

Are Cigarette Excise Taxes Effective in Reducing the Habit?

**The Impact of Income versus Price on the Percentage of Adults
Who Smoke**

Michael Palinkas

ABSTRACT

Existing research has shown that increasing cigarette taxes, and thus increasing the price of cigarettes per pack, has had a decreasing effect on the percent of adults who smoke, but only to a certain degree. Increasing the total price per pack of cigarettes and utilizing the tax revenue to fund anti-tobacco programs has been the mission of policymakers in all 50 states and the District of Columbia since 1988. These methods may no longer be efficient, as evidenced by the fact that many individuals still choose to smoke. This study sought to find any additional factors that may affect the percentage of adults who smoke.

The study looked at the effects of four variables on the percent of the adults who smoke: cigarette tax per pack, cigarette price per pack, median income, and the number of smoking-related deaths in 2005. The unit of analysis is the state, which also includes the District of Columbia for the purpose of this study. The data for this study were drawn from data produced by the U.S. Census Bureau and the Centers for Disease Control & Prevention for the year 2005.

Findings indicated that neither the tax per pack of cigarettes nor the price per pack has a statistically significant association with the percentage of adults who smoke. The number of deaths attributed per year to smoking also failed to affect the percentage of adults who smoke. In our statistical tests, median income was the only variable to have a significant association with the percentage of adults who smoke. Using a multivariate regression model, a \$10,000 increase in median income is associated with an average decrease of 2 percent in the percentage of adults who smoke, while all other variables remain constant.¹

Since total price per pack of cigarettes has been shown to have no statistically significant effect on the percentage of adults who smoke, additional research is necessary in order to better understand the ways that smokers have altered their behavior due to higher prices. Further research is also necessary in order to comprehend the income disparity that exists between low- and high-income smokers, especially in regards to their ability to receive and their exposure to anti-tobacco programs and cessation advice from health care providers.

1 $\hat{y}_i = 30.76 + 0.043X_{1i} - 0.319X_{2i} - 0.0002X_{3i} - 0.000019X_{4i} + e_i$

INTRODUCTION

In the United States alone, an estimated 443,000 deaths per year are attributed to smoking cigarettes.² In an effort to reduce the number of these preventable deaths, state governments have created legislation and programs that seek to decrease the number of smokers, and in turn decrease the number of deaths caused by smoking. Their actions have not been entirely successful.

Since the late 1980s, states have increased the excise tax on cigarettes in order to deter individuals from purchasing cigarettes, with the hope that an increase in the total price per pack of cigarettes will decrease the number of smokers.³ The simple fact that people continue to smoke requires an in-depth look at the use of taxes as a deterrent. Factors aside from the price must be responsible for the continued existence of cigarette smoking.

This study will look at four factors in relationship to the percentage of adults who smoke. Two factors will consider price – tax per pack of cigarettes and cost per pack of cigarettes – while two factors will consider an individual's environment – median income and smoking related deaths per year. This article is divided into five sections. In the first section, I will take a closer look at existing research. In an effort to determine the effectiveness of cigarette taxes to deter smoking, I will see how smoking behavior has changed since the late 1980s, when cigarette taxes were first used as a policy tool to decrease smoking. I will also examine how the revenue from cigarette taxes has been used for anti-smoking and cessation programs, and to what effect. In addition, I will analyze the disparity of income between different groups of smokers and how this factor contributes to the overall epidemic of smoking. This leads me to question possible options to deter smoking, if price is not an effective deterrent.

Next, I will look at four hypotheses to determine if an increase in the total cost of cigarettes empirically works to decrease the percentage of adults who smoke. These four tests will focus on cigarette tax, cigarette price, median income, and smoking-related deaths per year in an effort to offer alternative policy proposals in place of simply increasing the price of cigarettes.

The final sections will then address the methods of the study and highlight my analysis. In the third section, I will look at the data that were used to conduct this study and any relevant issues that they present in regards to the accuracy of my research and conclusions. The fourth section will present information concerning the specific variables that were examined for the study and how they should be interpreted throughout the analysis. Finally, the fifth section will showcase the statistical analysis and the findings that we can conclude from running a multivariate regression equation. This equation will help us determine the relationship between our independent variables (cigarette tax, cigarette price, median income, and smoking related deaths) and our dependent variable (percent of adults who smoke). Based on the equation, I will offer conclusions and additional comments in regards to future research and

2 Centers for Disease Control and Prevention, "Smoking-Attributable Mortality, Years of Potential Life Lost, and Productivity Losses: United States, 2000-2004," *Morbidity and Mortality Weekly Report* 57(45): 1226.

3 Howard K. Koh, "An Analysis of the Successful 1992 Massachusetts Tobacco Tax Initiative," *Tobacco Control* 5(3): 220.

possible policy options that may work in conjunction with cigarette taxes to decrease the percentage of adults who smoke. Cigarette taxes have been utilized as a tool to decrease cigarette smoking for over twenty years. Surely, additional factors must be at work that cause individuals to continue smoking. As a result of this research, alternative options can be proposed which would allow states to effectively control the percentage of adults who smoke and therefore decrease the number of preventable deaths that occur in the United States each year.

SECTION I: Existing Research

The existing research regarding the effects of cigarettes taxes on cigarette consumption is both deep and wide. A brief summary of the history of cigarette taxes and the ever-increasing price of cigarettes is in order, as well as a look at the research that has been conducted concerning the effects of increased cigarette prices on lower-income smokers.

The first state-levied cigarette tax was implemented by California in 1988.⁴ In just the first year, a \$0.25 per pack increase in the cigarette tax generated \$750 million in revenue, 20 percent of which was funneled towards tobacco control programs in an effort to thwart would-be smokers from picking up the habit.⁵ After 15 years, the new tax generated \$1.8 billion towards tobacco control programs and contributed to an estimated \$86 billion in savings on “personal health-care expenditures.”⁶

Following California’s lead, Massachusetts passed a similar piece of legislation in 1992, which increased the state cigarette tax and designated a percentage of the revenue to go toward new tobacco control programs. The law was enacted in 1993, and in only one year, consumption decreased by 17 percent.⁷ This finding collaborates well with the Center for Disease Control’s (CDC) assessment that “additional increases in cigarette excise taxes, and dedication of all resulting revenues to tobacco control and prevention programs ... could result in further reductions in smoking.”⁸

The CDC has been a strong proponent of increasing the cost of cigarettes, and specifically, increasing the tax per pack of cigarettes in order to decrease the rate of consumption. In 2009, the CDC found that a 10 percent increase in the price of cigarettes can reduce consumption by up to 4 percent among adult smokers.⁹ The CDC, along with the World Health Organization and the World Bank, adamantly support the perpetual increase of cigarette taxes both to reduce cigarette consumption and to continue supporting tobacco control programs that will help further diminish the use of cigarettes and thus, the number of deaths attributed to smoking.¹⁰

4 Ibid.

5 Ibid.

6 Center for Disease Control and Prevention (CDC), “State Cigarette Excise Taxes: United States, 2009,” *Morbidity and Mortality Weekly Report* 59(13): 388.

7 Koh, “An Analysis of the Successful 1992 Massachusetts Tobacco Tax Initiative,” 224.

8 CDC, “State Cigarette Excise Taxes,” 385.

9 Ibid., 386.

10 Mohammad Siahpush et al., “Taxation Reduces Social Disparities in Adult Smoking Prevalence,” *American Journal of Preventive Medicine* 36(4): 285.

In 2007, the Institute of Medicine (IOM) found that recent cigarette tax increases have been motivated in large part by state budget shortfalls.¹¹ Currently, 44 states and the District of Columbia levy a point-of-sale tax on top of state and federal cigarette taxes. In addition, the CDC reported that 460 localities impose an *additional* point-of-sale tax on cigarettes. With an aim to reduce the smoking rate to 10 percent by 2025, the IOM and CDC continue to support excise tax increases even though alternative research suggests that higher taxes will only work to a certain degree, especially among low-income smokers.¹²⁻¹³

The negative effects of cigarette taxes can be analyzed in conjunction with income. Siahpush, et al., found that an increase in taxes does not show an “effect of price on smoking or a difference in price responsiveness across socioeconomic groups.”¹⁴ Increased prices are financially viable for high-income smokers to accommodate, but low-income smokers are impacted more severely. In fact, studies have shown that smokers overall, but especially low-income smokers, are “relatively insensitive” to the price of cigarettes, which only suggests that low-income smokers are left with a “particular burden” if they continue to smoke following an increase in cigarette taxes or an increase in price per pack.¹⁵ In addition, the decline in cigarette smoking over the past half century has been “more marked in higher- than in lower-income persons.”¹⁶ This research shows that the increase in price resulting from excise taxes should presumably affect high- and low-income populations uniformly. In fact, and more specifically, neither group should change smoking rates due to the inelasticity of demand.

Additional studies suggest that the behavior of smokers has changed in response to an increase in the price per pack of cigarettes. Adda, et al., found that smokers “compensate” for an increase in excise tax by “smoking a given cigarette more intensely.”¹⁷ Adda concluded that a 1 percent increase in excise tax led to a 0.4 percent increase in smoking intensity.¹⁸

Smokers have also altered their purchasing behavior in reaction to the increase in cigarette prices over the past few decades. Franks, et al., estimate that a low-income household that consumes two packs of cigarettes per day spends roughly 25 percent of its income on cigarettes.¹⁹ Thus, it is no surprise that low-income smokers have begun to switch from brand-name products to generic, off-brand cigarettes. In search of lower cigarette prices, smokers have altered their purchasing behavior by traveling to adjacent states where prices are substantially lower, purchasing cigarettes at Indian reservations (on which they are tax-free), ordering cigarettes over the Internet, and buying cigarettes illegally on the “black market.”²⁰

11 CDC, “State Cigarette Excise Taxes,” 387.

12 Ibid., 388. In April 2009, the federal cigarette tax was increased 259%. (\$0.39 per pack to \$1.01 per pack).

13 Peter Franks et al., “Cigarette Prices, Smoking, and the Poor: Implications of Recent Trends,” *American Journal of Public Health* 97(10): 1873.

14 Siahpush et al., “Taxation Reduces Social Disparities,” 285.

15 Franks et al., “Cigarette Prices,” 1873.

16 Ibid., 1873.

17 Jerome Adda and Francesca Cornaglia, “Taxes, Cigarette Consumption, and Smoking Intensity,” *The American Economic Review* 96(4): 1013.

18 Ibid., 1014. Smoking intensity is measured by the deepness of each inhale and the total amount of an individual cigarette that was smoked.

19 Franks et al., “Cigarette Prices,” 1876.

20 Ibid.

Lee noted similar trends in Taiwan, where smokers have responded to increased prices by purchasing generic brands and smuggling cigarettes.²¹ Adda, et al., pointed out that some smokers compensate for price increases by purchasing cigarettes with higher levels of tar and nicotine in an effort to get more for their money.²² Lee goes on to recommend that governments should consider replacing cigarette quantity with actual nicotine content as the basis for future excise taxes.

In his research, Brown found that the elasticity of cigarette consumption is -0.5, suggesting that cigarettes are price inelastic.²³ Frank, et al., adds to this by suggesting that a “declining sensitively” to the price of cigarettes may reflect an “out-growth of the overall decline in smoking” and that any “remaining smokers are likely to be selectively more addicted ... than smokers from earlier time periods.”²⁴ He concludes with the fact that since price has increased as demand for cigarettes has decreased, remaining smokers must be both “price insensitive” and disproportionately low-income individuals.²⁵ In addition, Houston, et al., found that the overall smoking rate did not decline during the 1990s, when cigarette taxes were first put into place throughout the country. He suggests that some Southern states even saw an increase in smoking.²⁶

Gilman, et al., builds on this assessment by suggesting that in order to further reduce cigarette consumption, the socioeconomic gap inherent in smoking must be addressed.²⁷ Gilman, et al., found that the lower an individual’s socioeconomic status, the more likely they are to try their first cigarette.²⁸ A low socioeconomic status also leads to an increase in the risk of “progression to regular use ... and [a] decreased likelihood of cessation,” while each additional year of adult education is related to a higher chance of quitting.²⁹ Gilman, et al., argues that the “socioeconomic status gradient – that is, the increasing prevalence of smoking with a decrease in socioeconomic status ... has persisted for several decades” and continues to grow.³⁰

Auld discovered that regular (daily) smoking is associated with an 8 percent lower income as compared to an individual that does not smoke.³¹ Siahpush, et al., found that within the U.S., the social gradient in mortality among men would decrease by half if the differences that relate to smoking were eliminated.³² The Whitehall I Study, which began in 1967 and

21 Jie-Min Lee, “Effect of a Large Increase in Cigarette Tax on Cigarette Consumption: An Empirical Analysis of Cross-Sectional Survey Data,” *Public Health* 122(2008): 1066.

22 Adda, “Taxes, Cigarette Consumption,” 1013.

23 A. Blake Brown, “Cigarette Taxes and Smoking Restrictions: Impacts and Policy Implications,” *American Journal of Agricultural Economics* 77(4): 947.

24 Franks et al., “Cigarette Prices,” 1876.

25 Ibid.

26 Thomas K. Houston et al., “Patient Smoking Cessation Advice by Health Care Providers: The Role of Ethnicity, Socioeconomic Status, and Health,” *American Journal of Public Health* 95(6): 1056.

27 S. E. Gilman, D. B. Abrams, and S. L. Buka, “Socioeconomic Status over the Life Course and Stages of Cigarette Use: Initiation, Regular Use, and Cessation,” *Journal of Epidemiology and Community Health* 57(10): 802.

28 Ibid., 803.

29 Ibid., 804.

30 Ibid., 802.

31 M. Christopher Auld, “Smoking, Drinking, and Income,” *The Journal of Human Resources* 40(2): 515.

32 Siahpush et al., “Taxation Reduces Social Disparities,” 285.

continued for several years, found that “low job status” was related to chronic lung disease and that those in “lower [job] grades ... were indeed more likely [to smoke].”³³ At the opposite end of the spectrum, Houston, et al., found that a higher education is associated with a higher report of smoking cessation advice by health care providers.³⁴ These studies indicate that there seems to be a negative relationship between income levels and regular smoking habits and a positive relationship between income and cessation practices.

As we have seen, increasing the price of cigarettes by way of imposing taxes has ceased to be an effective measure to decrease smoking. The remainder of this study will look at both the costs associated with smoking and how they affect the percentage of adults who smoke. I will also examine environmental factors that may allow us to build a clearer picture about appropriate disincentives to smoking.

SECTION II: Hypotheses

A theoretical regression model was used to test the effects of four different variables and their combined contribution to the percent of adults who smoke. Each of the four tests is based on the following equation:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \varepsilon_i \text{ Where}$$

Y_i = Percentage of adults who smoke

X_{1i} = Cigarette tax (\$/pack)

X_{2i} = Price per pack of cigarettes (\$)

X_{3i} = Median income (\$)

X_{4i} = Deaths attributed to smoking in 2005

Hypothesis Test #1: Cigarette Tax

H_1 :

There is a relationship between the amount of tax per pack of cigarettes and the percentage of adults who smoke.

Hypothesis #1 will look at the effect that cigarette taxes have on the percentage of adults who smoke. Federal, state, and local governments have worked to increase the amount of tax per pack of cigarettes in order to dissuade individuals from smoking. As we have seen above, past research show has shown the effectiveness of such legislation to be mixed. Thus, it will be important for us to understand the actual effect that cigarette taxes have in regards to the percentage of adults who smoke in order to measure whether or not the policy of increasing

³³ Richard Wilkinson and Kate Pickett, *The Spirit Level: Why Greater Equality Makes Societies Stronger* (New York: Bloomsbury Press, 2009), 75.

³⁴ Houston et al., “Patient Smoking Cessation Advice,” 1057.

cigarette taxes is actually the most effective method to decrease the percentage of adults who smoke.

Hypothesis Test #2: Cigarette Prices

H₂:

There is a relationship between the price of cigarettes per pack and the percentage of adults who smoke.

Hypothesis test #2 will measure the effect that the price of cigarettes per pack has on the percentage of adults who smoke. Much like cigarette taxes, federal, state, and local governments have determined that increasing the cost of cigarettes will decrease the number of individuals who choose to smoke. To determine whether a policy of increasing cigarette prices should be implemented, it will be important to know whether this is actually effective in deterring smoking.

Hypothesis Test #3: Median Income

H₃:

There is a relationship between median income and the percentage of adults who smoke.

Hypothesis test #3 will analyze the effect of median income in relation to the percentage of adults who smoke. The relationship between median income and smoking is an important aspect to investigate so that anti-smoking and smoking cessation programs can be targeted to the appropriate income groups. In addition, this test will allow us to note any type of inequality between income groups in regards to smoking. If such a relationship is evident, policy-makers can use this information to better target smokers and to create legislation that will focus more on users' immediate environment as an additional effort to dissuade individuals from smoking.

Hypothesis Test #4: Smoking-Related Deaths

H₄:

There is a relationship between the number of deaths per year attributed to smoking and the percentage of adults who smoke.

Hypothesis test #4 will allow us to measure the effect of smoking-related deaths on the percentage of adults who smoke. Anti-smoking campaigns often stress the dangers of smoking. This test will look at the implied effectiveness of such campaigns. Public education related to the long term effects of smoking is crucial in order to prevent individuals from commencing a habit of smoking. In addition, public education is especially important because of the apparent relationship between socioeconomic groups and the diseases associated with smoking, as we have seen in the existing research.³⁵ Policymakers should take a close look at

³⁵ Wilkinson and Pickett, *The Spirit Level*, 75.

the message that is crafted by anti-smoking programs in order to dissuade individuals from smoking. A thorough study of the success of such efforts is necessary so that policymakers can gain a better understanding of how well anti-smoking programs work and how efficient they are at instilling the message that smoking is a dangerous habit.

SECTION III: Data

The data that have been used for this study were collected in 2005 and include information on population characteristics and smoking habits for each of the 50 states and the District of Columbia. The unit of analysis of the data is the state, which includes the District of Columbia, for the purposes of this study. Each variable used for this study has 51 observations and zero missing values.

Possible methodological issues regarding the data set include: underreporting of smoking habits due to social stigma and privacy concerns; underreporting of smoking related deaths due to attribution to supplementary causes of death; bias while collecting the information due to both the method and medium of accumulating data; and market fluctuation related to the price of cigarettes per pack during the span of time that the data was collected.

SECTION IV: Variables

This section will present detailed information in regards to each of the five variables that were considered and analyzed throughout the project. First, I will look at the dependent variable, the percentage of adults who smoke. Then I will discuss each independent variable and analyze its characteristics. The independent variables include cigarette tax, cigarette price, median income, and annual number of smoking-related deaths.

Variable	Mean	S.D.	Min.	Max.
% of adults who smoke	21.57	3.11	10.5	27.6
Cigarette tax (\$/pack)	0.92	0.60	0.07	2.46
Cigarette price (\$/pack)	3.87	0.69	3.01	5.62
Median income (\$)	45,754.76	7,271.55	33,090	61,694

Table 1: Descriptive Statistics of Interval-Ratio Variables

Percentage of Adults Who Smoke

In this dataset, the variable is measured by dividing the total number of adult smokers in a given state into the total number of adults in that state. This variable is interval-ratio measurement and, as we can see in Table 1, an average of 21.57 percent of adults in all U.S. states were smokers as of 2005. Utah has the lowest percent of adult smokers with 10.5 percent, while Kentucky has the highest percentage, at 27.6.

The objective of this study is to analyze the impact of other variables on the percentage of adults who smoke. Increasing the total price per pack of cigarettes

(price per pack + tax per pack) in order to decrease the number of adults who smoke has been a policy objective for several years. Let us examine how the lowest state (Utah) and the highest state (Kentucky) compare in regard to price. In Utah, the average total price per pack of cigarettes is \$4.46, while in Kentucky the average total price per pack is \$3.31. The difference between the state with the smallest proportion of smokers and the largest is \$1.15, on average.

Cigarette Tax

The next variable that was taken into consideration is cigarette tax. In the dataset, cigarette tax is an interval-ratio variable that represents the dollar amount of tax per pack of cigarettes. As Table 1 shows, the average cigarette tax in the United States is \$0.92 per pack. The state with the lowest cigarette tax is South Carolina (\$0.07) and the state with the highest cigarette tax is Rhode Island (\$2.46).

Cigarette Price

Another important variable that was used to predict the percentage of adults who smoke is the price of cigarettes per pack. In the dataset, this variable is measured in dollars per pack. Cigarette price is an interval-ratio variable, and as Table 1 shows, the average pack of cigarettes in the United States costs \$3.87. In Kentucky, a pack of cigarettes, pre-tax, costs \$3.01, which is the lowest in the country. The highest price per pack of cigarettes is in New Jersey, where one pre-tax pack costs \$5.62.

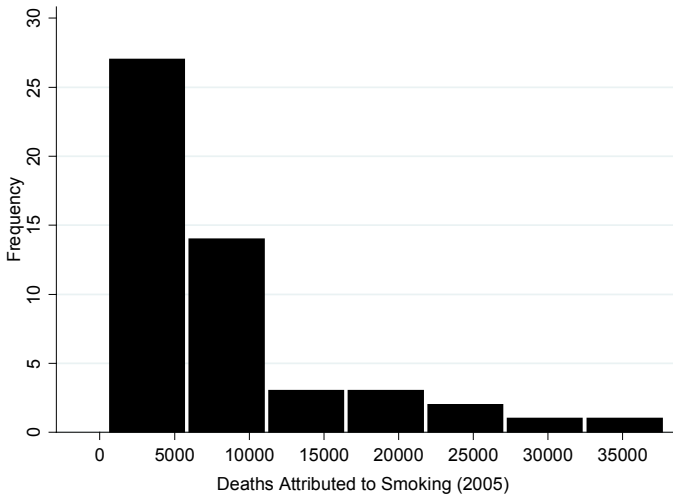
Median Income

The third variable used to determine the percentage of adults who smoke is that of median income, which is measured in dollars and is also an interval-ratio variable. In Table 1, we see that the average median income in the United States is \$45,754.76. The lowest median income per state is \$33,090 (Mississippi) and the highest is \$61,694 (New Jersey).

Smoking-Related Deaths

The final variable that I analyzed in relation to the percentage of adults who smoke is deaths attributed to smoking. This variable is ordinal, and its distribution can be seen in Figure 1. Over 50 percent of states had fewer than 6,000 deaths attributed to smoking in 2005. Alaska had the fewest deaths attributed to smoking with 500, while California had the most with 37,800.

Figure 1: *Smoking Related Deaths in 2005*



SECTION V: Discussion (Analysis and Findings)

Now that I have prepared the basis for the hypotheses described above, I will take a closer look at each test and analyze the findings. I will use the following equation to test the variables:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \varepsilon_i \text{ Where}$$

Y_i = Percent of adults who smoke

X_{1i} = Cigarette tax (\$)

X_{2i} = Price per pack of cigarettes (\$)

X_{3i} = Median income (\$)

X_{4i} = Deaths attributed to smoking in 2005

Using the data set described above, I estimate this theoretical equation and generate the following regression equation:

$$Y_i = 30.76 + 0.043X_{1i} - 0.319X_{2i} - 0.0002X_{3i} - 0.000019X_{4i}$$

From this equation, I can determine that if cigarette tax is zero, price per pack of cigarettes is zero, median income is zero, and deaths attributed to smoking in 2005 is zero, an average of 30.76 percent of adults would smoke.

Table 2: *Multivariate Regression Results*

Notes: * Statistical significance: $p < 0.05$ (two-tailed tests)

Standard errors shown in brackets

Dependent variable: % adults who smoke	Unstandardized Coefficients
Cigarette tax (\$/pack)	0.043 [1.401]
Cigarette price (\$/pack)	-0.319 [1.289]
Median income (\$)	-0.0002* [0.00007]
Smoking related deaths (2005)	-0.000019 [0.0000052]
Constant	30.76* [3.849]
N of Observations	51
R ²	0.2011

Hypothesis Test #1: Cigarette Tax

H₁:

There is a relationship between the amount of tax per pack of cigarettes and the percent of adults who smoke.

Using a two-tailed t-test, an alpha level of 0.05 (95% confidence), 46 degrees of freedom, and a $t_{(critical)}$ of ± 2.01 , we find that the $t_{(obtained)}$ is 0.031. Therefore, we cannot reject the null hypothesis. There is not a statistically significant relationship between the amount of tax per pack of cigarettes and the percentage of adults who smoke, while holding all other variables constant. Figure 2 demonstrates this lack of association more clearly.

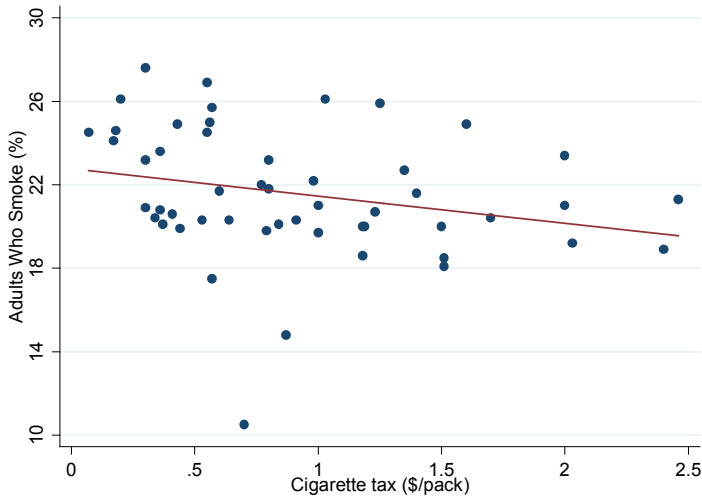


Figure 2: Cigarette taxes (\$/pack) have no relationship to the percentage of adults who smoke.

This finding suggests that the CDC, WHO, and World Bank may be incorrect in as far as their assessment that cigarette taxes have an affect on the percentage of adults who smoke, while holding cigarette prices, median income, and smoking related deaths constant. Franks, et al., and Lee may be correct in that taxes are not an appropriate policy solution to decrease smoking. As Frank, et al., suggests, smokers have become price insensitive and as Brown shows, cigarettes are price inelastic.^{36 37}

Hypothesis Test #2: Cigarette Prices

H₂:

There is a relationship between the price of cigarettes per pack and the percent of adults who smoke.

Using a two-tailed t-test, an alpha level of 0.05 (95% confidence), 46 degrees of freedom, and a t_(critical) of ±2.01, we find that the t_(obtained) is -0.247. Therefore, we cannot reject the null hypothesis. There is not a statistically significant relationship between the price of cigarettes per pack and the percentage of adults who smoke, while holding all other variables constant. Figure 3 illustrates this lack of association.

36 Franks et al., "Cigarette Prices," 1876.

37 Brown, "Cigarette Taxes," 947.

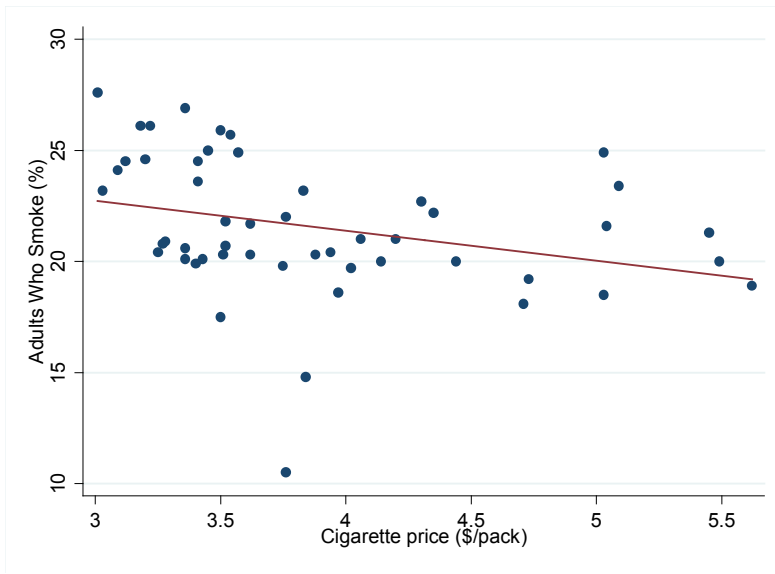


Figure 3: Cigarette prices (\$/pack) have no relationship to the percent of adults who smoke.

Much like cigarette taxes per pack, increasing cigarette prices themselves does not appear to significantly decrease the percentage of adults who smoke. Again, Frank, et al., and Lee were correct in their assessment that the cost of cigarettes may no longer be a deterrent.^{38 39} If price does not affect the percentage of adults who smoke in a statistically significant way, it is important to determine what may have more favorable effects.

Hypothesis Test #3: Median Income

H_3 :
There is a relationship between median income and the percent of adults who smoke.

Using a two-tailed t-test, an alpha level of 0.05 (95% confidence), 46 degrees of freedom, and a $t_{(critical)}$ of ± 2.01 , we find that the $t_{(obtained)}$ is -2.857. Therefore, we can reject the null hypothesis. There is a statistically significant relationship between median income and the percentage of adults who smoke, while holding all other variables constant. A \$10,000 increase in median income is associated with an average decrease of 2 percentage points in adults who smoke, holding all other variables constant. Figure 4 allows us to see this apparently negative association more clearly. As the existing research suggested, the higher an individual's income, the less likely he or she will smoke cigarettes, on average.^{40 41}

38 Franks et al., "Cigarette Prices," 1876.
 39 Brown, "Cigarette Taxes," 947.
 40 Auld, "Smoking, Drinking, and Income," 515.
 41 Wilkinson and Pickett, *The Spirit Level*, 75.

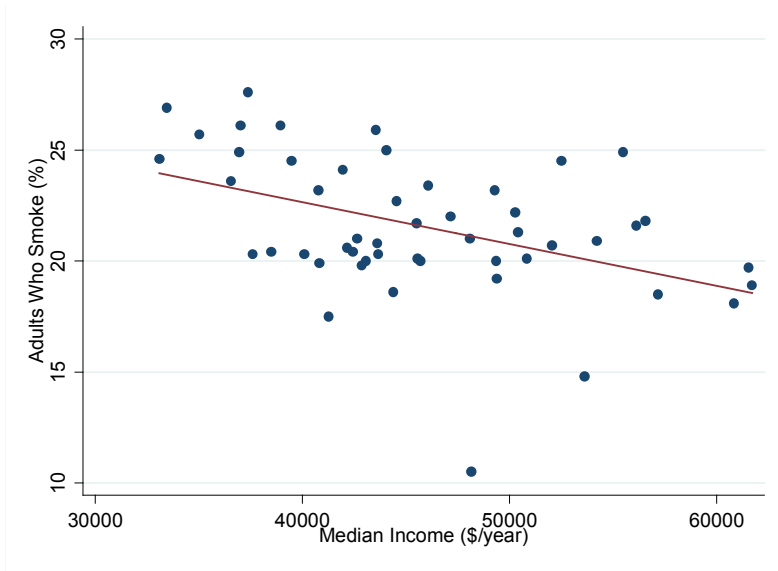


Figure 4: Median income (\$/year) has a negative relationship with the percentage of adults who smoke.

Hypothesis Test #4: Smoking-Related Deaths

$H_4:$

There is a relationship between the number of deaths per year attributed to smoking and the percentage of adults who smoke.

Using a two-tailed t-test, an alpha level of 0.05 (95% confidence), 46 degrees of freedom, and a $t_{(critical)}$ of ± 2.01 , we find that the $t_{(obtained)}$ is -0.365. Therefore, we cannot reject the null hypothesis. There is not a statistically significant relationship between the number of deaths per year attributed to smoking and the percentage of adults who smoke, while holding all other variables constant. Figure 5 allows us to see this lack of an association more clearly.

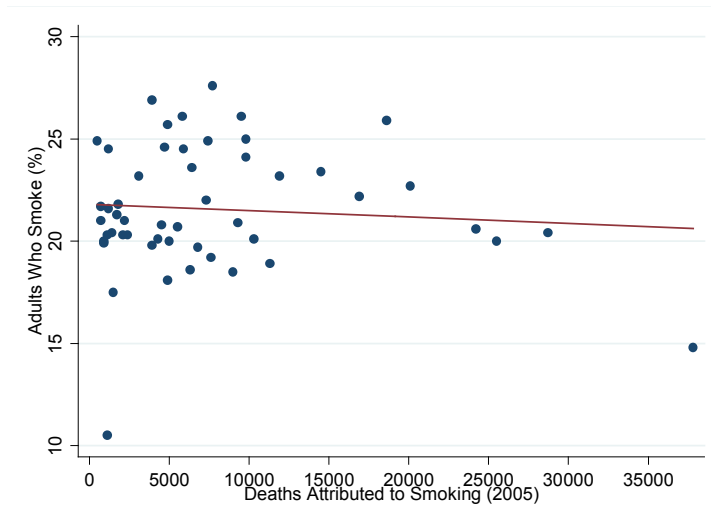


Figure 5: Deaths attributed to smoking has no relationship to the percentage of adults who smoke

Much like existing research has suggested, public education efforts have failed to motivate cessation of cigarette smoking. We can see this by the lack of association between the number of deaths attributed to smoking and the percentage of adults who smoke. Associations have been found between higher education and an increase in cessation advice from health care providers. The disparity between smoking and income levels allows us to see that low-income smokers do not have the same resources available as high-income smokers in regards to anti-tobacco programs.⁴²⁻⁴³ These findings suggest that low-income smokers are less aware of the long-term risks of smoking, and as Frank, et al., found, low-income smokers are also price insensitive, and we can now add, information insensitive.

CONCLUSIONS

As explained using the multivariate regression model, while holding all other variables constant, median income is the only factor found to be associated with a decrease in the percentage of adults who smoke. I found that a \$10,000 increase in median income is associated with an average decrease of 2 percentage points in the number adults who smoke. The total cost of cigarettes (tax and price per pack) did not significantly decrease the percent of adults who smoke, nor did the fact that hundreds of thousands of people die each year from smoking-related diseases.

With the combined knowledge of the effects of total cigarette price and median income on the percentage of adults who smoke, it seems that policymakers who seek to decrease the number of people who smoke should direct their efforts towards decreasing the inequality of income in order to decrease smoking. As Frank pointed out, smokers now seem to be price

42 Houston et al., “Patient Smoking Cessation Advice,” 1057.

43 Wilkinson and Pickett, *The Spirit Level*, 75.

insensitive,⁴⁴ thus, future anti-smoking policy proposals need to be focused on income rather than price. Although intuitively one might assume that the less money an individual makes, the less likely they will spend money on a habit such as cigarette smoking, but our data suggests otherwise. Low-income individuals are associated with a higher rate of smoking. The possibility exists that public education regarding cigarette smoking is lacking, which would work to explain the income disparity (assuming that the more income one earns, the more educated they are).

For the past twenty years, policymakers have been relying on public awareness campaigns that are funded in large part by utilizing cigarette excise tax revenues that are designed to decrease the prevalence of smoking. However, instead of stopping smoking, smokers have reacted by altering the way that they purchase and use cigarettes. Existing research suggests that smokers are now price insensitive. Thus, additional methods to curb the use of cigarettes must be adopted.

We can discern from our findings that policymakers may want to focus on decreasing the income disparity *in tandem* with the use of anti-tobacco programs in order to halt the use of cigarettes. Some policy implications may be to stop increasing cigarette taxes for a certain period of time because, as we have found, excise taxes on cigarettes disproportionately affect low-income smokers. New policies may want to address the number of cigarettes per pack in order to alleviate the increase in smoker intensity and the desire for higher tar and nicotine yields. Policymakers could also consider creating new regulations regarding the ingredients in cigarettes, which may help alleviate their habit-forming tendencies.⁴⁵ As the existing research suggests, cigarettes are more addictive than in the past, which may work to explain the “out-growth” of trends in smoking. People who currently smoke may be destined to smoke, some suggest.⁴⁶ Decreasing the number of cigarettes per pack from twenty to five or ten, while maintaining the current price and tax levels, may create such a disincentive to smoke that even those who are currently price insensitive will be forced to quit. Lower nicotine and tar yields in conjunction with smaller packs that remain at current pack prices may be a more effective deterrent than raising prices or imposing taxes. Another possible alternative, as Lee suggested, is to tax cigarettes based on nicotine and tar yield, rather than quantity. Further research in this area is necessary to measure the possible reactions from smokers regarding these new policies. One thing this study can conclude is that simply increasing the total cost of cigarettes is no longer effective as a deterrent to smoking.

As with any research project, methodological issues may limit the conclusions that we can draw from our study. Underreporting of cigarette smoking in the original survey would significantly alter our findings. Overreporting income would also cause our conclusions to be in error. In addition, if more smokers are crossing state lines and purchasing cigarettes at lower-than-retail rates, our research would become rather questionable. It is possible that high-income smokers are savvier and more willing to travel to purchase cigarettes at lower prices. In regard to the number of deaths attributed to cigarettes, each state may have a differ-

44 Franks, “Cigarette Prices,” 1876.

45 Lee, “Effect of a Large Increase,” 1066.

46 Franks et al., “Cigarette Prices,” 1876.

ent definition of a “smoking-related” cause of death, allowing the data for this variable to be quite skewed. In addition, misreporting the amount of cigarette tax in a given state and the price per pack of cigarettes may be in error, which would severely alter our findings.

New research is needed in this field. As mentioned above, studies should be conducted in order to measure the effect of nicotine- and tar-based taxes rather than quantity-based taxes. Researchers should conduct studies regarding the change in cigarette purchasing behavior in order to obtain better information regarding how many smokers travel elsewhere or use the Internet to buy cigarettes. Tests should be run to see if smaller packs at constant prices would affect smoking behavior. Additional research in the area of “smoker intensity” would also help us learn how smokers have adjusted their habits in the face of increased prices and taxes. Further research should be performed in order to accurately measure the effects of income inequality on smoking behavior.

Even as smoking decreased rapidly over the past fifty years, users remain. This study has shown that an increase in price and tax has ceased to be an effective tobacco-control policy, nor is public education in regards to the risks of smoking effective for low-income smokers. Further research and broad, wide-ranging policy options are necessary so that the addictive habit of smoking might be eradicated. Policymakers must focus on decreasing smoking rates in order to both save lives and allow current smokers to save significant amounts of money.⁴⁷ The CDC has set a goal of decreasing smoking rates to only 10 percent of the adult population by 2025.⁴⁸ With additional research, a debunking of long-held assumptions, and increasingly creative policy options, this goal may still be within reach.

⁴⁷ Franks et al., “Cigarette Prices,” 1876.

⁴⁸ CDC, “State Cigarette Excise Taxes,” 388.

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