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Determinants of Smoking Cessation:
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ABSTRACT

Substantial econometric efforts have been devoted to examining the impacts prices and tobacco control policies have on smoking propensity and intensity. However, little is known about the effects prices, smoking restrictions, and other influences have on smoking cessation. This paper uses longitudinal data from the Monitoring the Future Surveys, augmented with cigarette price and policy-related measures to estimate smoking cessation equations for young adult males and females separately. The estimates clearly indicate that increases in cigarette prices would lead a significant number of young adults to quit smoking. In addition, policies restricting smoking in private worksites increase the probability of smoking cessation among employed young adult females.

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I. Introduction

Since the publication of the first Surgeon General's Report on the health consequences of cigarette smoking in 1964, the government has been involved in a sporadic and often unsynchronized campaign to reduce the use of cigarettes in the United States. This campaign has included such elements as: wide-spread dissemination of information on the risks of smoking, anti-smoking advertisements, limits on cigarette manufacturer's advertisements, restrictions on smoking in private workplaces and public places, increases in cigarette excise taxes, restrictions on minors' access, and various others. (USDHHS, 1991) Throughout the twenty-five years following the onset of the government's anti-smoking effort, substantial progress was made in decreasing the prevalence of cigarette smoking among adults and youth alike. However, recent data suggests that the decades of steady decline have not been sustained. The prevalence of smoking among adults declined very slightly in the 1990's. According to the National Health Interview Surveys (NHIS), 25.5% of U.S. adults were current smokers in 1990 as compared to 24.7% in 1995.[1] Even more troubling however is the increased prevalence of cigarette smoking among youth and young adults in the 1990's. According to the Monitoring the Future Surveys (MTFS), the prevalence of cigarette smoking among 8th, 10th, and 12th graders has increased for the better part of a decade. (University of Michigan News and Information Services (UMNIS), 1998)

The upward trend in smoking among American teenagers in the 1990's has led to an increased effort to prevent the consumption of cigarettes by youth and young adults. The use of economic incentives to discourage cigarette smoking among America's young

people has reached the national spotlight. One of President Clinton's top domestic priorities for 1998 was to pass legislation containing strong tobacco control provisions, including a significant increase in the price of cigarettes. Similarly, on February 1, 1999, President Clinton unveiled his proposed budget for fiscal year 2000 which contained several important tobacco-related initiatives including a 55-cent excise tax increase on cigarettes.[2]

This paper investigates the determinants of the decision to quit smoking by young adults. In particular, this paper examines the impact price, clean indoor air laws, and other socioeconomic factors have on smoking cessation by males and females separately. Semi-parametric Cox duration models are estimated employing panels formed from the nationally representative cross-sectional surveys of high school seniors conducted by the Institute for Social Research at the University of Michigan as part of the Monitoring the Future project. While preventing youth and young adults from initiating smoking is an extremely important approach to tobacco control, 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. In fact, many researchers consider smoking cessation as the "gold standard" of healthcare cost effectiveness, producing higher quality and length of life at costs that are well below other health care interventions. (Warner, 1997)

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[1] The definition used to assess smoking prevalence changed in 1992. As of 1992, some-day smoking was included in the definition of current smoking. The inclusion of intermittent smokers in the new definition will increase the prevalence estimates by approximately 1.0% over the previous definition. (CDC, 1994)

[2] Other tobacco initiatives included a $34 million increase for the Food and Drug Administration's tobacco enforcement budget, a $27 million increase for the Center for Disease Control and Prevention anti-tobacco initiatives, and a $20 million increase for the department of Justice's Federal lawsuit against the tobacco industry.

II. Brief Review of Econometric Studies of Cigarette Demand

Over the past three decades, numerous econometric studies of the determinants of cigarette demand have been published.[3] Substantial econometric efforts have been devoted to examining what effect price has on individual's consumption of cigarettes. One general conclusion emerges from these studies – that the demand for cigarettes is responsive to the price of cigarettes.

Many of these studies employ aggregate level data. Price elasticity estimates obtained using aggregate data ranged from –0.14 to –1.23, with a majority of the estimates falling within a narrower range of –0.20 to –0.50. (USDHHS, 1994) Differences in the price elasticity estimates can be attributed to the use of diverse data, theoretical modeling, and estimation techniques.

A growing number of recent studies use micro-level data (individual or group level) to measure the impact price and other tobacco control policies have on the demand for cigarettes. The price elasticity estimates that are obtained from these studies are comparable to those using aggregate level data, however, the use of micro-level data has several advantages over using aggregate level data. First, simultaneity problems are lessened when using micro-level data. That is, price can be treated as exogenous when using individual-level data because no one person can smoke enough cigarettes to affect the market price. Second, the use of micro-level data allows researchers to analyze the effects of price on the probability that an individual smokes and on average cigarette consumption among smokers, and not just per-capita cigarette consumption, which is the primary focus of studies that use aggregate data. Finally, micro-level data can be used to

[3] For a comprehensive review of these studies, see U.S. Department of Health and Human Services (1989, 1994), and Chaloupka and Warner (forthcoming).

evaluate the differential effects of price on alternative demographic groups (such as by age, by gender, by race, etc.).

Although many econometric studies of cigarette demand have been published over the past 30 years, economists have given very little attention to estimating the determinants of the decisions to start or quit smoking in either empirical or theoretical work. Determining why people start smoking and what factors cause smoking cessation should be a central focus in formulating appropriate antismoking policies. Only two published econometric studies and three unpublished studies have examined the impact cigarette prices or taxes have on either smoking initiation or smoking cessation.

In an unpublished study, DeCicca, Kenkel, and Mathios (1998a) use the 1988 National Educational Longitudinal Study (NELS) to measure the responsiveness of youth cigarette consumption to cigarette excise tax changes. They estimate both cross-sectional demand functions and smoking onset functions in their evaluation of excise taxation. They conclude that in each of the cross-sections, cigarette excise taxes have a strong negative effect on cigarette consumption. However, in contrast to the cross-sectional results, the results from the smoking onset equations suggest that cigarette taxes are not important determinants of smoking initiation. They further conclude that jail penalties for illegal sales and licensure requirements do not significantly reduce youth cigarette consumption and do not deter smoking onset. Finally, they find that students who eventually drop out of high school are more likely to initiate smoking years before the student actually drops out, leading them to conclude individuals with high discount rates (time preference) may be the cause of both smoking and dropping out of high school.

Dee and Evans (1998) reevaluated the NELS data used by DeCicca et al., making several adjustments to the way in which the sample was constructed. First, unlike DeCicca et al. who deleted a large number of observations due to missing values for certain covariates, Dee and Evans included these observations in their analysis together with dummy variables indicating that the data were missing. Second, rather than constructing "continuous" variables from categorical data as did DeCicca et al., Dee and Evans used a variety of binary indicators. After making these changes, Dee and Evans obtained negative and significant price elasticities for the smoking onset function comparable to the prevalence elasticities estimated in studies that employed cross sectional data.

In an attempt to clarify the impact tax has on smoking initiation, DeCicca, Kenkel, and Mathios (1998b) reexamined their original study, and implemented an alternative approach to dealing with the missing data problem. Wherever possible, they filled in missing values with information from the longitudinal sample. When individual data could not be harnessed, they used a conditional mean imputation approach. Their reanalysis produced some negative and significant estimates for the effect of cigarette tax on smoking initiation, however, the significance and magnitude of the tax coefficients were not as strong as those obtained by Dee and Evans.

Douglas and Hariharan (1994) employ data from the 1978 and 1979 National Health Interview Survey: Smoking Supplement (NHISSS) to investigate the determinants of the decision to start smoking. They use a split population duration model first developed by Schmidt and Witte (1989) to estimate the probability that an individual will start smoking. After controlling for such factors as age, gender, race, education, marital

status, and family income, economic variables such as taxes (which increase the price of cigarettes) have no impact on teenage decisions to start smoking. However, the study finds that non-economic variables such as lifetime educational attainment, marital status, race, and gender do play a significant role in reducing the probability that teenagers will initiate smoking.

Expanding on the original study, Douglas (1998) used the 1987 National Health Interview Survey: Cancer Risk Factor Supplement to investigate the determinants of the decisions to start and quit smoking in the context of an economic model of addiction. Douglas uses several different functional forms (log-logistic, Weibull, and Schmidt and Witte Split Population) to model the starting and quitting hazard functions. He concluded that current, future, and past prices of cigarettes have a statistically insignificant effect on the probability of initiation. Likewise, current and past prices were found to be statistically insignificant in the probability of quitting. However, the duration estimates suggest that increases in future cigarette prices will significantly increase quitting rates. Douglas estimates a quitting hazard elasticity of 1.07 to 1.30 with respect to future price. This suggests that a 10% percent permanent increase in the future price of cigarettes will reduce the average duration of smoking by 11%-13%. In addition, the study indicated that information dissemination regarding the adverse health consequences of smoking, bans on cigarette advertising, and state level regulations significantly increase the probability of quitting.

While the recent studies by DeCicca, Kenkel, and Mathios (1998a), Douglas and Hariharan (1994), and Douglas (1998) make significant contributions to the investigation of the determinants of the decision to start and quit smoking, many of their findings,

particularly those that deal with price and tax changes, are at odds with a majority of the research on the determinants of cigarette smoking conducted over the past several decades. One possible explanation why Douglas and Hariharan (1994) and Douglas (1998) find insignificant current and past price effects may be due to the fact that they use cross-sectional data from 1978-1979, and 1987 respectively. The application of duration methods in the econometric analysis of cigarette smoking requires relatively high quality longitudinal data that can accurately measure cigarette consumption, cigarette prices, government enacted policy variables, income, and socio-demographic variables over a relatively long time period. Indeed, both studies that apply duration methods to cigarette smoking employ cross-sectional data with retrospective information on smoking initiation and cessation. Therefore, incorrect recall by participants can dramatically influence any results obtained. A second possible explanation stems from the error in matching prices to respondents' previous states of residence. Douglas and Hariharan (1994) and Douglas (1998) base all previous prices that a respondent would have paid for cigarettes on the respondent's current state of residence. Therefore, if a respondent lived in a different state in the past, significant errors in price matching would be likely. As Douglas (1998) notes, the panel data requirements needed to use duration modeling are not met in either study, and future investigation is needed using true longitudinal data.

Several recent econometric studies have examined the impact clean indoor air laws have on cigarette demand. Chaloupka and Grossman (1996) concluded that strong restrictions on smoking significantly reduce both the propensity and intensity with which youth smoke. Chaloupka and Wechsler (1997), and Tauras and Chaloupka (1999) concluded that strong smoking restrictions significantly reduce both smoking prevalence

and average daily cigarette consumption among young adults. After accounting for the potential endogeneity of smoking restrictions, Ohsfeldt, Boyle, and Capililouto (1998) concluded that the strongest restrictions on cigarette smoking lead to significant decreases in smoking prevalence. Finally, after accounting for the potential self selection of workers, Evans, Farrelly, and Montgomery (1996) concluded that workplace smoking bans reduce the probability of adult smoking by 5% and reduce the average daily cigarette consumption of smokers by 10%.

To summarize, much has been learned over the past 30 years about the effects of cigarette prices on smoking - increased cigarette prices are expected to decrease cigarette consumption in all segments of the U.S. population. Similarly, strong clean indoor air laws have been found to decrease both the propensity to smoke and the intensity with which smokers smoke. However, not much is known about how price, smoking restrictions, and other influences impact smoking cessation. A better understanding of what causes smoking cessation is of utmost importance in the efforts to decrease the burden that smoking causes. Our research proposes to address these issues by providing the first analysis of the impact prices, clean indoor air laws, and other socio-economic factors have on smoking cessation, using models based on duration, employing nationally representative longitudinal data.

III. Data and Methods

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 entitled Monitoring the Future: A Continuing Study of American Youth (MTF)[4]. 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 twenty 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.

One limitation that exists in the MTF data is that the survey includes only high school seniors who have not dropped out of high school or who were present the day the questionnaires were administered. Johnston, O'Malley and Bachman (1996) have argued that dropouts in general have substantially higher smoking prevalence rates than do in-school students, and that students who are consistently absent from school have similar smoking patterns to dropouts. DeCicca, Kenkel, and Mathios (1997) take the argument one step further and conclude that students who drop out of high school have higher smoking prevalence rates years before they actually drop out of high school.

Starting with the class of 1976, approximately 2,400 individuals from each senior class are chosen to participate in follow-up surveys. The 2,400 selected respondents are divided into 2 groups of 1,200 individuals each. One group is surveyed on even-

[4] In the past, the Monitoring the Future Study was sometimes called the National High School Senior Survey.

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 one year after baseline (senior year in high school), while the other group is resurveyed for the first time two years after the baseline year. Subsequent follow-ups are conducted at two-year intervals for both groups for up to seven follow-ups and then less frequently. Since a consistent measure of the duration of the smoking state is required across individuals, respondents surveyed one year after baseline are deleted from the sample. Similarly, individuals who are not at risk of making a transition (nonsmokers at baseline) are deleted. After deleting individuals for the reasons mentioned above, a sample of 4,826 females and 4,752 males are used in the analysis.

The questionnaires used in the follow-up surveys are very similar to those used in the baseline. Respondents are mailed the same form of the questionnaire that they received in the baseline year in all subsequent follow-ups. Many of the questions that were asked in the baseline are also asked in all the subsequent follow-up questionnaires 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.

As with any longitudinal survey, the retention rate declines over time. However, the panel retention rates from the MTF surveys have been very high. According to Johnston, O'Malley, and Bachman (1996), an average of 80% of those selected for inclusion in the first follow-up have returned questionnaires. The 1995 panel retention from the class of 1981 (where individuals had reached a modal age of 32) was 60%.

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 initiation/experimentation to 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 for 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 thirty days prior to the survey, and equal to zero otherwise. Tracked over time, the participation variable was used to construct a measure of each respondent's duration of smoking until cessation or censoring. The first followup that an individual responds not smoking based on 30 day use is considered to have stopped smoking. Since followups are conducted at two-year intervals, cessation based on past month use may not imply long term cessation because there is no way to assess whether or not an individual has stopped smoking for 30 days or two years. Furthermore, reinitiation of smoking is not looked at and therefore no conclusions on permanent smoking cessation can be drawn.

In addition to the cigarette consumption variables, a variety of independent variables was 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, Black – omitted); indicators of college student status (full-time, half-time, less than half-time, no college - omitted); indicators of frequency of participation in religious services (never - omitted, infrequent participation, moderate participation, and frequent participation); indicators of marital status (married, engaged, separated or divorced, and single - omitted); indicators of family structure (live alone, live with parents, live with spouse, live with child); and indicators of type of city/town (urban - omitted, suburban, and rural).

In addition, indicators of region according to the Bureau of Labor Statistics (Northeast, South, Midwest, and West –omitted) and variables capturing the year the questionnaires were administered (Year and Year Squared) 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 annual Tax Burden on Tobacco. Each year, the Tobacco Institute publishes state level cigarette prices as of November 1. 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 November 1, 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 six months of the year is computed. The average price for the first six months of

every year is computed by subtracting state and federal excise taxes from the current year's price and the previous year's price and weighting the pre-tax prices accordingly (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 six month's average pretax 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 and magnitude of state 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.

In an attempt to capture the magnitude of each state's clean indoor air laws, a clean indoor air index variable was created. The construction of this variable is similar to the classification scheme presented in various Surgeon General Reports (USDHHS 1986a and 1989). The index variable is defined as follows: it takes on a value of 4 if the state has "extensive" restrictions on cigarette smoking, that is, if it regulates smoking in private workplaces; it takes on a value of 3 if the state has "moderate" restrictions, that is, if it regulates smoking in restaurants but not in private worksites; it takes on a value of 2 if the state has "basic" restrictions, that is, if it limits smoking in health care facilities, grocery stores, or government worksites and not in restaurants or private worksites; it takes on a value of 1 if the state has "nominal" restrictions, that is, if it limits smoking in public places other than health care facilities, grocery stores, restaurants, government

worksites, and private worksites; and finally, it takes on a value of 0 if the state has no restrictions on cigarette smoking, that is, if it does not restrict cigarette smoking in private worksites, restaurants, health care facilities, grocery stores, government worksites, or any other public place.

To control for the potential differential impact that restrictions on smoking in private workplaces have on smoking behaviors among individuals in the labor force versus those that are not working, an interaction variable between work status and private workplace restrictions was created. This variable is equal to one if the respondent is currently employed in a state that restricts smoking in private workplaces and is equal to zero otherwise. When the interaction variable is used as a regressor, an alternative clean indoor air index variable that excludes private worksite restrictions is used. The index takes a value of three if the state restricts smoking in restaurants; two if the state restricts smoking in health care facilities, grocery stores, or government worksites and not restaurants; one if state restricts smoking in other public places excluding restaurants, grocery stores, health care facilities and government worksites; zero if the state does not restrict smoking in any public place.

Duration modeling is the appropriate statistical tool for investigating the structural determinants of the probability of transition from one discrete state to another. A semi-parametric non-proportional Cox hazard regression is used to assess the probability of making a transition from the smoking state to the nonsmoking state. The Cox model allows changes in exogenous covariates to affect the quitting hazard (probability of cessation conditional on being a continuous smoker) while assuming no specific functional form for the underlying hazard function.

IV. Results

Historical differences in patterns of smoking exist between men and women. Smoking prevalence rates for men increased dramatically during the first few decades of the century. Smoking prevalence rates among women however did not begin to rise rapidly until a few decades later. Consequently, by 1965, one year after the release of the first Surgeon General's report, 51.9% of men currently smoked, whereas only 33.9% of women currently smoked. (NHIS, 1965) Since that time, cigarette smoking among both sexes has declined, but the rate of decline has been slower among women than men. In 1994, 28.2% of men were smokers, as compared to 23.1% of women. In order to explore the differences in smoking patterns, smoking cessation equations are estimated for males and females separately.

Table 2 contains the estimates from the smoking cessation equations for males, whereas Table 3 contains comparable estimates for females. Four alternative models are estimated. Model 1 of each table controls for the real price of cigarettes, race, income, age, religiosity, type of community, average work hours, marital status, family structure, formal years of schooling, college student status, region, and two time trend variables (year and year squared). In addition, with the exception of price, time trend, region, and the indicators of family structure, which were not mutually exclusive, indicators for respondents with missing data for all of 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 frequency of participation at religious services is unknown for a given time period, each of the religion participation variables takes on a value of

zero for that time period, while an additional indicator, unknown religious service participation, takes on a value of one. This missing value indicator takes on a value of zero for all respondents whose religious participation is known. Model 2 of each table is identical to Model 1, except Model 2 adds a clean indoor air index variable. Model 3 of each table is identical to Model 2, except the clean indoor air index variable is replaced by three dichotomous indicators for smoking in private worksites, restaurants, and any other public place restriction. Model 4 of each table is identical to Model 2, except the clean indoor air index variable is replaced by an interaction variable between work status and private worksite restrictions, and a modified clean indoor air index variable that excludes private worksite restrictions.

The real price of cigarettes is found to have a positive and significant impact on the quitting hazard for both males and females in all the models that are estimated. These estimates clearly show that increases in the real price of cigarettes will increase the probability of cessation by both young adult men and women. Table 4 contains the estimated price elasticities of cessation. The price elasticity of male cessation ranges from 1.07 to 1.17 and has an average elasticity of 1.12. The price elasticity of female smoking cessation ranges from 1.17 to 1.21 and has an average elasticity of 1.19. These estimates imply that a 10% increase in the real price of cigarettes will increase the probability of smoking cessation by approximately 11% and 12% for young men and women respectively.

State-level policies restricting smoking in private workplaces have a positive impact on the probability of cessation among employed young adult females. Other restrictions on smoking in public places seem to have little impact on female smoking

cessation decisions. In general, laws restricting smoking in private worksites and public places have no significant impact on young adult male smoking cessation decisions.[5]

Briefly reviewing the estimates for the other independent variables: income has an insignificant impact on the probability of cessation for both males and females. With respect to race and ethnicity, the probability of cessation for both male and female Caucasians is significantly higher than that of Blacks. Both males and females with strong attachments to religion, as measured by religious service attendance, are more likely to quit smoking than individuals with less religious attachment. The probability of quitting and age are inversely related for both males and females, however the relationship for females is not significant in any of the models.

With respect to the type of community individuals reside in, both males and females who live in either rural or suburban localities are more likely to quit smoking than individuals who live in urban settings. However this relationship is only significant at the 5% level for women living in rural communities. The number of hours worked has a negative impact on the probability of cessation for both males and females, however, the relationship is significant solely for males. Being married has a positive impact on the probability of cessation by both men and women, although the relationship is not significant for either gender. Both males and females who are engaged or are either separated or divorced have a lower probability of cessation than are individual's who are single, however these relationships do not reach conventional significance for females.

Females who live alone are significantly less likely to stop smoking than are females who do not live alone. No significant differences are observed between any of

[5] The state-level clean indoor air measures used in this analysis may underestimate the full impact smoking restrictions have on smoking cessation because they cannot account for local-level policies or employer

the other variables capturing living arrangements and the probability of smoking cessation. The probability of smoking cessation among both males and females and education, as measured by the number of formal years of schooling completed, is positively related. However, the relationship between schooling and cessation is only significant for females. Females who attend college full time are more likely to quit smoking than females who do not attend college. No other significant relationships exist between college student status and cessation. Finally, individuals who live in the Northeast, Midwest, and South are less likely to quit smoking than those who live in the West region of the United States.

V. Discussion

A significant number of previous studies have concluded that price and smoking participation are inversely related. However, these studies were unable to distinguish whether this decrease in participation was a result of decreased initiation or increased cessation. This paper is the first research to conclude that price is positively related to the probability of smoking cessation for both young adult males and females. The estimated average price elasticity of cessation was 1.12 and 1.19 for males and females respectively. The estimates clearly indicate that large increases in cigarette excise taxes, as proposed in President Clinton's budget for fiscal year 2000, would lead a significant number of young adults to quit smoking. Moreover, the estimates imply that stronger restrictions on smoking in private worksites will increase the probability of cessation among young adult females.

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initiated policies that may play an important role in smoking cessation.

Although president Clinton's proposal to increase the excise tax on cigarettes is aimed at preventing youth from initiating smoking until they are capable of making a mature and informed decisions, according to the results described above, higher cigarette prices (which would result from higher excise taxes) will also increase the probability of cessation among young adults of both gender.

According to the 1994 Surgeon General's report, almost all first use of cigarettes occurs before high school graduation. Much like adults, many adolescents readily become addicted to cigarettes and find it very difficult to quit. Given the estimates above and the well-documented benefits of smoking cessation (USDHHS, 1990), a significant increase in the excise tax may result in substantial reductions in tobacco causing disease and other harms caused by tobacco.

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Table 1

Variables	Definition, Male Mean (μ_m), Female Mean (μ_f)
Duration	Time until smoking cessation occurs or respondent's observations are censored, in years. μ_m= 3.79 μ_f= 4.48
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. μ_m= 1.058 μ_f=1.068
Clean Indoor Air Index	Index of state restrictions on smoking in public places and private workplaces. The index is equal to: four if the state restricts smoking in private worksites; three if the state restricts smoking in restaurants and not private worksites; two if the state restricts smoking in health care facilities, grocery stores, or government worksites and not restaurants or private worksites; one if state restricts smoking in other public places excluding private worksites, restaurants, grocery stores, health care facilities and government worksites; zero if the state does not restrict smoking in any public place or private workplace. μ_m=1.48 μ_f=1.50
Private Workplace Restriction	Dichotomous indicator equal to one if respondent resides in a state that restricts cigarette smoking in private worksites and zero otherwise. μ_m=0.22 μ_f=0.23
Restaurant Restriction	Dichotomous indicator equal to one if respondent resides in a state that restricts cigarette smoking in restaurants and zero otherwise. μ_m=0.31 μ_f=0.32
Other Indoor 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. μ_m=0.47 μ_f=0.47
Clean Indoor Air Index Without Private Workplace Restriction	Index of state restrictions on smoking in public places. The index is equal to: three if the state restricts smoking in restaurants; two if the state restricts smoking in health care facilities, grocery stores, or government worksites and not restaurants; one if state restricts smoking in other public places excluding restaurants, grocery stores, health care facilities and government worksites; zero if the state does not restrict smoking in any public place. μ_m=1.25 μ_f=1.25
Work Status and Private Workplace Interaction	Dichotomous indicator equal to one for individuals who are currently employed and zero otherwise; multiplied by a dichotomous indicator equal to one if respondent resides in a state that restricts cigarette smoking in private worksites and zero otherwise. μ_m=0.19 μ_f=0.18
White	Dichotomous indicator equal to one if White or Caucasian and zero otherwise. μ_m=.84 μ_f=.84
Yearly Income	Average real yearly income from employment sources only (in dollars), deflated by the national Consumer Price Index, 1982-

	1984=100. μ_m=92.92 μ_f=64.55
Age	Age, in years. μ_m=23.01 μ_f=23.25
Infrequent Religion	Dichotomous indicator equal to one for individuals who attend religious services infrequently and zero otherwise. μ_m=0.51 μ_f=0.49
Moderate Religion	Dichotomous indicator equal to one for individuals who attend religious services occasionally and zero otherwise. μ_m=0.14 μ_f=0.18
Frequent Religion	Dichotomous indicator equal to one for individuals who attend religious services frequently and zero otherwise. μ_m=0.15 μ_f=0.19
Suburban	Dichotomous indicator equal to one for individuals who live in a suburban community and zero otherwise. μ_m=0.64 μ_f=0.66
Rural	Dichotomous indicator equal to one for individuals who live in a rural community and zero otherwise. μ_m=0.17 μ_f=0.14
Work Hours	Number of hours worked per week in the past thirty days. μ_m=30.12 μ_f=25.21
Married	Dichotomous indicator equal to one for individuals who are married, and zero otherwise. μ_m=0.24 μ_f=0.31
Engaged	Dichotomous indicator equal to one for individuals who are engaged, and zero otherwise. μ_m=0.07 μ_f=0.10
Separated / Divorced	Dichotomous indicator equal to one for individuals who are separated or divorced, and zero otherwise. μ_m=0.03 μ_f=0.05
Live Alone	Dichotomous indicator equal to one for individuals who live alone, and zero otherwise. μ_m=0.07 μ_f=0.05
Live Parents	Dichotomous indicator equal to one for individuals who live with their parents, and zero otherwise. μ_m=0.46 μ_f=0.40
Live Spouse	Dichotomous indicator equal to one for individuals who live with their spouse, and zero otherwise. μ_m=0.23 μ_f=0.30
Live Child	Dichotomous indicator equal to one for individuals who live with their child or children, and zero otherwise. μ_m=0.15 μ_f=0.25
School Years	Number of formal school years completed. μ_m=12.61 μ_f=12.77
College Less Than Half time	Dichotomous indicator equal to one for individuals who are attending college less than half-time, and zero otherwise. μ_m=0.04 μ_f=0.05
College Half Time	Dichotomous indicator equal to one for individuals who are attending college half-time, and zero otherwise. μ_m=0.02 μ_f=0.03
College Full Time	Dichotomous indicator equal to one for individuals who are attending college full-time, and zero otherwise. μ_m=0.12 μ_f=0.13

Table 2

Estimates from Male Cessation Models

Independent Variables	Model 1	Model 2	Model 3	Model 4
Price	0.701 (5.37)	0.703 (5.32)	0.749 (6.03)	0.746 (5.86)
Clean Indoor Air Index		-0.001 (0.01)		
Private Workplace Restriction			0.001 (0.01)	
Restaurant Restriction			0.086 (0.46)	
Other Indoor Restriction			-0.148 (2.10)	
Clean Indoor Air Index Without Private Workplace Restriction				-0.027 (0.72)
Work Status and Private Workplace Interaction				-0.012 (0.01)
White	0.441 (6.96)	0.441 (6.96)	0.438 (6.88)	0.438 (6.87)
Yearly Income	0.001 (0.59)	0.001 (0.59)	0.001 (0.63)	0.001 (0.64)
Age	-0.128 (5.73)	-0.128 (5.73)	-0.125 (5.38)	-0.130 (5.85)
Infrequent Religion	0.003 (0.01)	0.003 (0.01)	0.004 (0.01)	0.003 (0.01)
Moderate Religion	0.139 (1.79)	0.139 (1.70)	0.139 (1.78)	0.138 (1.76)
Frequent Religion	0.391 (15.94)	0.391 (15.93)	0.390 (15.84)	0.390 (15.88)
Suburban	0.113 (1.59)	0.114 (1.58)	0.112 (1.53)	0.113 (1.56)
Rural	0.182 (2.76)	0.182 (2.76)	0.181 (2.72)	0.182 (2.76)
Work Hours	-0.006 (4.06)	-0.006 (4.06)	-0.006 (3.97)	-0.006 (3.99)
Married	0.212 (0.99)	0.212 (0.99)	0.212 (1.00)	0.214 (1.02)
Engaged	-0.278 (4.26)	-0.278 (4.25)	-0.274 (4.16)	-0.276 (4.20)
Separated / Divorced	-0.618 (4.33)	-0.618 (4.33)	-0.600 (4.07)	-0.615 (4.28)
Live Alone	-0.276 (2.68)	-0.276 (2.68)	-0.271 (2.59)	-0.274 (2.64)

Live Parents	-0.015 (0.03)	-0.015 (0.03)	-0.016 (0.03)	-0.017 (0.04)
Live Spouse	-0.359 (2.28)	-0.360 (2.28)	-0.357 (2.25)	-0.362 (2.31)
Live Child	-0.162 (1.02)	-0.162 (1.02)	-0.159 (0.99)	-0.161 (1.02)
School Years	0.034 (1.03)	0.034 (1.03)	0.034 (1.03)	0.034 (1.03)
College Less Than Half time	-0.091 (0.19)	-0.090 (0.19)	-0.082 (0.16)	-0.084 (0.17)
College Half Time	0.319 (2.16)	0.319 (2.17)	0.323 (2.22)	0.321 (2.20)
College Full Time	0.212 (2.56)	0.213 (2.56)	0.217 (2.67)	0.214 (2.60)
Year	0.439 (3.51)	0.438 (3.48)	0.414 (3.06)	0.415 (3.10)
Year Squared	-0.003 (4.01)	-0.003 (3.99)	-0.003 (3.53)	-0.003 (3.57)
Northeast	-0.156 (2.52)	-0.158 (2.30)	-0.214 (3.89)	-0.195 (3.40)
Midwest	-0.168 (3.15)	-0.169 (2.91)	-0.218 (4.24)	-0.198 (3.92)
South	-0.127 (1.63)	-0.130 (1.43)	-0.163 (2.12)	-0.168 (2.40)

All equations also include missing indicators for income, age, religiosity, type of community, average work hours, marital status, and family structure. Wald Chi-Square statistics are in parentheses. The critical values for the Chi-Square statistics are 6.66, 3.84, and 2.69 at the 1, 5, and 10% significance levels. All equations based on Chi-Square tests are significant at the one percent significance level.

Table 3

Estimates from Female Cessation Models

Independent Variables	Model 1	Model 2	Model 3	Model 4
Price	0.759 (9.49)	0.742 (8.92)	0.753 (9.26)	0.742 (9.00)
Clean Indoor Air Index		0.011 (0.32)		
Private Workplace Restriction			0.069 (0.51)	
Restaurant Restriction			-0.001 (0.001)	
Other Indoor Restriction			-0.036 (0.17)	
Clean Indoor Air Index Without Private Workplace Restriction				-0.024 (0.86)
Work Status and Private Workplace Interaction				0.179 (4.20)
White	0.280 (5.89)	0.281 (5.93)	0.281 (5.90)	0.283 (5.97)
Yearly Income	0.001 (0.06)	0.001 (0.06)	0.001 (0.05)	0.001 (0.06)
Age	-0.028 (0.29)	-0.027 (0.27)	-0.027 (0.27)	-0.026 (0.27)
Infrequent Religion	0.137 (3.03)	0.137 (3.02)	0.136 (2.97)	0.134 (2.90)
Moderate Religion	0.301 (10.99)	0.301 (10.90)	0.298 (10.77)	0.296 (10.64)
Frequent Religion	0.479 (29.52)	0.478 (29.39)	0.476 (29.15)	0.475 (28.98)
Suburban	0.110 (2.36)	0.110 (2.36)	0.112 (2.43)	0.114 (2.50)
Rural	0.192 (4.43)	0.193 (4.47)	0.194 (4.50)	0.193 (4.48)
Work Hours	-0.004 (1.86)	-0.004 (1.84)	-0.004 (1.84)	-0.004 (2.38)
Married	0.128 (0.42)	0.127 (0.41)	0.132 (0.44)	0.131 (0.43)
Engaged	-0.100 (1.46)	-0.101 (1.47)	-0.099 (1.45)	-0.099 (1.44)
Separated / Divorced	-0.148 (1.01)	-0.148 (1.01)	-0.148 (1.00)	-0.150 (1.03)
Live Alone	-0.296 (3.83)	-0.296 (3.85)	-0.293 (3.76)	-0.293 (3.75)

Live Parents	-0.015 (0.04)	-0.016 (0.05)	-0.016 (0.05)	-0.016 (0.05)
Live Spouse	-0.183 (0.81)	-0.184 (0.82)	-0.185 (0.82)	-0.182 (0.79)
Live Child	0.013 (0.02)	0.013 (0.02)	0.015 (0.02)	0.015 (0.03)
School Years	0.070 (6.31)	0.070 (6.28)	0.070 (6.21)	0.069 (6.06)
College Less Than Half time	0.021 (0.02)	0.020 (0.02)	0.023 (0.02)	0.027 (0.03)
College Half Time	-0.070 (0.15)	-0.071 (0.15)	-0.071 (0.15)	-0.074 (0.16)
College Full Time	0.234 (4.77)	0.234 (4.75)	0.233 (4.73)	0.225 (4.38)
Year	0.574 (8.72)	0.586 (8.96)	0.578 (8.57)	0.591 (9.03)
Year Squared	-0.003 (8.94)	-0.004 (9.19)	-0.003 (8.77)	-0.004 (9.22)
Northeast	-0.274 (11.47)	-0.255 (8.55)	-0.274 (9.05)	-0.267 (9.14)
Midwest	-0.151 (3.74)	-0.135 (2.63)	-0.140 (2.44)	-0.123 (2.14)
South	-0.109 (1.75)	-0.087 (0.91)	-0.095 (1.02)	-0.078 (0.71)

All equations also include missing indicators for income, age, religiosity, type of community, average work hours, marital status, and family structure. Wald Chi-Square statistics are in parentheses. The critical values for the Chi-Square statistics are 6.66, 3.84, and 2.69 at the 1, 5, and 10% significance levels. All equations based on Chi-Square tests are significant at the one percent significance level.

Table 4

Estimated Price Elasticities of Cessation

	Model 1	Model 2	Model 3	Model 4
Male	1.07	1.08	1.17	1.15
Female	1.21	1.17	1.20	1.17