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THE TRANSITION TO SMOKING CESSATION: EVIDENCE FROM MULTIPLE FAILURE DURATION ANALYSIS

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ABSTRACT

While much is known about the impacts prices and tobacco control policies have on smoking participation and frequency of cigarette use, little is known about their impacts on smoking cessation. This paper addresses the dynamics of smoking cessation using longitudinal data on young adults from the Monitoring the Future Surveys. Site-specific prices and several measures of clean indoor air restrictions are added to the survey data. Both parametric and semi-parametric duration models are used to model multiple cessation attempts of young adults. The estimates indicate that increases in the price of cigarettes increase the probability of initial smoking cessation as well as subsequent cessation for those individuals who are unable to remain smoke-free after at least one prior cessation attempt. The average price elasticity of cessation is 0.343. In addition, stronger restrictions on smoking in private worksites and public places other than restaurants increase the probability of young adult smoking cessation.

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I. I. Introduction

Since the publication of the first Surgeon General's report on the health consequences of cigarette smoking in 1964, numerous studies on the determinants of cigarette demand have been published. These studies have used diverse data, theoretical modeling, and statistical techniques to examine the impacts prices and other policy-related variables have on individual's consumption of cigarettes. While a significant number of these studies have concluded that cigarette prices and smoking participation are inversely related, they have been unable to distinguish whether or not a decrease in participation, due to a price increase, is a result of decreased smoking initiation or increased smoking cessation. Economists have neglected the dynamics of smoking transitions in their investigation of cigarette demand. Very little attention has been devoted to investigating the determinants of smoking pathways and trajectories including: experimentation, addiction, and cessation. Determining why individuals start smoking, and what factors cause smoking cessation should be a central focus in formulating appropriate anti-smoking policies. This paper addresses the dynamics of smoking cessation and provides the first econometric analysis of the impact prices, clean indoor air laws, and other socio-economic factors have on multiple quit attempts of young adults.

Cigarette smoking is the single most preventable cause of premature death and disability in the United States, responsible for more than 400,000 premature deaths each year. (CDC, 1999) 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 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)

II. II. Previous Research

Many studies of cigarette demand have been published over the past three decades. One general conclusion emerges from these studies – the demand for cigarettes is responsive to changes in the price of cigarettes. According to a recent National Cancer Institute (NCI) sponsored gathering of economists and other experts, the overall price elasticity of cigarette smoking falls in the range of –0.3 to –0.5. (NCI, 1993)

Only three studies have examined the impact economic factors have on individual's decisions to quit smoking. 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. He estimated several alternative parametric duration models in his assessment of smoking initiation and cessation. Douglas concluded that current, future, and past prices of cigarettes have an insignificant effect on the probability of initiation. Likewise, current and past prices were found to be statistically insignificant in the probability of quitting. However, his 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 study by Douglas (1998) made significant contributions to the investigation of the determinants of the decision to start and quit smoking, many of his findings, particularly those that deal with prices, 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 finds insignificant current and past price effects may be due to the fact that he uses one year of cross-sectional data. 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, Douglas' study employs 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 bases 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 notes, the panel data requirements needed to use duration modeling are not met in this study, and future investigation is needed using true longitudinal data.

In a more recent study, Forster and Jones (1999) use both parametric and semi-parametric techniques to investigate the determinants of smoking initiation and cessation. As did Douglas, Forster and Jones use cross-sectional data (British Health and Lifestyle Survey) with retrospective information on cigarette smoking to approximate the length of

time each individual smokes and abstains from smoking. Furthermore, in line with Douglas' work, they allow cigarette tax to act as a time-varying covariate.[1] They find cigarette taxes to be an insignificant determinant of smoking initiation. In addition, they find that the estimated elasticity of the number of years smoked before quitting with respect to tax falls in a range of -0.40 to -0.63, suggesting that a 5% increase in tax would lead to a reduction in smoking of approximately 6 to 9.5 months. However, the authors find strong evidence of 5 and 10 year recall bias in their quitting models. To control for the effect of recall bias, they include dummy variables equal to one for individual's who recall quitting either 5 or 10 years ago and zero otherwise. The authors conclude that recall bias had limited impact on the parameter estimates.

Finally, Tauras and Chaloupka (1999) employ data from the Monitoring the Future Surveys (MTFS) to estimate smoking cessation equations for young adult men and women separately. The MTFS are longitudinal data that track individual's smoking behaviors and other socio-economic characteristics over time for up to fourteen years. Using a single-failure semi-parametric Cox regression model, they conclude that price has a positive and significant impact on the probability of first-time cessation for both young adult males and females. In addition, they find that policies restricting smoking in private worksites increase the probability of smoking cessation among employed females.

While much has been learned over the past 30 years from economic research on the determinants of cigarette demand, there is much more to learn. In general, cigarette price increases appear to increase the probability of first-time smoking cessation. However, due to the addictive nature of cigarettes and the withdrawal (disutility)

[1] Although Douglas allowed price to vary at the state level over time, whereas Forster and Jones allow tax to vary solely at the national level over time.

associated with termination of cigarette use, many smokers are unable to remain smoke free and revert back into daily smoking. To date, no research has attempted to model the dynamics of multiple quit decisions by smokers. This paper proposes to address this issue by providing the first analysis of the impact prices and clean indoor air laws have on multiple cessation attempts by individuals.

III. 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)[2]. 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.

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

One limitation that exists in the MTF data is that the surveys do not include individuals who have dropped out of high school or who were absent 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. Similarly, they argue that students who are consistently absent from school have higher prevalence rates than do regular school attendees. DeCicca, Kenkel, and Mathios (1998) 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-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.

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 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 maps out each individual's smoking trajectory for up to fourteen years or until loss due to censoring occurs.

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); gender (male, female – 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 (New England, East, South East, Midwest, South, Plains, Mountain, North West, New York/New Jersey, and West - Omitted) 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 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 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 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 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.

IV. Methods

In the case of cigarette smoking, an individual can occupy one of two discreet states: smoking and nonsmoking. At any point in time, each of these states is associated with a certain level of utility for each individual. Each individual decides which state to occupy based on the discounted present value of utility for each of the states. If the remaining discounted lifetime utility of the smoking state exceeds the remaining discounted lifetime utility of the nonsmoking state, then the individual chooses to become a smoker or remain a smoker. If on the other hand, the remaining discounted lifetime utility of the nonsmoking state exceeds the remaining discounted lifetime utility of the smoking state, then the individual decides to abstain from smoking or quit the habit. An individual's utility for each state fluctuates over time in response to changes in

exogenous covariates including: information on the health hazards of cigarette smoking; tobacco control policies such as clean indoor air laws, excise taxation, and youth access laws; level of addiction; peer pressure; tastes; and various others.

Duration 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 both parametric and semi-parametric duration models 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 multiple-failure Cox regression in which the hazard at time *t* for a subject in group *i* is assumed to be:

$$h_i(t,x(t)) = h_{oi}(t)exp(x(t)B_i).$$

$h_{oi}(t)$ is the baseline hazard at time *t*, which is unknown, $x(t)$ is a vector of time-varying explanatory variables, and *Bi* 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. This is equivalent to estimating separate Cox models for each consecutive failure under the constraint that the coefficients are the same regardless of the number of failures, but assumes that the baseline hazard function differs across successive quit attempts. Parameter estimates are obtained by maximizing the following partial log-likelihood function:

$$\ln L = \sum_{j=1}^{D} \left\{ \sum_{k \in D_j} x_k B - d_j \ln \left[\sum_{i \in R_j} \exp(x_i B) \right] \right\}$$

where j indexes the ordered time until cessation $t_{(j)}$ (j=1,…,D), D_j is the set of d_j observations that quit smoking at $t_{(j)}$, and finally, R_j is the set of k observations that are at risk of cessation at time $t_{(j)}$.

The parametric model employed in this study takes the form of a Gompertz regression. Unlike the semi-parametric Cox regression described above which left the baseline hazard, $h_o(t)$, unspecified, the Gompertz model assumes that the baseline hazard takes on a specific parametric functional form. The Gompertz parameterization yields the following hazard, survival, and density functions:

$$h(t,x(t)) = \exp(\gamma t)\exp(xB)$$

$$S(t,x(t)) = \exp[(-e^{xjB})/g)(e^{\gamma t} - 1)]$$

$$f(t,x(t)) = \exp[(x_jB + \gamma t) - \{1/g\ (e^{xjB+\gamma t} - e^{xjB})\}]$$

This distribution implies that the baseline hazard $h_o(t) = \exp(\gamma t)$, where γ is a shape parameter that determines the shape of the distribution curve. The hazard rate increases with time if $\gamma>0$, decreases with time if $\gamma<0$, and remains constant if $\gamma=0$. The Gompertz distribution is therefore well suited to model the hazard of quitting, which is monotonically increasing with time. Since the Gompertz model assumes an underlying functional form for the baseline hazard, stratification based on previous failures cannot be incorporated. The baseline hazard remains unchanged regardless of the number of previous quit attempts. That is, the hazard of quitting changes over time, but is independent of when the last cessation attempt occurred. Parameter estimates are obtained by maximizing the following full log-likelihood function:

$$\ln L = \sum_{j=1}^{U} \ln\{f(t, x(t)\} + \sum_{j=U+1}^{N} \ln\{S(t, x(t)\}$$

In which $f(t,x(t))$ and $S(t,x(t))$ are the Gompertz survival and density functions respectively, N is the number of observations, U of which are uncensored. This implies that a subject known to fail at time t will contribute the value of the density function to the log likelihood function, whereas a censored observation will contribute the value of the survivor function to the log likelihood function.

According to Moffitt (1985), parametric estimates can be very sensitive to the assumed shape of the baseline hazard. If the parametric functional form for the baseline hazard is misspecified, inconsistent estimates of the coefficients will result. However, when the baseline hazard is specified correctly, a parametric approach will usually provide a small increase in efficiency (Meyer, 1990). The Cox semi-parametric model uses variation in the covariates across observations to estimate the covariate coefficients, while the over-time variation in the mean of the covariates is absorbed by the baseline hazard. Parametric estimation uses the part of the variation in the mean of the explanatory variables not accounted for by the baseline hazard component to estimate the regressor coefficients.

To account for the correlation among the 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 (1989) is used.

V. Results

Estimates from the stratified Cox regressions are presented in Table 2, with the corresponding estimates from the Gompertz regressions presented in Table 3. Each table contains eight alternative models. The model presented in the first column of each table (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 region 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 through 8 are identical to models 1 through 4, except models 5 through 8 contain nine dichotomous region 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 using the stratified Cox regression. Similarly, the real price of cigarettes is found to have a positive impact on the quitting hazard at at least the 5% significance level for all the models estimated using the Gompertz regression, with the exception of models 5 and 6 which were significant at the 6% significant level. These estimates clearly indicate that increases in the real price of cigarettes increase the probability of initial smoking cessation as well as subsequent cessation for those individuals who are unable to remain smoke free after at least one cessation attempt. Table 4 contains the estimates of the price elasticities of cessation based on the semi-parametric and fully-parametric estimates presented in tables 2 and 3. The estimated price elasticities derived from the Cox models are very similar to those derived from the Gompertz models. The Cox elasticities range from 0.269 to 0.466 and have an average elasticity of 0.350, whereas the Gompertz elasticities range from 0.245 to 0.464 and have an average elasticity of 0.336. These estimates imply that a 10% increase in the real price of cigarettes will increase the probability of cessation among young adults by approximately 3.4% - 3.5%.

Policies restricting smoking in private worksites are found to have a positive impact on smoking cessation in all of the models using both Cox and Gompertz

techniques. However, when region fixed effects are controlled for (models 5-8), the coefficients for private worksite restrictions are no longer significant at conventional levels. Policies restricting smoking in public places other than restaurants are found to have a positive and significant impact on smoking cessation in both the Cox and Gompertz models when region fixed effect are not controlled for, but have a negative and insignificant impact on smoking cessation when region dummies are included. In general, restaurant restrictions have an insignificant impact on young adult smoking cessation decisions.

Briefly reviewing the estimates for the other independent variables: 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, however, the estimates are only significant at the 5% level for the models employing Gompertz regressions.

The results are mixed with respect to real yearly income. In the Cox regressions, 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 (i.e. Wasserman, et al., 1991). However, in the Gompertz regressions, individuals with higher yearly incomes are significantly less likely to quit smoking than are individuals with lower yearly incomes, implying that cigarette smoking is an economically superior behavior for young adults. This view is consistent with Chaloupka and Grossman's (1996) and Tauras and Chaloupka's (1999) estimates for youth and young adult smoking behaviors. Given the

high correlation between age and income, the discrepancy between methodologies on how income effects smoking cessation is likely due to how each method controls for respondent's age in the models.[3] That is, the Cox model uses variation in the independent variables across observations to estimate the regressor coefficients, while the over time variation in the mean of the covariates is absorbed by the baseline hazard. The Gompertz regression uses the part of the variation in the mean of the independent variables not accounted for by the baseline hazard to estimate the covariate coefficients. Given this, the effect of age is likely to be fully controlled for in the Cox model allowing differences in income at each age level to directly impact the probability of cessation. In the Gompertz model however, if the baseline hazard is misspecified, inconsistent estimates of the income coefficients may result. Therefore, it is likely that income plays a positive role on young adult smoking cessation decisions.

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 using the semi-parametric techniques. 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

[3] In both methodologies, age is treated as a time variable. That is, age measures how time is recorded in the data. Therefore, explicit control of age as a covariate is not feasible given its perfectly collinear relationship with the time variable.

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, although the relationship is not significant at conventional levels for mothers who worked full-time employing Gompertz techniques.

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 regions of the United States are significantly less likely to quit smoking than are individuals who live in the West region. Finally, young adults were much more likely to quit smoking in 1977-1993 than they were in 1976.

V. Discussion

Since the release of the first Surgeon General's report on the health consequences of cigarette smoking in 1964, the United States government has been involved in a sporadic and often unsynchronized campaign to reduce the use of cigarettes among the American people. Throughout the 25 years following the onset of the government's campaign, significant progress was made in reducing cigarette smoking in all segments of the population. Overall smoking prevalence declined from 40.4% in 1965 to 25.5% in 1990. (CDC, 1999) Much of this success can be attributed to tobacco control strategies, including wide-spread dissemination of information on the health hazards of cigarette smoking, anti-smoking advertisements, limits on cigarette manufacturers advertisements, cigarette excise tax increases, restrictions on smoking in public places and private worksites, and restrictions on youth access to cigarettes. (USDHHS, 1991)

However, recent data suggests that the decades of steady decline in smoking prevalence have not been sustained. The prevalence of smoking among adults declined very slightly in the 1990's. According to the National Health Interview Surveys, 25.5% of U.S. adults were current smokers in 1990 as compared to 24.7% in 1995.[4] 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) Moreover, according to the Harvard University College Alcohol Study,

[4] 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 one percentage point over the previous definition. (CDC, 1994)

smoking prevalence among college students increased by 28% between the years 1993 and 1997. (Wechsler, et al., 1998) These trends, coupled with the strong addictive nature of cigarettes, have led policymakers to increase their efforts on discouraging cigarette use, particularly by youth and young adults. Understanding the impacts prices (which can be increased via excise taxation) and tobacco control policies, such as clean indoor air laws, have on young adult's decisions to quit smoking is essential to formulating appropriate policies aimed at reducing young adult cigarette consumption.

This paper uses both parametric and semi-parametric techniques to estimate the impact prices and clean indoor air laws have on young adult's decisions to quit smoking. The estimates clearly support the hypothesis that increasing the price of cigarettes would increase the probability of smoking cessation among young adults and therefore decrease the amount of time they smoke. The estimated price elasticity of smoking cessation fell in a narrow range of 0.245 to 0.466, with an average price elasticity of 0.343 for all the models using both methods. In addition, the estimates indicate that stronger restrictions on smoking in private worksites and public place other than restaurants generally have a positive impact on young adult smoking cessation.

Given the estimates above, and the well-documented (USDHHS, 1990) benefits of smoking cessation, a significant increase in cigarette excises taxes may be an extremely effective means to reduce the death and disease caused by tobacco use in the United States.

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Table 1

Variables	Definition, Mean (m), Standard Deviation (s)
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. μ= 1.01 σ=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. μ=0.173 σ=0.379
Restaurant Restriction	Dichotomous indicator equal to one if respondent resides in a state that restricts cigarette smoking in restaurants and zero otherwise. μ=0.261 σ=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. μ=0.389 σ=0.488
Male	Dichotomous indicator equal to one if respondent is a male, and zero otherwise. μ=0.444 σ=0.497
White	Dichotomous indicator equal to one if White or Caucasian and zero otherwise. μ=0.859 σ=0.348
Real Yearly Income	Average real yearly income from employment sources only (in dollars), deflated by the national Consumer Price Index, 1982-1984=100. μ=67.072 σ=68.336
Infrequent Religion	Dichotomous indicator equal to one for individuals who attend religious services infrequently and zero otherwise. μ=0.517 σ=0.500
Moderate Religion	Dichotomous indicator equal to one for individuals who attend religious services occasionally and zero otherwise. μ=0.163 σ=0.370
Frequent Religion	Dichotomous indicator equal to one for individuals who attend religious services frequently and zero otherwise. μ=0.151 σ=0.358
Suburban	Dichotomous indicator equal to one for individuals who live in a suburban community and zero otherwise. μ=0.656 σ=0.475
Rural	Dichotomous indicator equal to one for individuals who live in a rural community and zero otherwise. μ=0.150 σ=0.357
Work Hours	Number of hours worked per week in the past thirty days. μ=26.51 σ=18.41
Married	Dichotomous indicator equal to one for individuals who are married, and zero otherwise. μ=0.203 σ=0.402
Engaged	Dichotomous indicator equal to one for individuals who are engaged, and zero otherwise. μ=0.085 σ=0.279
Separated / Divorced	Dichotomous indicator equal to one for individuals who are separated or divorced, and zero otherwise. μ=0.040 σ=0.197
Live Alone	Dichotomous indicator equal to one for individuals who live

Variables	Definition, Mean (m), Standard Deviation (s)
	alone, and zero otherwise. μ=0.062 σ=0.241
Live Parents	Dichotomous indicator equal to one for individuals who live with their parents, and zero otherwise. μ=0.489 σ=0.500
Live Spouse	Dichotomous indicator equal to one for individuals who live with their spouse, and zero otherwise. μ=0.192 σ=0.394
Live Child	Dichotomous indicator equal to one for individuals who live with their child or children, and zero otherwise. μ=0.140 σ=0.347
School Years	Number of formal school years completed. μ=12.513 σ=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. μ=0.040 σ=0.196
College Half Time	Dichotomous indicator equal to one for individuals who are attending college half-time, and zero otherwise. μ=0.026 σ=0.160
College Full Time	Dichotomous indicator equal to one for individuals who are attending college full-time, and zero otherwise. μ=0.152 σ=0.359
Father Some High School	Dichotomous indicator equal to one if father attended high school, but did not graduate, and zero otherwise. μ=0.149 σ=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. μ=0.307 σ=0.461
Father Some College	Dichotomous indicator equal to one if father attended college, but did not graduate, and zero otherwise. μ=0.136 σ=0.343
Father College Graduate	Dichotomous indicator equal to one if father graduated from college, but pursued no further education, and zero otherwise. μ=0.162 σ=0.368
Father Professional	Dichotomous indicator equal to one if father earned a graduate degree in a professional occupation, and zero otherwise. μ=0.112 σ=0.316
Father Education Unknown	Dichotomous indicator equal to one if father's education is unknown, and zero otherwise. μ=0.042 σ=0.202
Mother Some High School	Dichotomous indicator equal to one if mother attended high school, but did not graduate, and zero otherwise. μ=0.144 σ=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. μ=0.423 σ=0.494
Mother Some College	Dichotomous indicator equal to one if mother attended college, but did not graduate, and zero otherwise. μ=0.152 σ=0.359
Mother College Graduate	Dichotomous indicator equal to one if mother graduated from college, but pursued no further education, and zero otherwise. μ=0.137 σ=0.344

Variables	Definition, Mean (m), Standard Deviation (s)
Mother Professional	Dichotomous indicator equal to one if mother earned a graduate degree in a professional occupation, and zero otherwise. μ=0.064 σ=0.244
Mother Education Unknown	Dichotomous indicator equal to one if mother's education is unknown, and zero otherwise. μ=0.021 σ=0.144
Mother Occasionally Worked	Dichotomous indicator equal to one if mother occasionally worked while individual was growing up, and zero otherwise. μ=0.287 σ=0.452
Mother Usually Worked	Dichotomous indicator equal to one if mother usually worked while individual was growing up, and zero otherwise. μ=0.177 σ=0.381
Mother Always Worked	Dichotomous indicator equal to one if mother worked full-time while individual was growing up, and zero otherwise. μ=0.229 σ=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. μ=0.074 σ=0.261
New York/ New Jersey	Dichotomous indicator equal to one if individual resides in New Jersey or New York and zero otherwise. μ=0.102 σ=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. μ=0.129 σ=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. μ=0.139 σ=0.346
Midwest	Dichotomous indicator equal to one if individual resides in Illinois, Indiana, Michigan, Minnesota, Ohio, or Wisconsin and zero otherwise. μ=0.256 σ=0.436
South	Dichotomous indicator equal to one if individual resides in Arkansas, Louisiana, New Mexico, Oklahoma, or Texas and zero otherwise. μ=0.086 σ=0.280
Plains	Dichotomous indicator equal to one if individual resides in Nebraska, Iowa, Kansas, or Missouri and zero otherwise. μ=0.063 σ=0.243
Mountain	Dichotomous indicator equal to one if individual resides in Colorado, Montana, North Dakota, South Dakota, Utah, or Wyoming and zero otherwise. μ=0.029 σ=0.167
Northwest	Dichotomous indicator equal to one if individual resides in Washington, Oregon, Idaho, or Alaska and zero otherwise. μ=0.032 σ=0.176

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)

Independent Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
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)
Mother Professional	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)

Independent Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
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)

Independent Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
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)

Table 3

Estimates From Gompertz Models

Independent Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Real Cigarette Price	0.320 (2.84)	0.350 (3.12)	0.377 (3.40)	0.340 (3.05)	0.216 (1.59)	0.220 (1.61)	0.226 (1.67)	0.225 (1.68)
Private Worksite Restrictions	0.051 (1.39)	0.052 (1.89)			0.016 (0.39)	0.006 (0.17)		
Restaurant Restrictions	-0.072 (-1.87)		0.027 (1.10)		0.001 (0.03)		-0.006 (-0.23)	
Other Clean Indoor Air Laws	0.096 (3.09)			0.069 (3.01)	-0.021 (-0.56)			-0.015 (-0.54)
White	0.157 (3.24)	0.154 (3.18)	0.154 (3.17)	0.154 (3.18)	0.154 (3.16)	0.154 (3.16)	0.154 (3.16)	0.154 (3.16)
Male	-0.069 (-3.12)	-0.066 (-3.01)	-0.066 (-3.02)	-0.068 (-3.10)	-0.070 (-3.16)	-0.070 (-3.18)	-0.070 (-3.18)	-0.070 (-3.17)
Real Income	-0.002 (-7.70)	-0.002 (-7.72)	-0.002 (-7.72)	-0.002 (-7.72)	-0.002 (-7.53)	-0.002 (-7.54)	-0.002 (-7.54)	-0.002 (-7.53)
Suburb	-0.015 (-0.54)	-0.018 (-0.67)	-0.019 (-0.71)	-0.016 (-0.60)	-0.008 (-0.29)	-0.008 (-0.29)	-0.007 (-0.28)	-0.008 (-0.28)
Rural	-0.029 (-0.78)	-0.032 (-0.87)	-0.034 (-0.93)	-0.031 (-0.84)	-0.023 (-0.62)	-0.023 (-0.62)	-0.023 (-0.61)	-0.023 (-0.62)
Married	-0.147 (-1.93)	-0.145 (-1.91)	-0.145 (-1.91)	-0.146 (-1.93)	-0.150 (-1.97)	-0.150 (-1.97)	-0.150 (-1.97)	-0.150 (-1.97)
Engaged	-0.074 (-2.15)	-0.073 (-2.12)	-0.074 (-2.14)	-0.074 (-2.16)	-0.076 (-2.21)	-0.076 (-2.21)	-0.076 (-2.21)	-0.076 (-2.21)
Separated/Divorced	-0.445 (-7.71)	-0.440 (-7.62)	-0.440 (-7.61)	-0.443 (-7.66)	-0.452 (-7.83)	-0.452 (-7.83)	-0.452 (-7.83)	-0.452 (-7.83)
Live Alone	-0.058 (-1.40)	-0.055 (-1.33)	-0.055 (-1.33)	-0.056 (-1.37)	-0.056 (-1.36)	-0.056 (-1.36)	-0.056 (-1.36)	-0.056 (-1.36)
Live With Parents	0.152 (6.18)	0.150 (6.10)	0.150 (6.10)	0.152 (6.16)	0.159 (6.44)	0.159 (6.44)	0.159 (6.44)	0.159 (6.44)

Independent Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Live With Spouse	-0.053 (-0.68)	-0.053 (-0.68)	-0.053 (-0.67)	-0.052 (-0.67)	-0.052 (-0.67)	-0.052 (-0.66)	-0.052 (-0.66)	-0.052 (-0.66)
Live With Child	-0.471 (-12.17)	-0.470 (-12.15)	-0.471 (-12.17)	-0.471 (-12.19)	-0.469 (-12.14)	-0.469 (-12.14)	-0.469 (-12.15)	-0.469 (-12.15)
Father Some High School	-0.030 (-0.55)	-0.031 (-0.56)	-0.032 (-0.58)	-0.032 (-0.58)	-0.022 (-0.41)	-0.023 (-0.42)	-0.023 (-0.41)	-0.023 (-0.41)
Father High School Graduate	0.011 (0.22)	0.010 (0.20)	0.010 (0.19)	0.010 (0.19)	0.019 (0.37)	0.018 (0.36)	0.019 (0.37)	0.019 (0.37)
Father Some College	0.059 (1.07)	0.060 (1.09)	0.060 (1.08)	0.058 (1.05)	0.057 (1.03)	0.057 (1.03)	0.057 (1.03)	0.057 (1.03)
Father College Graduate	0.026 (0.46)	0.026 (0.48)	0.026 (0.47)	0.024 (0.44)	0.024 (0.44)	0.024 (0.43)	0.024 (0.43)	0.024 (0.44)
Father Professional	0.063 (1.06)	0.063 (1.07)	0.063 (1.07)	0.062 (1.05)	0.060 (1.01)	0.059 (1.01)	0.060 (1.01)	0.060 (1.01)
Father Education Unknown	-0.036 (-0.49)	-0.035 (-0.48)	-0.036 (-0.48)	-0.038 (-0.51)	-0.038 (-0.51)	-0.038 (-0.52)	-0.038 (-0.51)	-0.038 (-0.51)
Mother Some High School	-0.005 (-0.07)	-0.001 (-0.01)	-0.002 (-0.03)	-0.004 (-0.06)	-0.004 (-0.06)	-0.005 (-0.07)	-0.005 (-0.07)	-0.005 (-0.07)
Mother High School Graduate	0.028 (0.43)	0.029 (0.44)	0.028 (0.43)	0.028 (0.43)	0.029 (0.46)	0.029 (0.46)	0.029 (0.45)	0.029 (0.45)
Mother Some College	0.183 (2.67)	0.186 (2.71)	0.185 (2.70)	0.183 (2.68)	0.172 (2.52)	0.172 (2.52)	0.171 (2.51)	0.171 (2.52)
Mother College Graduate	0.146 (2.09)	0.147 (2.11)	0.148 (2.11)	0.147 (2.10)	0.141 (2.02)	0.141 (2.03)	0.141 (2.02)	0.141 (2.02)
Mother Professional	0.168 (2.21)	0.171 (2.24)	0.171 (2.25)	0.170 (2.22)	0.159 (2.09)	0.159 (2.10)	0.159 (2.10)	0.159 (2.10)
Mother Education Unknown	0.041 (0.41)	0.043 (0.44)	0.042 (0.43)	0.041 (0.41)	0.043 (0.43)	0.043 (0.43)	0.043 (0.43)	0.043 (0.43)
Mother Occasionally Worked	-0.055 (-2.00)	-0.055 (-1.98)	-0.055 (-1.97)	-0.055 (-1.99)	-0.055 (-1.97)	-0.055 (-1.98)	-0.055 (-1.98)	-0.055 (-1.97)
Mother Usually Worked	-0.099 (-3.01)	-0.099 (-3.01)	-0.099 (-3.00)	-0.098 (-2.99)	-0.098 (-2.98)	-0.098 (-2.98)	-0.098 (-2.98)	-0.098 (-2.98)
Mother Always Worked	-0.007 (-0.22)	-0.007 (-0.22)	-0.007 (-0.22)	-0.006 (-0.20)	-0.010 (-0.32)	-0.010 (-0.32)	-0.010 (-0.33)	-0.010 (-0.33)
Infrequent Religious	0.094	0.093	0.092	0.093	0.104	0.104	0.104	0.104

Independent Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Attendance	(3.12)	(3.08)	(3.05)	(3.10)	(3.47)	(3.47)	(3.46)	(3.46)
Moderate Religious Attendance	0.371 (10.58)	0.369 (10.52)	0.368 (10.48)	0.371 (10.56)	0.385 (10.92)	0.385 (10.93)	0.385 (10.92)	0.384 (10.92)
Frequent Religious Attendance	0.540 (15.39)	0.539 (15.36)	0.538 (15.33)	0.540 (15.39)	0.554 (15.70)	0.554 (15.71)	0.554 (15.71)	0.554 (15.70)
Hours Worked	-0.013 (-15.38)	-0.013 (-15.39)	-0.013 (-15.41)	-0.013 (-15.39)	-0.013 (-15.39)	-0.013 (-15.39)	-0.013 (-15.39)	-0.013 (-15.39)
Formal School Years	-0.070 (-8.41)	-0.071 (-8.48)	-0.071 (-8.47)	-0.070 (-8.42)	-0.069 (-8.23)	-0.069 (-8.23)	-0.069 (-8.22)	-0.069 (-8.23)
College Less Than Half-Time	-0.028 (-0.58)	-0.028 (-0.59)	-0.028 (-0.58)	-0.029 (-0.61)	-0.035 (-0.73)	-0.035 (-0.73)	-0.035 (-0.73)	-0.035 (-0.73)
College Half-Time	0.051 (0.92)	0.051 (0.92)	0.052 (0.93)	0.051 (0.90)	0.044 (0.78)	0.044 (0.78)	0.044 (0.78)	0.044 (0.78)
College Full-Time	0.238 (8.27)	0.237 (8.23)	0.237 (8.22)	0.238 (8.27)	0.243 (8.45)	0.243 (8.45)	0.243 (8.45)	0.243 (8.44)
D77	0.475 (5.02)	0.479 (5.06)	0.480 (5.07)	0.476 (5.03)	0.489 (5.20)	0.488 (5.18)	0.489 (5.19)	0.490 (5.20)
D78	0.385 (4.49)	0.389 (4.55)	0.390 (4.55)	0.383 (4.47)	0.393 (4.58)	0.391 (4.56)	0.392 (4.58)	0.393 (4.59)
D79	0.478 (5.77)	0.484 (5.84)	0.486 (5.86)	0.477 (5.76)	0.482 (5.80)	0.480 (5.78)	0.482 (5.80)	0.483 (5.81)
D80	0.398 (4.85)	0.406 (4.95)	0.409 (4.98)	0.398 (4.86)	0.392 (4.75)	0.391 (4.74)	0.393 (4.76)	0.394 (4.78)
D81	0.464 (5.80)	0.471 (5.89)	0.475 (5.93)	0.463 (5.80)	0.461 (5.71)	0.460 (5.69)	0.462 (5.72)	0.463 (5.74)
D82	0.428 (5.48)	0.436 (5.59)	0.438 (5.61)	0.428 (5.48)	0.431 (5.49)	0.429 (5.47)	0.431 (5.49)	0.432 (5.51)
D83	0.350 (4.54)	0.352 (4.57)	0.350 (4.55)	0.345 (4.49)	0.366 (4.74)	0.364 (4.71)	0.365 (4.73)	0.366 (4.74)
D84	0.351 (4.54)	0.355 (4.60)	0.354 (4.57)	0.348 (4.50)	0.365 (4.71)	0.363 (4.69)	0.364 (4.70)	0.365 (4.71)
D85	0.408 (5.33)	0.414 (5.41)	0.413 (5.38)	0.406 (5.29)	0.431 (5.60)	0.428 (5.57)	0.429 (5.58)	0.431 (5.60)

Independent Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
D86	0.384 (4.97)	0.389 (5.03)	0.386 (4.99)	0.380 (4.92)	0.412 (5.29)	0.409 (5.26)	0.410 (5.26)	0.412 (5.28)
D87	0.330 (4.23)	0.335 (4.30)	0.331 (4.25)	0.325 (4.17)	0.358 (4.54)	0.354 (4.50)	0.355 (4.51)	0.357 (4.53)
D88	0.290 (3.63)	0.296 (3.71)	0.292 (3.66)	0.285 (3.56)	0.326 (4.00)	0.321 (3.96)	0.323 (3.97)	0.325 (4.00)
D89	0.299 (3.65)	0.308 (3.76)	0.304 (3.71)	0.294 (3.58)	0.354 (4.18)	0.348 (4.13)	0.350 (4.14)	0.353 (4.17)
D90	0.248 (2.91)	0.256 (3.02)	0.250 (2.94)	0.237 (2.78)	0.313 (3.52)	0.305 (3.47)	0.308 (3.48)	0.312 (3.51)
D91	0.210 (2.31)	0.214 (2.37)	0.207 (2.28)	0.199 (2.19)	0.289 (2.97)	0.281 (2.91)	0.282 (2.92)	0.287 (2.96)
D92	0.265 (2.71)	0.272 (2.81)	0.266 (2.74)	0.254 (2.61)	0.368 (3.47)	0.358 (3.41)	0.360 (3.43)	0.366 (3.46)
D93	0.244 (2.50)	0.261 (2.70)	0.256 (2.64)	0.235 (2.42)	0.357 (3.37)	0.345 (3.30)	0.347 (3.32)	0.355 (3.36)
East					-0.245 (-4.81)	-0.238 (-4.78)	-0.244 (-5.04)	-0.250 (-5.03)
Midwest					-0.209 (-4.57)	-0.204 (-4.57)	-0.211 (-5.17)	-0.217 (-5.14)
Mountain					-0.029 (-0.40)	-0.030 (-0.42)	-0.038 (-0.55)	-0.039 (-0.58)
New England					-0.182 (-3.32)	-0.175 (-3.24)	-0.182 (-3.46)	-0.188 (-3.53)
New Jersey/New York					-0.247 (-4.85)	-0.238 (-4.82)	-0.245 (-5.06)	-0.252 (-5.09)
North West					0.029 (0.42)	0.024 (0.36)	0.016 (0.25)	0.016 (0.26)
Plains					-0.262 (-4.55)	-0.255 (-4.51)	-0.260 (-4.64)	-0.266 (-4.65)
South					-0.115 (-2.09)	-0.118 (-2.21)	-0.127 (-2.47)	-0.126 (-2.63)
South East					-0.184 (-3.45)	-0.173 (-3.39)	-0.182 (-3.64)	-0.190 (-3.67)

Table 4

Estimated Price Elasticities of Cessation

	COX	GOMPERTZ
Model 1	0.377	0.383
Model 2	0.415	0.425
Model 3	0.466	0.464
Model 4	0.417	0.411
Model 5	0.269	0.245
Model 6	0.274	0.249
Model 7	0.293	0.257
Model 8	0.291	0.256