
AN ANALYSIS OF TEEN SMOKING DEMAND IN SOUTHEAST TEXAS

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ABSTRACT

This paper examines the demand for cigarettes among a group of Texas high school students who currently smoke. The paper estimates the price consumption and income elasticities for the students as well as the response of student consumption to key demographic variables and variables associated with addictive behavior. The paper finds the price elasticity of demand among teens to be inelastic but considerably more elastic than the price elasticity for the adult population. The results also provide evidence that teens consume cigarettes as a normal good and that cigarette purchases are heavier among older, female, non-white, and non-working teens.

INTRODUCTION

Recent public debate on ways to control teen smoking has focused on the use of excise tax increases to raise cigarette prices and, therefore, reduce the quantities demanded of cigarettes. The excise tax proposal was part of President Clinton's health care reform effort in 1993 and different versions of the proposal have appeared and failed in Congress in the years since (NCPA, 1997). The most recent unsuccessful attempt by Senator John McCain of Arizona attempted to increase the cigarette tax by \$1.10 a pack over five years (ASH, 1998). One criticism of the McCain proposal and others was that specific excise tax increases would not substantially reduce teen consumption of cigarettes. In order to answer this question accurately, the price elasticity of demand for cigarettes among teen smokers must be measured.

On first examination, the estimates of price elasticity of demand for the commodity cigarettes are not encouraging. Studies of the demand for cigarettes have traditionally found that cigarette consumption is less responsive to price changes than are the demands for most other products. A price elasticity coefficient of approximately -0.4 is believed to be a good estimate for the entire population. Lewit and Coate (1982), Sung, Hu, and Keeler (1994), and Becker, Grossman, and Murphy (1994) have all calculated price elasticities in that range. In recent years, however, researchers have found that the price elasticity coefficients for young people, in general, and teenagers, in particular, are notably higher than the elasticity coefficients for the general population.

Most of the studies examine both the effect of price changes on the number of cigarettes smoked by teen smokers, the cigarette consumption elasticity, and the effect on the decision to begin smoking, the smoking participation elasticity. The cigarette consumption elasticity is identical to the standard price elasticity of demand;

i.e., the ratio of the percentage change in quantity of cigarettes demanded to the percentage change in cigarette prices. The smoking participation elasticity measures the effect of cigarette price changes on the decision for begin smoking. The latter concept has been significant in distinguishing teen smokers from other smokers because ninety percent of adult smokers first participated as smokers before the age of 18 (USDHHS, 1994). In the previous studies cited below researchers have summed the cigarette consumption elasticity and smoking participation elasticity coefficients to obtain an overall price elasticity for cigarettes. The overall elasticity is composed of the quantity responses to price changes of both those who currently smoke and those who make the decision to begin smoking.

An early study using individual responses to a 1976 Health Interview Survey from the National Center for Health Statistics (Lewit and Coate, 1982) found that the overall demand elasticity among a group of 20-25 year olds was -0.89 , while the estimate for all smokers was -0.42 . The overall elasticity is the sum of consumption and participation elasticity coefficients. A study, which appeared about the same time (Lewit, Coate, and Grossman, 1981), relied on the Health Examination Survey from the period March 1966 to March 1970. Its estimate of the overall elasticity for individuals in the age group from 12 to 17 was -1.44 . Evans and Farrell (1995) examined 13 years of National Health Interview Surveys and found that the overall price elasticity of demand for 18-24 year olds was -0.63 or about 1.5 times the -0.42 value estimated for 25-39 year olds. Chaloupka and Wechsler (1997) found an overall price elasticity of -1.11 using the 1993 Harvard College Alcohol Study data. Chaloupka and Grossman (1996) used data from the University of Michigan Institute of Social Research's Monitoring for the Future Project to get an estimate of -1.313 . In each of the cases, the smoking participation portion of the overall price elasticity was found to be a major component in the response of teen smokers. There was, however, a great deal of variation among the studies concerning the consumption elasticity.

Lewit and Coate (1982) found a very small consumption elasticity for the 20-25 year age group, -0.15 , which was not significantly different from the overall population. Lewit, Coate, and Grossman (1981) found the consumption elasticity among 12-17 year olds to be only about -0.24 . The more recent studies, however, have shown greater consumption elasticities. Chaloupka and Wechsler (1997) found the consumption elasticity to be about -0.58 or slightly more than half of their estimate of overall elasticity among the college students studied. Chaloupka and Grossman (1996) found a consumption elasticity of -0.638 and a participation elasticity of -0.675 among eighth, tenth, and twelfth grade students in the University of Michigan's Monitoring for the Future Project.

Our study focuses on the consumption elasticity of demand for cigarettes among Southeast Texas teens. The price elasticity estimates are limited to consumption elasticity primarily because of data limitations. The estimates come from a single survey (Appendix A) which provided no opportunity for the examination of the participation decision over time. The results are, nonetheless, of interest because they contribute findings about the size of the consumption elasticity among teens. Other variables are also included that will provide information about demographic characteristics of teens smokers and an estimate of income elasticity among teens.

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DATA AND METHODOLOGY

The data were taken from a survey of 786 Southeast Texas high school juniors and seniors, 153 of whom were smokers, and from published data for the seven zip codes in which the students reside. All high school students taking required English courses at the junior and senior levels completed the surveys under the supervision of undergraduate college students. Survey data used in the study represent the responses of the teen smokers to questions regarding their current smoking habits, their responses to specific proposed price changes for cigarettes, their overall spending habits, employment status, gender, age, and race. The demographic variables for the larger population are aggregated at the zip code level and were taken from CACI Marketing's *Sourcebook of Zip Code Demographics* (1998).

Table 1 provides a demographic breakdown of the teen smokers responding to the survey. The sample is composed of slightly more males than females, slightly more students who were not employed, and contains almost 60% white, non-Hispanics. The average age of the respondents was 16.83 years, the working teens averaged working 29.17 hours per week, and the mean spending level on all goods among the respondents was \$48.42 per week. The students were asked to indicate the number of cigarettes they believed they would smoke for various price increases, ranging from \$0.25 to \$2.50 per pack, above the present \$2.50 per pack. When their present consumption was included, this created a price range from \$2.50 to \$5.00 per pack. The sample includes respondents from urban, suburban, and rural schools districts.

Table 1
Demographics of Smokers In The Sample

Characteristic	Relative Frequency	Mean Value
Male/Female	54.9%/45.1%	
Employed/Not Employed	42.5%/57.52%	
White, Non-Hispanic/non-white	58.8%/41.2%	
Hours worked per week by Employed teen		29.17
Age in years		16.83
Spending on all goods and services		\$48.42

Multiple regression analysis was used to analyze data from the responses. Although the primary objective is to examine the price-quantity relationship, proper identification of that relationship requires the measurement of factors that affect demand and, therefore, are capable of shifting the demand function. The spending variable, the student's weekly total spending on all goods and services, was included as a measure of the income of the student. It was assumed that student expenditures would very closely parallel their personal incomes. The other student specific variables; number of months they had smoked, employment status, gender, age and race; were included to determine which of those variables had significant impacts on

the tastes and preferences for cigarettes. The broader demographic variables for the zip codes were used to study the impact of the broader community from which they come on cigarette consumption.

Four ordinary least squared regression models were employed to measure the teen demand for cigarette consumption among smokers. Models 1 and 2 provide estimates using only the responses from the survey. Models 1 and 2 differ in that Model 1 employs a monetary measure of the total spending of each teen and Model 2 uses cigarette spending as a percentage of total spending to estimate the income impact on cigarette purchases. The two income variables cannot be used in the same model because they are logically and factually colinear. Models 3 and 4 differ from one another for the same reason that Models 1 and 2 differ. Models 3 and 4 differ from Models 1 and 2 in that the former include underlying demographic variables for the population of the zip codes in which the students reside. The demographic variables were selected to correspond with similar concepts in the surveys. For example, students were asked what their genders were and the male-female ratio for the zip code was included in Models 3 and 4. The demographic variables for the zip codes are expected to reveal characteristics of the homes from which the students come. The models are shown as Equations (1) through (4) below.

- (1) $\log Q = f(\log \text{ Price, log Spending, log Months, Employment, Gender, Age, Race})$
- (2) $\log Q = f(\log \text{ Price, percent Cigarette Spending, log Months, Employment, Gender, Age, Race})$
- (3) $\log Q = f(\log \text{ Price, log Spending, log Months, Employment, Gender, Age, Race, log Per Capita Income, Male/Female Ratio, percent White})$
- (4) $\log Q = f(\log \text{ Price, percent Cigarette Spending, log Months, Employment, Gender, Age, Race, log Per Capita Income, Male/Female Ratio, percent White})$

where

$\log Q$ is the common log of responses to the number of cigarettes smoked at current and proposed prices

$\log \text{ Price}$ is the log of the current and proposed prices of a pack of cigarettes

$\log \text{ spending}$ is the log the student's weekly total expenditures for all goods

$\text{percent cigarette spending}$ is the ratio of student's weekly cigarette expenditures to the student's total spending level

$\log \text{ Months}$ is the log the number of months the student has smoked

employment is a dichotomous variable which is equal to 1 if the student is employed and 0 otherwise

gender is a dichotomous variable which is 1 if the student is male and 0 if the student is female

age is the age in years of the student

race is a dichotomous variable which is 1 if the student is white, non-Hispanic and 0 otherwise

log Per Capita Income is the log of per capita income for the zip code in which the student resides
male/female ratio is the ratio males to female for the zip code in which the student resides
percent White is the percentage of the population in the student's zip code which is classified as white, non-Hispanic

FINDINGS

The estimates of Equations (1) to (4) are shown in Table 2. Because the logarithm form was used for the price and quantity variables, the slope coefficients in the equations measure the cigarette consumption price elasticity. Distances along logarithmic scales represent percentage changes rather than absolute number changes. Therefore, slope coefficients where both variables are expressed in logarithms show the percentage in one variable over the percentage change in the other variable. The elasticity coefficients in each of the equations are similar to those found by Chaloupka and Wechsler (1997) and Chaloupka and Grossman (1996) and differ substantially from the earlier findings of Lewit and Coate (1982) and Lewit, Coate and Grossman (1981). The former studies estimate the consumption elasticity to be from -0.58 to -0.638 ; the latter group made estimates in the -0.15 to -0.24 range. The price elasticity estimates in our study range from -0.645 to -0.782 . The estimates are of particular interest when compared to overall elasticity estimates for the adult population, which are approximately equal to -0.4 . The overall elasticity for the adult population can be used as the consumption elasticity because the participation decision is made primarily before the age of 18. The consumption elasticities in our models are from 1.5 to 2 times the estimates for the adult population. Cigarette consumption by both teens and adults is inelastic, but the consumption elasticities of teens are substantially higher than the elasticities of adults.

The total spending variable is included in Equations (1) and (3) as an estimate of student income. The authors expect student spending to closely parallel student income. Since the log form was again used, the coefficients are a measure of the income elasticity of cigarettes. The presence of positive signs in each of the equations indicates that cigarettes are viewed as normal goods by the teens. Chaloupka and Grossman (1996) have also found cigarette consumption to be a normal good among teens. Becker, Grossman, and Murphy (1994) found cigarettes to be normal among adults but Wasserman, Manning, Newhouse, and Winkler (1991) produced results indicating that they are inferior goods among adults. Equations (2) and (4) examine spending levels on cigarettes from another perspective. Both equations indicate that teens who consume more cigarettes not only have more spending money but they also spend a larger portion of their money on cigarettes. This finding may be seen as consistent with the well-known addictive properties of the product.

A second finding that appears to be consistent with addiction to cigarettes is the significantly positive relationship between cigarette consumption rates and the number of months that the teen has smoked. In each of the equations, it is clear that the longer a teen has smoked, the greater is the number of cigarettes smoked. This result can be seen as consistent with Becker and Murphy's (1988) theory of rational addiction that argues that a good is potentially addictive if increases in past consumption raise current consumption. Becker, Grossman, and Murphy (1994)

produced strong evidence to indicate that cigarette smoking among adults does fit the theory of rational addiction.

The individual demographic variables reveal a great deal about what type of teen will smoke. Each of the four equations indicates that smoking is more common among females, older students, and non-whites. Furthermore, Equations (2) and (4) suggest that employed teens, those who presumably are spending their personal earnings, are less likely to smoke. These findings support some previous findings but are in conflict with others.

Sung, Hu and Keeler (1994) found that males were marginally less likely to smoke than females. Chaloupka and Grossman (1996) found that males were significantly more likely to be smokers but that female smokers consumed significantly more cigarettes than males. That study also agreed with our findings

Table 2
Regression Results

Variable/Equation	1	2	3	4
log Price	-0.721 (-4.027)**	-0.782 (-4.651)**	-0.645 (-3.638)**	-0.710 (-4.357)**
log Spending	0.202 (4.509)**	---	0.171	---
Percent Cigarette Spending	---	1.950 (9.251)**	---	1.997 (9.760)**
log Months	0.230 (5.712)**	0.258 (6.896)**	0.259 (6.306)**	0.300 (8.141)**
Employment	0.073 (1.873)	-0.100 (-2.975)**	0.029 (0.741)	-0.142 (-4.281)**
Gender	-0.144 (-4.179)**	-0.113 (-3.473)**	-0.128 (-3.586)**	-0.080 (-2.402)*
Age	0.026 (3.274)**	0.032 (4.288)**	0.023 (2.831)**	0.024 (3.219)**
Race	-0.090 (-10.011)**	-0.068 (-7.816)**	-0.091 (-9.255)**	-0.077 (-8.423)**
log Per Capita Income	---	---	-1.529 (-3.385)**	-1.149 (-2.759)**
Male/Female Ratio	---	---	-0.008 (-1.029)	-0.004 (-0.531)
Percent White	---	---	0.002 (1.292)	-0.001 (-0.773)
Constant	0.433 (1.985)*	0.678 (3.446)**	7.365 (3.376)**	5.123 (2.540)*
R ²	.335	.415	.364	.462
F-statistic	(34.317)**	(47.940)**	(32.887)**	(39.191)**
N	463	463	445	445

*significant at the .05 level
**significant at the .01 level

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that older teens consume larger quantities of cigarettes. The most notable disagreement between our results and those of previous studies is in the influence of race. Our results clearly show non-whites consuming larger quantities of cigarettes. Chaloupka and Grossman (1996) and Sun, Hu and Keeler (1994) both find that minority groups consume fewer cigarettes.

The demographic variables for the overall population were included in Equations (3) and (4) to capture some of the characteristics of the homes in which the students reside. The significantly negative relationship between the per capita income variable and cigarette consumption suggests that teens from poorer backgrounds are more likely to smoke. Although we are not aware of any other study that used this variable, the result is supportive of a finding by Chaloupka and Grossman (1996). They found that the education level of the teens' parents was inversely related to be consumption of cigarettes. Since it is well known that education levels and income levels are closely correlated, it is not surprising that we should find an inverse relationship between family income and cigarette consumption. The other variables for the general population; male to female ratio and percentage of the population classified as White, non-Hispanic; were not shown to have any impact on teen smoking.

CONCLUSIONS

The study examined the smoking habits of a 153 Southeast Texas teens who are currently smokers. The findings show them to be considerably more responsive to price changes than is the general population. These findings show consumption demand to be inelastic but not nearly as inelastic as the consumption demand of the adult population. The results also indicate that the teens in the study consider cigarettes to be normal goods. There are two findings that are consistent with a pattern of early addiction. Heavy teen smokers spend a larger proportion of their budgets on cigarettes and are the teens who have smoked for longer periods of time.

Within the group studied, there is strong evidence that students who are more likely to smoke are female, older and non-white. There is also some evidence that teens who work are less likely to smoke. Finally, the demographic variables for the zip codes in which the teens reside suggest that teens from poorer backgrounds are more likely to smoke.

RESEARCH QUESTIONNAIRE ON SMOKING

This study is designed to obtain information about various aspects of cigarette smoking. We are surveying people such as yourself who may or may not spend money on cigarettes. **This survey is completely confidential. Do not place your name anywhere on the questionnaire.** Please give each question considerable thought before answering. We are seeking approximate yet very specific answers. For example, when a question asks you "how many cigarettes per day do you smoke?" please think very carefully and give an approximate number such as 15 cigarettes. There may be days when you smoke more or less, but try to give us an average number.

- 1) Do you smoke cigarettes? Yes _____ No _____
If no, please go to question 14. If yes, please continue with question 2.

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- 2) How long have you smoked cigarettes? _____ (example: 1 year and 3 months)
- 3) How many cigarettes do you smoke per day? _____ (example: 12 cigarettes)
- 4) How many cigarettes would you smoke per day if the price were to increase 25 cents per pack? _____ (example: 10 cigarettes)
- 5) How many cigarettes would you smoke per day if the price were to increase 50 cents per pack? _____
- 6) How many cigarettes would you smoke per day if the price were to increase \$1.00 per pack? _____
- 7) How many cigarettes would you smoke per day if the price were to increase \$1.50 per pack? _____
- 8) How many cigarettes would you smoke per day if the price were to increase \$2.00 per pack? _____
- 9) How many cigarettes would you smoke per day if the price were to increase \$2.50 per pack? _____
- 10) How much of an increase per pack would make you quit smoking altogether? _____ (example: \$2.75)
- 11) Which factor most influenced you to select the brand that you now smoke?
Ads _____ Peers _____ Price _____ Other _____ (please specify)
- 12) Are you employed? _____ Yes _____ No
If yes, approximately how many hours per week do you work? _____
- 12) In a typical week how much do you spend on all goods and services? _____
- 14) Your Gender _____ Male _____ Female
- 15) Your Age _____
- 16) Your Race _____ White _____ African-American _____ Asian
_____ Hispanic _____ Native American _____ Other
- 17) What Zip Code do you currently reside in? _____

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