-0.17)	-0.008 (-0.19)	-0.007 (-0.16)	-0.007 (-0.17)	-0.007 (-0.17)	-0.006 (-0.16)
Live with parents	0.080 (3.40)	0.078 (3.33)	0.078 (3.33)	0.080 (3.38)	0.087 (3.69)	0.087 (3.69)	0.087 (3.68)	0.087 (3.68)
Live with spouse	-0.017 (-0.23)	-0.017 (-0.23)	-0.016 (-0.22)	-0.016 (-0.21)	-0.015 (-0.21)	-0.015 (-0.20)	-0.015 (-0.20)	-0.015 (-0.20)
Live with child	-0.336 (-9.13)	-0.336 (-9.12)	-0.337 (-9.15)	-0.338 (-9.17)	-0.334 (-9.07)	-0.334 (-9.08)	-0.334 (-9.09)	-0.335 (-9.09)
Father some high school	-0.042 (-0.85)	-0.043 (-0.87)	-0.044 (-0.89)	-0.044 (-0.90)	-0.035 (-0.70)	-0.035 (-0.72)	-0.035 (-0.71)	-0.035 (-0.71)
Father high school graduate	-0.017 (-0.37)	-0.018 (-0.39)	-0.019 (-0.40)	-0.019 (-0.41)	-0.009 (-0.20)	-0.010 (-0.21)	-0.009 (-0.20)	-0.009 (-0.20)
Father some college	0.013 (0.27)	0.014 (0.28)	0.014 (0.28)	0.012 (0.24)	0.010 (0.19)	0.009 (0.18)	0.009 (0.19)	0.010 (0.19)
Father college graduate	-0.021 (-0.42)	-0.021 (-0.41)	-0.021 (-0.41)	-0.022 (-0.45)	-0.022 (-0.45)	-0.023 (-0.46)	-0.023 (-0.46)	-0.023 (-0.45)
Father professional	0.014 (0.27)	0.015 (0.28)	0.015 (0.28)	0.014 (0.26)	0.011 (0.22)	0.011 (0.21)	0.011 (0.21)	0.011 (0.21)
Father education unknown	-0.048 (-0.72)	-0.048 (-0.71)	-0.048 (-0.71)	-0.050 (-0.74)	-0.047 (-0.71)	-0.049 (-0.72)	-0.048 (-0.71)	-0.048 (-0.71)
Mother some high school	0.003 (0.05)	0.006 (0.10)	0.005 (0.08)	0.003 (0.06)	0.005 (0.08)	0.004 (0.07)	0.004 (0.07)	0.005 (0.08)
Mother high school graduate	0.025 (0.42)	0.025 (0.43)	0.024 (0.41)	0.024 (0.42)	0.027 (0.47)	0.028 (0.48)	0.027 (0.47)	0.027 (0.47)
Mother some college	0.156 (2.54)	0.159 (2.57)	0.158 (2.57)	0.157 (2.55)	0.147 (2.39)	0.147 (2.39)	0.146 (2.38)	0.147 (2.39)
Mother college graduate	0.120 (1.90)	0.121 (1.92)	0.121 (1.92)	0.121 (1.92)	0.117 (1.86)	0.117 (1.87)	0.117 (1.87)	0.117 (1.87)

Table 2 (Continued)

Independent variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Mother professional education	0.130 (1.90)	0.132 (1.92)	0.132 (1.93)	0.131 (1.91)	0.124 (1.81)	0.124 (1.82)	0.124 (1.82)	0.124 (1.82)
Mother education unknown	0.050 (0.56)	0.053 (0.59)	0.052 (0.58)	0.051 (0.57)	0.054 (0.60)	0.055 (0.61)	0.054 (0.60)	0.054 (0.60)
Mother occasionally worked	-0.059 (-2.35)	-0.058 (-2.32)	-0.058 (-2.32)	-0.058 (-2.33)	-0.059 (-2.35)	-0.059 (-2.37)	-0.059 (-2.37)	-0.059 (-2.36)
Mother usually worked	-0.118 (-3.95)	-0.118 (-3.95)	-0.117 (-3.93)	-0.117 (-3.92)	-0.118 (-3.94)	-0.118 (-3.95)	-0.118 (3.95)	-0.118 (-3.95)
Mother always worked	-0.043 (-1.55)	-0.043 (-1.55)	-0.043 (-1.55)	-0.043 (-1.54)	-0.048 (-1.72)	-0.048 (-1.72)	-0.048 (-1.73)	-0.048 (-1.73)
Infrequent religious attendance	0.084 (2.96)	0.084 (2.94)	0.082 (2.89)	0.084 (2.94)	0.094 (3.30)	0.094 (3.29)	0.094 (3.28)	0.094 (3.29)
Moderate religious attendance	0.328 (9.94)	0.327 (9.90)	0.325 (9.84)	0.327 (9.91)	0.340 (10.26)	0.340 (10.26)	0.340 (10.25)	0.340 (10.25)
Frequent religious attendance	0.498 (15.17)	0.498 (15.16)	0.496 (15.11)	0.498 (15.17)	0.511 (15.47)	0.511 (15.48)	0.511 (15.47)	0.511 (15.47)
Hours worked	-0.011 (-14.30)	-0.011 (-14.32)	-0.011 (-14.33)	-0.011 (-14.32)	-0.011 (-14.32)	-0.011 (-14.32)	-0.011 (-14.32)	-0.011 (-14.33)
Formal school years	-0.014 (-1.71)	-0.014 (-1.76)	-0.014 (-1.75)	-0.014 (-1.71)	-0.012 (-1.48)	-0.012 (-1.48)	-0.012 (-1.47)	-0.012 (-1.47)
College less than half-time	-0.051 (-1.13)	-0.052 (-1.15)	-0.052 (-1.13)	-0.053 (-1.16)	-0.059 (-1.28)	-0.059 (-1.29)	-0.059 (-1.29)	-0.059 (-1.29)
College half-time	-0.003 (-0.06)	-0.004 (-0.07)	-0.002 (-0.04)	-0.004 (-0.07)	-0.012 (-0.21)	-0.012 (-0.22)	-0.011 (-0.21)	-0.011 (-0.21)
College full-time	0.096 (3.34)	0.094 (3.30)	0.094 (3.29)	0.095 (3.34)	0.100 (3.51)	0.100 (3.52)	0.100 (3.51)	0.100 (3.51)
D77	0.486 (5.40)	0.490 (5.44)	0.493 (5.47)	0.488 (5.42)	0.499 (5.54)	0.497 (5.53)	0.499 (5.55)	0.500 (5.56)
D78	0.332 (3.99)	0.335 (4.03)	0.336 (4.05)	0.330 (3.97)	0.339 (4.08)	0.336 (4.04)	0.339 (4.07)	0.340 (4.09)
D79	0.422 (5.26)	0.426 (5.31)	0.430 (5.35)	0.422 (5.26)	0.427 (5.30)	0.424 (5.26)	0.427 (5.30)	0.428 (5.32)
D80	0.359 (4.49)	0.364 (4.57)	0.369 (4.63)	0.360 (4.51)	0.356 (4.43)	0.353 (4.40)	0.357 (4.45)	0.358 (4.47)
D81	0.433 (5.56)	0.438 (5.63)	0.445 (5.71)	0.434 (5.58)	0.434 (5.51)	0.431 (5.48)	0.436 (5.54)	0.437 (5.56)
D82	0.405 (5.31)	0.411 (5.39)	0.415 (5.44)	0.406 (5.31)	0.410 (5.35)	0.407 (5.31)	0.411 (5.36)	0.412 (5.38)
D83	0.369 (4.91)	0.369 (4.92)	0.368 (4.91)	0.364 (4.85)	0.384 (5.10)	0.380 (5.06)	0.382 (5.08)	0.384 (5.09)
D84	0.380 (5.04)	0.382 (5.07)	0.381 (5.05)	0.376 (4.98)	0.394 (5.20)	0.390 (5.15)	0.392 (5.18)	0.393 (5.19)
D85	0.469 (6.28)	0.473 (6.34)	0.472 (6.33)	0.466 (6.24)	0.490 (6.54)	0.485 (6.48)	0.487 (6.50)	0.489 (6.53)
D86	0.461 (6.13)	0.463 (6.17)	0.460 (6.13)	0.455 (6.07)	0.486 (6.42)	0.481 (6.36)	0.483 (6.38)	0.485 (6.40)
D87	0.445 (5.91)	0.447 (5.95)	0.444 (5.90)	0.439 (5.83)	0.470 (6.17)	0.465 (6.12)	0.466 (6.12)	0.468 (6.15)
D88	0.407 (5.28)	0.409 (5.32)	0.406 (5.28)	0.400 (5.20)	0.437 (5.58)	0.431 (5.51)	0.433 (5.53)	0.436 (5.56)
D89	0.432 (5.50)	0.436 (5.57)	0.434 (5.53)	0.424 (5.41)	0.479 (5.90)	0.470 (5.82)	0.473 (5.85)	0.477 (5.88)
D90	0.367 (4.51)	0.369 (4.57)	0.366 (4.51)	0.354 (4.36)	0.423 (4.97)	0.410 (4.88)	0.415 (4.91)	0.420 (4.95)
D91	0.339 (3.92)	0.338 (3.93)	0.332 (3.85)	0.324 (3.76)	0.405 (4.37)	0.392 (4.27)	0.395 (4.29)	0.401 (4.33)
D92	0.381 (4.13)	0.383 (4.17)	0.379 (4.12)	0.368 (3.99)	0.468 (4.64)	0.453 (4.55)	0.458 (4.58)	0.465 (4.62)
D93	0.355 (3.84)	0.366 (3.98)	0.363 (3.94)	0.344 (3.73)	0.452 (4.48)	0.435 (4.38)	0.440 (4.42)	0.450 (4.47)



East	-0.227 (-4.81)	-0.218 (-4.73)	-0.232 (-5.20)	-0.239 (-5.22)
Midwest	-0.192 (-4.52)	-0.187 (-4.51)	-0.202 (-5.41)	-0.209 (-5.40)
Mountain	-0.016 (-0.24)	-0.015 (-0.23)	-0.034 (-0.54)	-0.035 (-0.56)
New England	-0.168 (-3.33)	-0.157 (-3.18)	-0.174 (-3.62)	-0.181 (-3.72)
New Jersey/ New York	-0.227 (-4.83)	-0.215 (-4.71)	-0.231 (-5.18)	-0.240 (-5.25)
North West	0.049 (0.79)	0.044 (0.71)	0.024 (0.42)	0.025 (0.45)
Plains	-0.234 (-4.42)	-0.224 (-4.32)	-0.235 (-4.59)	-0.243 (-4.63)
South	-0.098 (-1.93)	-0.100 (-2.03)	-0.120 (-2.54)	-0.118 (-2.71)
South East	-0.149 (-3.01)	-0.134 (-2.83)	-0.152 (-3.32)	-0.162 (-3.40)

*Note:* All equations also include missing value indicators for race, gender, income, type of community, marital status, parental education, mother's work status while growing up, religious participation, hours worked, formal years of schooling, and college enrollment status. Asymptotic *t*-ratios are in parentheses. The critical values for the *t*-ratios are 2.58 (2.33), 1.96 (1.64), 1.64 (1.28) at the 1, 5, and 10% significance levels, respectively, based on a two-tailed (one-tailed) test.

Table 3  
Estimated price elasticities of cessation

Model 1	0.377
Model 2	0.415
Model 3	0.466
Model 4	0.417
Model 5	0.269
Model 6	0.274
Model 7	0.293
Model 8	0.291

are controlled for (models 5–8), the coefficients for private worksite restrictions are no longer significant at conventional levels. The average hazard ratio across the alternative specifications that include private worksite restrictions as a covariate indicates that individuals who reside in states that regulate smoking in private worksites have a 4.55% greater probability of quitting smoking than do individuals who reside in states that do not regulate smoking in private worksites. Policies restricting smoking in public places other than restaurants are found to have a positive and significant impact on smoking cessation when census division fixed effect are not controlled for, but have a negative and insignificant impact on smoking cessation when census division dummies are included. In general, restaurant restrictions have an insignificant impact on young adult smoking cessation decisions, although in model 1, restaurant restrictions have an anomalous negative impact on cessation.

The mixed results with respect to the clean indoor air laws are not surprising. Other than private worksites, young adults are likely spending a small fraction of their time in places that are regulated by smoke free air laws. Moreover, the clean indoor air laws used in this analysis likely underestimate the true impact smoking restrictions have on young adult smoking cessation because they do not account for local level policies that are often more stringent than state level policies, they do not take account the magnitude of the restriction, they do not control for the level of enforcement that takes place within states, and there may not be enough variation within census divisions in the existence of these policies during the period under study here.

Briefly reviewing the estimates for the other independent variables: holding all other factors constant, males are significantly less likely to quit smoking than

are females. With respect to race and ethnicity, the probability of cessation is higher among Caucasians than for those of African American descent, although conventional significance levels are not reached.

Individuals with higher yearly incomes from employment are significantly more likely to quit smoking than are individuals with lower yearly incomes. This positive relationship implies that cigarette smoking is an economically inferior behavior, and supports much of the recent empirical evidence on adult cigarette demand [26].

No significant differences are observed between the variables capturing the type of community individuals reside in and the probability of smoking cessation. Individuals who are either engaged or are separated or divorced are significantly less likely to quit smoking than are individuals who are single. Married individuals are also less likely to quit than are individuals who are single, although the estimates are not significant at conventional levels. Young adults who live with their parents are significantly more likely to quit smoking than are individuals who do not live with their parents. Young adults who live with their children are significantly less likely to quit smoking than are individuals who do not live with their children. No other significant differences are observed with respect to family structure.

Individuals whose mothers have at least some college education are much more likely to quit smoking as young adults than are individuals whose mother's education did not exceed the high school level. No significant differences are observed between paternal education and the probability of smoking cessation. Individuals whose mothers worked while they were growing up are less likely to quit smoking as young adults than individuals whose mothers did not work while they were growing up.

Young adults with a strong attachment to religion, as measured by the frequency of attendance at religious services, are much more likely to quit smoking than are young adults with little or no attachment to religion. Individuals who work many hours a week as young adults are significantly less likely to quit smoking than are individuals who work less hours per week. Individuals who attend college full time are significantly more likely to quit smoking than are individuals who do not attend college at all, however, young adults with more years of formal schooling are

significantly less likely to quit than are those with less formal education. Individuals who live in the East, Midwest, New England, New York/New Jersey, Plains, South, and South East census divisions of the United States are significantly less likely to quit smoking than are individuals who live in the West census division. Finally, young adults were much more likely to quit smoking in 1977–1993 than they were in 1976.

## 5. Discussion

The Balanced Budget Act of 1997 (Public Law 105-33, Section 9302) imposed a two-stage Federal excise tax increase on cigarettes. As part of the Balanced Budget Act of 1997, the Federal excise tax on a pack of 20 cigarettes increased by 10 cents on 1 January 2000. Two years later, the Federal excise tax on cigarettes increased an additional 5 cents per pack bringing the total Federal excise tax on cigarettes to 39 cents per pack.

In the wake of significant declines in revenues and large budget shortfalls, thirty states have implemented or passed higher cigarette excise tax rates since 1 January 2002. As of 24 July 2003, state excise tax rates on cigarettes ranged from a low of US\$ 0.025 per pack in the state of Virginia to US\$ 2.05 in New Jersey. It is this differential tax rate that causes substantial variation in the price of cigarettes across states.

The findings from this study clearly support the hypothesis that increasing the price of cigarettes (which would result from cigarette excise tax increases) would increase the number of young adults who quit smoking. The estimated average price elasticity of smoking cessation is 0.35, suggesting that a 10% increase in the price of cigarettes will increase the likelihood of young adult smoking cessation by 3.5%.

In addition, the estimates indicate that stronger restrictions on smoking in private worksites and public place other than restaurants are likely to have a positive impact on young adult smoking cessation.

Given the estimates above, and the well-documented benefits of smoking cessation [27], a significant increase in cigarette excises taxes along with more stringent smoke free air laws may be an extremely effective means to reduce the death and disease caused by tobacco use in the United States.

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