The History and Effects of Cigarette Regulation:
A Historical and Econometric Analysis of Cigarette
Taxation and Regulation in the United States

by

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Introduction

Cigarette taxes and regulations have historically been used by governments to raise revenues and more recently discourage the habit of smoking. In the past year alone, the United States government increased the federal tax rate on a pack of cigarettes by 62 cents (the largest increase in history of the U.S. federal tax rate on cigarettes), and the government of Greece has chosen to increase the tax on cigarettes to help offset its current debt crisis. This thesis will attempt to provide an explanation for why cigarettes have become such a popular commodity for government regulation, as well as the economic theories behind these decisions. This paper will also attempt to quantify the economic effects of cigarette regulation using econometric techniques to determine whether these theories hold in reality.

The first chapter of this study is a comprehensive literature review detailing the history of tobacco and cigarette taxation and regulation in the United States, as well as the evolving justifications for taxing and regulating these goods. This review is arranged chronologically, and is designed to explain how changes in scientific methods, economic theory, statistical analysis, government policy, and the social acceptability of tobacco and cigarettes have all played a part in the evolution of cigarette taxation in the United States. The review closes with a discussion of contemporary theories regarding addictive behavior and cigarette taxes.

The second chapter of this study is an econometric analysis of the effects of cigarette taxation and regulation using two separate regression models. The first model attempts to determine the effects of tax-induced price changes on annual per capita cigarette consumption, and the second model estimates the effects of ordinary
price changes on smoking prevalence. Using the results from these two models, the conclusion section discusses how cigarette taxation and regulation affect smoking behavior in the United States, and assesses the validity of the economic theories described in the literature review.
Literature Review

In this section, the history of economic thought surrounding the justification for cigarette taxation and regulation will be examined, as well as the evolving rationale behind why such policies should or should not be enacted. The review will begin with an explanation of the economic theories of excise taxation that influenced the early tax policies of the United States, starting with the excise tax theories of the philosopher Adam Smith. Not only will these theories be discussed in this review, but the actual excise taxes imposed by the United States throughout the later 18th and 19th centuries will be examined in light of these theories. Next, this review will show why tobacco taxes were initially imposed in the United States, and how the introduction of cigarettes in the American market dramatically changed the social and medical implications of tobacco consumption.

After a discussion of the early excise taxation policies of the United States and their relation to tobacco taxes, this review will discuss the medical discoveries of the twentieth century concerning the health consequences and addictive properties of cigarettes. Not only will the discoveries themselves be explained in this section, but the implications that these medical discoveries have for government taxation and regulation of cigarettes will also be examined.

The literature review will also focus on more recent additions to the literature surrounding cigarette regulation. Many of these studies have focused on the issue of addiction and consumer preferences, and have attempted to determine how changes in prices and smoking restrictions will influence cigarette consumption. Three separate
models of consumer preferences for cigarettes will be examined in this part of the literature review.

The final sections of this chapter will discuss policy concerns with cigarette taxes and regulations, such as the regressivity of cigarette taxes, the effects of cross-border cigarette purchases, and the effects of regulations on different age groups. The justifications for these concerns will be examined, as well as the policy implications for governments attempting to increase its taxation or regulation of cigarettes.

I. Early Economics of Excise Taxation in the United States

The first western philosopher to discuss the use of tobacco taxes as an economic policy was Adam Smith. In *An Inquiry into the Nature and Causes of the Wealth of Nations*, Smith describes the types of taxes on consumable commodities that should be imposed so as not to increase the natural wage rate of laborers. Smith defines “necessity items” as commodities which are either essential for survival or would be “indecent for credible people, even of the lowest order, to be without” (Smith 1818, 287). Throughout the mid-1700s when Smith was writing, salt, candles, and soap were considered necessity items. When necessity items are taxed, producers have to pay the tax and the increase in cost forces producers to raise the price of their items. By raising the price of these items, producers also raise the price of subsistence since these items are necessary for survival. This increase in the price of subsistence forces a rise in wages, because if laborers are earning below the subsistence level there will be a decrease in the number of available workers, which will push producers to pay higher wages so as to re-establish equilibrium between
labor supply and demand (Smith 1818, 287-290). Thus, taxes on necessities are undesirable for consumers because they force the price of subsistence to rise, and are also undesirable for producers since such taxes cause their costs to increase through higher wages and less of their products to be sold.

Conversely, Smith defines a “luxury item” as a commodity that is not essential to survival. Tobacco, rum, and sugar are examples of luxury goods that Smith lists in *Wealth of Nations*, and he claims that such items are “extremely proper subjects of taxation” because of their widespread consumption (Smith 1818, 341). When a luxury item is taxed, governments are able to raise the revenues they need with less disruption, since the tax does not force a rise in the subsistence wage level. Although Smith does not explicitly advocate taxing “sin” in his writings, he does support taxing luxury items that are widely consumed and lead consumers to form bad habits, such as alcoholism, which could generate negative externalities.

Thus, taxes on goods like liquor are favored by Smith, as he claims they can benefit a society by generating citizens who are more capable of raising families. By discouraging the purchase of “spirituous liquors,” a father might drink less, causing him to rear more thoughtful children, and also allowing him to spend more on the welfare of his family. With more productive members, a society can generate more output, and in turn become more prosperous (Smith 1818, 288-289). Therefore, taxes on luxury goods that generate bad habits not only allow governments to generate revenues so that the price of labor and other commodities do not rise, but also discourage negative behavior that would inhibit a country from reaching its potential level of output.
Although alcohol consumption was viewed as a habit that generated negative externalities during Smith’s era, tobacco consumption did not harbor nearly the same amount of social stigma. Until the 1870s, almost all tobacco consumed domestically in the United States was chewed, pinched as snuff, or smoked in pipes and cigars (Brandt 2007, 25). Even into the 20th century it was not widely believed that tobacco harbored negative side effects, and up until the late 1700s it was argued that tobacco was a panacea for almost all ailments of the human body (Robert 1949, 4). Thus, Smith would likely have considered excise taxes on tobacco to be a means for generating government revenues that would lead to little disturbance in the market economy. It is therefore important to note that although Smith’s argument for taxing tobacco predated the idea of consuming tobacco as a “sin,” the growing acceptance of tobacco as a taxable commodity created a precedent that allowed higher taxes to be placed on tobacco throughout the twentieth century under the label of a “sin tax.”

Sin taxes are taxes on commodities that are believed to generate negative externalities or cause undesirable behavior from their consumers, and have been levied by rulers for many centuries. During his papal rule from 1046 to 1047 A.D., Pope Clement II established a sin tax that dictated prostitutes give half of their property to the Church when they died. Similarly, in the early 1500s Pope Leo X established a sin tax on licensed prostitutes in an attempt to fund the lavish expenses he incurred as head of the Catholic Church (Lorenzi 2004, 59). The Russian Czar Peter the Great even levied a tax on the length of Russian beards during his reign to tax the sin of vanity. All citizens, excluding peasants and priests, were forced to pay an annual “beard tax” and wear a medal proclaiming “Beards are a ridiculous
ornament” (Stanley 1986, 20). These taxes were designed to raise revenues for the state or Church, while at the same time discouraging behaviors that were seen as immoral or unnecessary by the ruling body.

The first example of a sin tax levied in the United States was an excise tax on whiskey and rum passed on March 1, 1779, and was based on Smith’s tax theories in Wealth of Nations. This was the first internal excise tax of the newly established United States, imposing a tax of seven cents per gallon on whiskey, and a tax of ten cents per gallon on rum. The tax was established by the new Secretary of the Treasury, Alexander Hamilton, who had read Smith’s Wealth of Nations, and relied upon Smith’s teachings as guidance for his tax policies (Shughart 1998, 33). This new excise tax was unpopular in Western Pennsylvania, Virginia, North Carolina, and Maryland, as whiskey was not only the liquor of choice in those parts of the country, but was also used as a medium of exchange in the more rural sectors of these states. Since the excise tax was a uniform tax on all production of whiskey, the tax also served to shift consumption away from small distillers of whiskey in the Western states to the higher-quality whiskey distilleries of the New England states. This is because the higher-quality whiskey distilled in New England was almost twice the price of the whiskey produced in the Western states, but since the tax was universally seven cents per gallon across the country, the tax had the effect of reducing the price of New England whiskey relative to whiskey in other parts of the country (Shughart 1998, 61).

Farmers in these Western and Southern states were outraged by the new alcohol tax. Not only did they feel discriminated against by the politically powerful
New England states, but they also believed they were being taxed without sufficient representation. The tax led to a farmers’ revolt in 1794 known as the Whiskey Rebellion. Farmers in these Southern and Western states tarred and feathered revenue collectors that tried to enforce the tax, and many collectors were threatened with physical violence or property damage. Some distillers who complied with the new tax were targeted by members of the Rebellion, and experienced property damage or holes shot in their stills where the whiskey was produced. Alexander Hamilton believed that a government could not claim to be established until “some signal display has manifested its power of military coercion,” and convinced President George Washington that force had to be demonstrated to make the Western and Southern Rebels comply with the laws of the United States Government. Thus, in 1794, thirteen thousand troops were called out to combat the Rebellion with President Washington initially at their head. Before the troops could confront the Rebellion, the Rebels dispersed, ending the short-lived uprising. Although no blood was shed during the Whiskey Rebellion, the incident firmly established the power of the United States to levy excise taxes, despite the fact that such taxes remained unpopular throughout the country for some time (Shughart 1998, 62-63).

Thus, Smith’s early discourse on excise taxation played an important role in the development of tax policy in the United States. Despite Smith’s argument that excise taxes on luxury items were appropriate means for governments to raise revenues, excise taxes were socially unpopular in the United States during the late 1700s and much of the 1800s. Even though Congress levied excise taxes on whiskey and rum in 1791, and carriages, snuff, sugar, salt, and auction sales in 1794, Thomas
Jefferson later repealed these taxes in 1801 (with the exception of the salt tax which was repealed in 1807) and used the abolishment of internal taxation as one of his leading campaign promises. In fact, up until the Great Depression era, most excise taxes in the United States were levied during wartime periods to provide additional sources of government revenue. Although such taxes remained unpopular during these periods, they were greeted with greater public support due to their patriotic nature as war taxes which were to be repealed after each war.

During the War of 1812, excise taxes were placed on carriages, sugar refining, and distilled spirits, but were repealed as promised at the end of the war in 1817 (Shughart 1998, 35-36). During the Civil War, Congress passed the Internal Revenue Act of 1 July 1862, which expanded the list of items taxed during the War of 1812 and included the first established income tax. The Internal Revenue Act of 1 July 1862 also established the first excise tax on cigars, which was the first tax in the United States on rolled tobacco. Excise taxes were expanded a second time during this war with the Internal Revenue Act of 30 June 1864, which increased the taxes levied on distilled spirits, and also established the first excise tax in the country on cigarettes (Werner 1922, 358). Although most of these taxes were repealed after the end of the Civil War in 1867 and 1870, excise taxes on liquor and tobacco remained permanent taxes that would fund government revenues. Similarly, during both World War I and World War II, excise taxes from the Civil War Internal Revenue Acts were reintroduced and expanded to include more contemporary items, such as theater admissions, telephone calls, and sales of chewing gum during World War I, and
automobiles, refrigerators, and electrical energy in World War II (Shughart 1998, 37-38).

The majority of goods taxed during these wartimes in the United States were luxury goods by the standards of Adam Smith. Thus, Smith’s argument that taxes, when necessary, should be placed on popular luxury goods was adhered to by policy makers throughout the 1800s and early 1900s. Much of this can be attributed to the early taxation policies of Alexander Hamilton, who laid the foundation for taxing popular luxury items with the establishment of the Whiskey Taxes, and created a precedent for future excise taxes that could generate revenue for the American government.

The English political economist David Ricardo helped to expand many of Smith’s theories on taxation, and mirrored Smith’s claims in his Principles of Political Economy and Taxation (1817) that “taxes on luxuries have some advantage over taxes on necessaries” as taxes on luxuries do not increase the wage rate and reduce the profits of producers. Ricardo also argued that consumers would eventually reach a “taxation limit” if an excise tax on a given commodity were to keep increasing. Once that tax limit was reached, a consumer would stop or decrease his purchases of the good, not because he could no longer afford it, but because he would have to pay a higher price for a good than he thought it was worth (Ricardo 1996, 167-168). Thus, Ricardo reaches an important conclusion that consumers will reach a limit as to how much they are willing to spend on any item regardless of how much enjoyment they gain from it. For some, this “breaking point” will be higher than others, the deciding factor being the relative satisfaction that a consumer derives from
the good. From Ricardo’s theory, even the most addictive substances will have a limit to how much they can be taxed, and after the limit is reached consumers will curtail or entirely stop their consumption of the good.

The French economist Jules Dupuit expanded on Ricardo’s idea of a taxation limit in his 1844 essay on the optimal tax level for bridges and public works. According to Dupuit, “If a tax is gradually increased from zero up to the point where it becomes prohibitive, its yield is at first nil, then increases by small stages until it reaches a maximum, after which it gradually declines until it becomes zero again” (Dupuit 1969, 278). This was not an entirely new argument in economics, as both Adam Smith and Alexander Hamilton had expressed the issue of diminishing revenues from government taxation in their earlier writings. In *Wealth of Nations*, Smith had claimed that higher taxation often led to lower revenues than were yielded by more moderate levels of excise taxes (Smith 1818, 78), and in *The Federalist Papers*, Alexander Hamilton asserted that if taxes are too high “the product to the treasury is not so great as when they are confined within proper and moderate bounds” (Hamilton 1993, 138). Thus tobacco taxes, as with taxes on other goods, could theoretically reach a point where government revenues would begin to decrease given further increases in the tax rates. Dupuit’s theory of optimal taxation was backed by his theory of a demand curve with diminishing marginal utility, and was the first time that a demand curve had been explained by using the theory of marginal utility. The theory itself is often popularly recognized as the Dupuit-Laffer Curve (the theory was expanded by twentieth century economist Alfred B. Laffer), and implies that escalating taxation of a given commodity may not be an effective means
for policymakers to raise government revenues, as there may be a point where the tax is so high as to decrease government earnings.

II. Initial Opposition to Tobacco

There were some early opponents of tobacco, such as King James I who decried the “loathsome” custom of smoking which was “hateful to the Nose” and “dangerous to the lungs” in his Counterblaste to Tobacco (Robert 1949, 6). There were also early reports that linked tobacco consumption to illness, as well as arguments that tobacco consumption created a tendency for alcoholism. In 1761, Dr. John Hill reported in his Cautions Against the Immoderate Use of Snuff that there existed a link between tobacco and “polypusses” in the nostrils of six London individuals who indulged excessively in the use of snuff. A “polypus” was described by Hill as a swelling in the nostril that became hard, black, and developed “all the frightful symptoms of an open cancer” which Hill believed could prove fatal. Although Hill is credited as being the first to report an association between the use of tobacco and cancer, his warning was not widely heeded during the time of its publication (Redmond 1970, 21). In 1798, Dr. Benjamin Rush published his Observations Upon the Influence of the Habitual Use of Tobacco Upon Health, Morals, and Property, which claimed that the habits of smoking and chewing tobacco promoted drunkenness in a society (Robert 1949, 106). Although Rush’s warning was not acknowledged by contemporary policy makers, his findings were later employed in the anti-alcohol movements of the nineteenth and twentieth centuries to
promote the prohibition of alcohol and tobacco in the United States (Brooks 1952, 219).

Although some cigarettes were consumed before and during the Civil War, cigarettes were viewed as a cheap novelty for individuals who could not afford more appropriate forms of tobacco. The earliest forms of cigarettes were likely tobacco wrapped in corn husks, but in the seventeenth century Spanish consumers replaced the husk with a fine paper that burned evenly when rolled around crushed tobacco. Cigarettes began to become popular in the United States during the 1870s, which is also when they began to be mass produced in the country (Brandt 2007, 25-26). James Duke, the pioneer of early tobacco manufacturing, soon consolidated tobacco production through the creation of the American Tobacco Company, which became known as the “Tobacco Trust.” Using vertical consolidation and the elimination of competition through integration or destruction, the Tobacco Trust soon became a monopoly power in the market for tobacco (Brandt 2007, 33-38). As cigarettes became more popular throughout the early 1900s, opposition to the tobacco industry focused on tobacco’s moral implications.

Not only was the Tobacco Trust disliked by policymakers of the late 19th century at a time when industrial collusion and monopoly powers like Standard Oil were controlling large shares of the market, but tobacco began to be seen as a good that bred immorality. Many reformers of the late nineteenth and early twentieth centuries believed that the popularization of tobacco in the form of cigarettes was a moral offense to the American culture. The reformers argued that the waste, indulgence, and self-harm that cigarettes brought to society went against the
backbone of Victorian culture, which held that idleness and material waste were strong threats to personal character and morality (Brandt 2007, 45-46).

As cigarettes and tobacco began to be seen as threats to the morality of America, anti-alcohol reformers across the country added the prohibition of tobacco to their goals. Such anti-liquor crusaders as John B. Gough and Lucy Gaston preached temperance by citing the moral threat of tobacco, as well as the link between tobacco and alcohol consumption that had first been proposed by Dr. Rush in 1798. For men, smoking cigarettes was also seen as a loss of “manhood,” as the New York Times warned in 1884, “the decadence of Spain began when the Spaniards adopted cigarettes.” Not only was smoking viewed as an effeminate male practice, but some doctors also claimed that smoking was a leading cause of male sterility (Wagner 1971, 40-42). Leo W. Marsden, the officer in charge of the Police Juvenile Bureau of Los Angeles, reported in 1915 that there was an inherent link between smoking and juvenile delinquency. Even Henry Ford took a stance against tobacco consumption in his 1916 publication The Case Against the Little White Slaver, where he stated he would not hire smokers addicted to the habit because company studies had found a correlation between cigarette smoking and poor work ethic (Brandt 2007, 47-48). For females, smoking was seen as a habit that signified loose morals, and similarly to male smoking it was claimed that such a habit would create sterility in women (Wagner 1971, 41).

As tobacco began to be condemned as an immoral good, the justification for its taxation began to shift as well. Throughout the 1800s, philosophers continued to expand on the taxation principles established by Adam Smith. In an extension of
Smith’s ideas in *Wealth of Nations*, the French economist Jean-Baptiste Say was critical of taxes, particularly on necessities, because he believed they reduced the available supply of money in an economy and that government authorities too often approached their fiscal duties with corruption and ineptitude (Say 1880, 238). In *A Treatise on Political Economy* (1803), Say also expands upon Smith’s nascent idea of taxation as a means of discouraging bad or immoral, as he claims that if taxation cannot be avoided, a component of “good taxes” (or those that are “least bad”) is that they are “rather favourable than otherwise to the national morality; that is to say, to the prevalence of habits, useful and beneficial to society.” Say gives an example of a “good tax” as an existing Mexican tax on cock-fighting, which not only generated revenues for the government, but also helped to check the “cruel and barbarous diversion” (Say 1880, 239-243). Thus, Say helped to expand Smith’s connection between excise taxation and morality by claiming that goods or practices which cause society to be more “immoral” should be taxed over goods lacking this characteristic.

The political economist John Stuart Mill, a staunch supporter of personal liberties throughout the 1800s, was another economist who wrote in support of taxes on commodities that bred immorality and were a nuisance to the general public. Although Mill was an opponent of government paternalism and interventionist policies, he did understand that some taxation was necessary for the government to be able to carry out its duties. Even though Mill acknowledges in *On Liberty* that taxes on stimulants such as alcohol are prohibitory, he claims that such intoxicants should be taxed because they are the commodities the “consumer can best spare” (Mill 1993, 170). According to Mill, government should levy the highest taxes on goods “of
which it deems the use, beyond a very moderate quantity, to be positively injurious” (Mill 1993, 170), and should be raised to the point that smuggling is not encouraged so as to generate the largest amount of revenue (Mill 1986, 861). Mill supported taxing stimulants because large revenue could be raised, but also because taxation discouraged the social disruption that the consumption of intoxicants caused. In 1865, Mill claimed that he was not in favor of repealing the English malt tax (a tax on the barley malted to make beer), because “public-houses were very often a nuisance,” and that they should be “out of the way as much as possible consistent with the public convenience” (Mill 1988, 31). Mill even made his views against tobacco known, particularly the irritation of tobacco smoke to passengers on railways in England where the habit had become so frequent and the “abuse of tobacco had become so great” (Mill 1988, 328).

As cigarettes began to be touted as a “nuisance” that produced moral corruption, their taxation appeared more justified by the taxation philosophies of such economists as Say and Mill. Not only were taxes on tobacco increased in 1865, 1866, and 1875, but some states even began to take prohibitory measures against the sale of cigarettes. Although many states had already passed laws prohibiting the sale of cigarettes to minors by the late 1800s, Washington became the first state to ban the sale of cigarettes entirely in 1893 (Brandt 2007, 45). This law was enacted because of the air of corruption surrounding cigarettes, not only in the moral implications of smoking, but also the immoral business practices of the Tobacco Trust which had “secured control of the manufacture of all the leading brands of smoking tobacco and of nearly all cigarettes in the United States” and had been “grinding the merchants
and retailers to such an extent that they [were] glad to see it get a dose of its own medicine” (Brandt 2007, 45). Between 1900 and 1909, Oklahoma, Indiana, Wisconsin, Arkansas, Illinois, Nebraska, Kansas, Minnesota, and South Dakota had also passed laws prohibiting the sale of cigarettes. These bans were weakly enforced, however, and many were repealed within a year of being passed. Kansas was the final state to repeal its ban on cigarette sales in 1927 (Dinan and Heckelman 2005, 532).

The introduction of cigarettes in the tobacco market thus created a fundamental shift in rationalizing tobacco taxes. Prior to the popularization of cigarettes, consuming tobacco had been viewed as a luxury habit with negligent moral and health implications. Although it was agreed that tobacco was appropriate for taxation because it was not essential for survival, there was no further argument that tobacco should be taxed or prohibited to generate social benefits. Cigarettes changed this view of tobacco, and by the early 1900s tobacco taxation was further justified by popular disapproval of this “dirty habit” (Brandt 2007, 45). Taxes on tobacco became more than just effective means for raising revenue during this period; such legislation could help curtail a habit that had attacked the Puritan backbone of American culture.

Despite the early efforts of some states to curtail smoking, sales of cigarettes across the United States soared throughout the early 1900s. The rising popularity of cigarettes during this period was unexpected; even tobacco producers in the late nineteenth century thought cigarettes were a fad that would be short-lived in popularity. As late as 1904, cigarette sales constituted approximately five percent of
the American tobacco market (70 cigarettes consumed per capita each year) (Brandt 2007, 37), but effective advertising and increased youth appeal generated by the Tobacco Trust helped to cement the popularity of cigarettes. The cigarette industry targeted men by emphasizing the connection between manhood and the newly introduced image of soldiers smoking cigarettes during World War I, and advertising aimed at women asserted that smoking cigarettes generated sex appeal and social freedom. One popular advertising slogan for Lucky Strike cigarettes during the 1920s was “For a Slender Figure – Reach for a Lucky Instead of a Sweet,” demonstrating the desire and ability of the Tobacco Trust to “fit” the American consumer to their product by changing the image associated with smoking cigarettes (Brandt 2007, 72). By 1914, annual cigarette consumption had risen to 285 per capita in the United States, and consumption rose continuously each year until its peak of 4,259 per capita in 1965 (U.S. Department of Agriculture 2006).

III. Addiction and Cigarette Regulation

As the popularity of cigarettes increased dramatically in the early twentieth century, the science surrounding the health implications of cigarettes increased as well. One important health issue focused on the addictive nature of cigarettes. Although the difficulty of quitting smoking had been widely recognized since the introduction of cigarettes in the American tobacco market, there was not yet agreement as to whether this difficulty constituted an addiction (Brandt 2007, 337). Although it was unknown at the time, the inhalation of nicotine allows the highly addictive chemical to be rapidly absorbed into the bloodstream, which then reaches
the brain seven seconds later. Prior to cigarettes, tobacco smoke had been too harsh to inhale, and was typically held in the mouth when smoking pipes or cigars. Similarly, the practice of pinching snuff or using chewing tobacco entailed holding tobacco in the mouth or drawing it in through the nose. Although some nicotine is absorbed from these forms of tobacco, the absorption is more rapid and potent when the nicotine is introduced to the bloodstream through the lungs. The process of flue-curing, which involves the use of large furnaces with iron piping to cure tobacco leaves, developed after the Civil War and gave producers greater control over the curing process compared with using open wood and charcoal flames. Flue-curing also altered the chemistry of tobacco used in cigarettes by making the leaf slightly acidic as opposed to alkaline. The mildness of this new blend of tobacco promoted inhalation, which led to greater levels of nicotine being absorbed by American smokers (Brandt 2007, 24).

Although it was widely recognized in the early twentieth century that there was some level of addictiveness to smoking cigarettes, there was not yet any scientific evidence to support this claim. In the early 1900s, there was not enough information about the habits of cigarette smokers simply because cigarettes were still being established as a product in the American market. In fact, it was not until 1964 that cigarettes were formally declared to cause dependence in the Surgeon General’s Report on Smoking and Health. Although this report claimed that “smokers and users of tobacco in other forms usually develop some degree of dependence upon the practice, some to the point where emotional disturbances occur if they are deprived of its use,” the report drew a clear distinction between “habituation” and “addiction”
(Brandt 2007, 336). The report maintained that an addiction leads to states of “periodic or chronic intoxication” and the desire to obtain an addictive substance by any means, whereas cigarettes simply created a “desire (but not a compulsion)” to continue using the drug (U.S. Department of Health, Education, and Welfare 1964).

It would not be until May of 1988 that the Surgeon General would recognize the addictive nature of cigarettes in a second report concerning cigarettes. In this report, the Surgeon General’s office reported three major findings: that cigarettes were addictive, that nicotine was the drug causing addiction, and that addiction processes of nicotine “are similar to those that determine addiction to drugs such as heroin or cocaine” (U.S. Department of Health and Human Services 1988).

The addictive nature of nicotine, and the ability of consumers to satisfy this addiction by smoking cigarettes, implies that cigarettes have a relatively inelastic price elasticity of demand. Price elasticity of demand is a concept credited to the economist Alfred Marshall, who introduced the idea in his *Principles of Economics*. According to Marshall, an individual’s change in consumption of a good following a price increase or decrease depends on the price elasticity of demand for the good. A relatively high price elasticity of demand indicates that a consumer would purchase much less of a good if its price were to increase, whereas a relatively lower price elasticity of demand indicates that consumption would not decrease by as much given the same price increase (Marshall 1953, 102-113). Thus, a commodity that is perfectly inelastic (a price elasticity equal to zero) would not be consumed in less quantity if its price were to increase. It follows from Marshall’s discussion of price elasticities that addictive substances have relatively inelastic demand functions, as
perfectly addicted consumers will be willing to pay as high a price as necessary to satisfy their addictions.

In *A Contribution to the Theory of Taxation* (1927), economist and mathematician Frank P. Ramsey expands on Marshall’s idea of price elasticities with respect to taxes. According to Ramsey, governments can maximize the efficiency of taxation by levying taxes on goods in inverse proportion to their price elasticities of demand (Shughart 1998, 17). Thus, commodities that are relatively price inelastic should be taxed more than goods that have a greater price elasticity of demand. In fact, Ramsey claims that if goods exist which exhibit perfectly inelastic demand, the entirety of government revenues should be derived from their taxation. Not only would such a tax system allow a government to raise its desired level of revenue, but the utility derived by consumers would not diminish at all if the tax were to be raised (Ramsey 1978, 254).

One qualification Ramsey made was that this system of taxation would be efficient for any finite amount of revenue that the government desired to raise. Ramsey did not specify whether such a system of taxation would remain efficient if government were attempting to raise the maximum level of revenue possible, and it has been argued by economists Geoffrey Brennan and James Buchanan that government taxation seeking as much revenue as possible using Ramsey’s system would be greatly inefficient. Acting like a “Leviathan,” such a government would be a monopoly power exploiting the inelastic demand of certain goods, and would drive up the deadweight loss in society by levying higher and higher excise taxes on them (Brennan and Buchanan 1980, 55-80). Thus, taxation following the “Ramsey Rule”
could allow governments to raise only finite, predetermined revenues while simultaneously minimizing disruption and loss of consumer utility in society.

Although the Ramsey Rule justifies taxing cigarettes on the grounds that cigarettes have a low price elasticity of demand, this justification is incongruent with earlier arguments that supported taxing cigarettes so as to diminish their consumption. Following Ramsey’s theory, governments should levy taxes on cigarettes specifically because an increase in the price of cigarettes will not greatly decrease their consumption. In light of the earlier arguments of the twentieth century that favored regulating cigarette sales for moral purposes, any government taxing cigarettes in accordance with Ramsey’s Rule would be profiting off of a sinful, addictive behavior of its consumers, and would itself be acting as an immoral agent. Thus, even though Ramsey’s Rule established a new justification for levying taxes on tobacco, there is a moral question that accompanies such policy of whether it is appropriate for governments to be profiting from the addictive habits of its citizens. Today, the Ramsey Rule is one of the more important ideas used to validate taxing cigarettes, as it is believed these taxes are more efficient in that government revenues can be raised without creating large distortions in consumption and production habits (Yurekli 2002, 17).

IV. Externalities of Smoking and Cigarette Regulation

Another health issue that influenced cigarette taxation in the twentieth century was the connection between smoking and lung cancer. Similar to the research on the addictive nature of cigarettes, by the mid-1900s there were no conclusive results that
linked smoking cigarettes to lung cancer. Although the increase in lung cancer rates across the country paralleled the rise in popularity of cigarettes throughout the first half of the twentieth century, proving causality was a difficult task for researchers at the time. Medical research on the health effects of cigarettes was hindered in two important ways. First, there is a long latency period between the start of smoking and the onset of disease, but by the early twentieth century cigarettes had only recently been popularized in the United States (Brandt 2007, 111). Thus, doctors and researchers up until the late 1930s found little connection between smoking and lung cancer largely because Americans had not been smoking for long enough to develop health complications from cigarettes. The second barrier to proving the connection between cigarettes and lung cancer was the lack of rigorous statistical methods that could prove causation with statistical significance. The method popular amongst scientific researchers during the late 1800s and early 1900s was to observe and study collections of medical cases, which was subjective, unreliable, and lacked statistical backing (Brandt 2007, 123).

Some physicians and surgeons across the country did begin to suspect the connection between the increase in lung malignancies and smoking during the 1930s, noting that patients with lung cancer were typically smokers. Despite these observations, the traditional research techniques of observation were not sufficient in proving that cigarettes had caused this increase in lung cancer. Although it was possible that smoking cigarettes led to diseases that caused premature death, it could have also been the case that less healthy individuals were predisposed to smoke (Brandt 2007, 127-128). Some researchers, such as the medical statistician Richard
Doll, believed that other factors may have been the cause of the new rise in lung cancer. Doll initially believed the increase in motor exhaust and tarred roads in the twentieth century led individuals to inhale a greater number of carcinogens, and that these factors were to blame for the rise in lung cancer (Brandt 2007, 137). Thus, despite the increasing suspicion of physicians, surgeons, consumers, and researchers throughout the early 1900s that cigarette smoking was linked to lung cancer, this question of causation could not be proved definitively given the primitive statistical methods exercised at the time. As the surgeon Evarts Graham stated, “Yes there is a parallel between the sale of cigarettes and lung cancer, but there is also a parallel between the sale of silk stockings and cancer of the lung” (Brandt 2007, 128).

As the twentieth century progressed, the popularization of cigarettes generated a greater number of smokers who could now smoke “anytime, anywhere,” allowing for more opportunities to witness the health effects of smoking. Methods in scientific research also improved significantly throughout the 1900s, as rudimentary statistical techniques began to be applied to medical evaluations (Brandt 2007, 132). One such improvement that influenced research on the effects of smoking was the introduction of a “control group,” which could be used to examine the health differences between citizens who were smokers, and those who were not. In using a control group, researchers could better isolate the effects that smoking had on health; if the groups were kept as similar as possible with the exception of smoking habits, any substantial differences in health patterns observed between the groups could be attributed to smoking cigarettes (Brandt 2007, 136-137).
Using the increased data on smoking and these more powerful statistical methods, medical researchers in the 1950s sought to prove formally the link between smoking and lung cancer that had been suspected for two decades. Throughout the 1950s, studies in both the United States and Europe asserted that although smoking cigarettes could not be the only cause of lung cancer (since there were instances of lung cancer in patients who were non-smokers), there was a strong statistical association between cigarette smoking and the occurrence of lung malignancies (Brandt 2007, 133-142). These findings drew many opponents, particularly from the tobacco industry, and the counter-arguments created controversy over their results. Some claimed that the rise in lung cancer rates was attributed to genetic constitution, and that it was a constitutional factor that led individuals both to become smokers and develop lung cancer. Others were critical of the selection of individuals used in the studies, claiming that there could be underlying bias in the sample selections used (Brandt 2007, 142-143). Thus, up until the 1960s the causal relationship between smoking and lung cancer was not definitive, despite the growing literature and clinical evidence which supported this claim.

It was not until the 1964 Surgeon General’s Report that a definite causal relationship between cigarette smoking and lung cancer was established. In 1962, the Surgeon General Luther Terry formed a committee to investigate the ongoing questions of smoking and health. Terry sought a political document that would be “scientifically unimpeachable,” without which the government would not be able to create powerful health policies and regulations relating to smoking if cigarettes were in fact detrimental to one’s health (Brandt 2007, 219-223). Two years later, after
extensive research into the effects of smoking on health, the Surgeon General’s Report announced that cigarette smoking was causally related to lung cancer, and that cigarette smoking was the most important cause of chronic bronchitis in the United States (U.S. Department of Health, Education, and Welfare 1964). Finally, following decades of uncertainty surrounding the health effects of cigarettes, the American public had an answer to the causality question.

The Surgeon General’s Report, coupled with studies released in the 1980s that showed second-hand smoke (otherwise known as ETS, environmental tobacco smoke) posed a significant health risk, led to the justification that cigarette smoking imposed a negative cost, or externality, on society (Brandt 2007, 279-285). Some have claimed that since smoking is an action that creates medical complications, the habit increases the medical costs which have to be borne by society, particularly through taxpayer funded programs such as Medicare and Medicaid (Shughart 1998, 20). Others have argued that smoking cigarettes causes insurance premiums to rise for everyone, since the risk-level of insurance consumers in the United States is greater overall because of the health threat from cigarettes. This rise in insurance premiums would impose an added cost for all purchasers of insurance, even non-smokers who would be paying for the risky habits of smokers. Finally, if second-hand smoke is a significant threat to the health of non-smokers, there are external costs imposed on society in the form of illness or death for citizens who are not necessarily active smokers (Shughart 1998, 236-240).

An important twentieth century economist to discuss taxation and negative externalities in society was Arthur Cecil Pigou, who introduced the idea of taxation to
help correct for such social costs. Pigou recognized that externalities were imposed through the consumption of certain goods, and that the private costs paid by consumers for the good were not equivalent to the public costs incurred through their consumption. Pigou provides the example of alcoholic drinks as a good with such externalities in his 1954 essay, “Some Aspects of the Welfare State.” According to Pigou, “the social costs involved in the supply of alcoholic drinks includes the provision of police to control the effects of excess, but these costs do not enter into the price that the purchasers of such drinks have to pay for them” (Pigou 1954, 6). The existence of negative external costs associated with these goods means there are gaps between the private and public costs paid for them, which can be corrected through government taxation. If the gap between private and public costs were removed for a good through an excise tax, the true cost of the good would be reflected in its price, and the greatest amount of social welfare would be achieved.

Although Pigou realized the taxation of such goods could minimize deadweight loss in society and correct for externalities, he also acknowledged that it was a difficult task to quantify the gap between private and public costs of a commodity, and distrusted the politics of taxation. “Politicians are not philosopher kings,” he claimed, and believed that even with a perfect blueprint of how much to tax a good, that such a blueprint would “quickly yield place on their desks to the propaganda of competing pressure groups” (Pigou 1954, 6). Despite Pigou’s lack of faith in the abilities of government to use “Pigouvian Taxes” successfully, his argument of taxation as a corrective method for externalities has become one of the
main justifications in recent years for the efficiency of cigarette taxes in addition to the Ramsey Rule (Yurekli 2002, 17).

Since the introduction of Pigouvian Taxes, there has been widespread debate over the true external costs of smoking. The Center for Disease Control reports that smoking-related costs have continued to climb in recent years, and that the external cost of smoking in the United States is $6.79 per pack of cigarettes (Centers for Disease Control and Prevention 2006). This estimate includes the costs of lost productivity incurred by premature deaths of smokers who could otherwise have continued to contribute to society. The cost estimate also includes Medicaid expenses attributed to smoking, as it is believed that smokers incur a disproportionate share of medical care from government provided programs. Similarly, in the 2004 publication *The Price of Smoking*, Sloan, Conover, and Ostermann estimate that the external costs of smoking are $6.88 per pack of cigarettes. This estimate also includes the costs of quasi-externalities, the most important of which are the health effects imposed on spouses of smokers, as well as the costs of infant mortality and low birth weight complications resulting from smoking during pregnancy (Conover, et al. 2004, 254-257). Another cost of smoking that has been suggested is an “annoyance cost” of smoking, the cost imposed on others who are subjected to the irritation of breathing in cigarette smoke. Although it may be true that environmental cigarette smoke is a nuisance imposed on society, such a cost would be difficult to estimate, as a subjective measure of how much society is willing to pay to avoid others’ cigarette smoke would need to be calculated.
Although the fiscal effects of smoking cigarettes are often cited when quantifying the cost of smoking, it is also recognized that it is inappropriate to use economic arguments alone when determining the true external costs of smoking. One important cost that would not be directly included in economic arguments is the cost to individuals who are unaware of the addictive qualities of nicotine, and who do not recognize or completely understand the future health risks of smoking. Although it is often assumed that smokers are aware of the health risks associated with cigarettes, some have claimed that this assumption cannot be extended to adolescents who are not responsible enough to make rational decisions that could negatively affect their future health. If it were true that adolescents smoke with an imperfect understanding of the health consequences of their habit, then the internal costs of cigarettes would need to be taken into account to some extent when determining an appropriate level of cigarette taxation. A higher tax on cigarettes could thus be justified by including this cost under the assumption that higher taxes act as a deterrent for children to start smoking before they are aware of its negative consequences to their health.

However, other economic findings have brought uncertainty to these high external cost estimates associated with cigarettes. In *The Social Security Cost of Smoking*, Shoven, Sundberg, and Bunker (1987) find that premature deaths resulting from cigarette smoking actually “save” the Social Security system hundreds of billions of dollars. Because smokers live shorter lives on average than non-smokers, smokers are paying into the Social Security system but ultimately collecting less from it than non-smokers later in life. Thus, smokers are subsidizing the Social Security benefits of non-smokers, and are generating an economic benefit to society rather
than imposing a cost. Similarly, economist W. Kip Viscusi has reported that for each pack of cigarettes smoked in the United States there is a net cost savings of 32 cents by taking into account the shorter life expectancy and reduced Social Security payments to smokers (Viscusi 2002-2003, 62). There are some who criticize these estimates, however, and find it objectionable that an early death for a smoker can be considered a “benefit” in these calculations (Evans, Ringel, and Stech 1999, 44-45).

In _The Cost of Poor Health Habits_, Manning et al. (1991) find more moderate external costs associated with smoking, ranging from 31 to 52 cents per pack. Evans, Ringel and Stech (1999) find slightly higher estimates than Manning for the external costs of smoking, and believe that the cost to society is 42 to 72 cents per pack. There are several reasons for the differences in these estimates of the external costs of smoking, the main factors being whether the studies take into account the effects of maternal smoking, and what the economists consider to be “external costs.” For instance, Manning, et al. (1991) define the individual economic unit to be the household, and thus do not take into account the external costs that smoking might have on spouses or infants, even though Viscusi (1995) and Manning, et al. (1991) both claim that the majority of deaths from second hand smoking are likely from exposed spouses. Viscusi (1995) also ignores the external costs associated with maternal smoking in his study.

Evans, Ringel, and Stech (1999) estimate higher external costs per pack of cigarettes, because they find the costs of maternal smoking to be greater than those estimated by Manning, et al (1991). By taking into account the higher medical costs, education expenditures, and infant mortality associated with maternal smoking, Evans,
Ringel, and Stech (1999) arrive at higher external cost estimates per pack of cigarettes than other studies that take into account the effects of premature smoking deaths on Social Security expenditures. Due to the complicated nature of determining the costs of cigarettes, research and debate continues over what the true costs of smoking are, and how the government can intervene to align the private and public costs of smoking.

V. The Theory of Rational Addiction

Recent additions to the literature surrounding cigarette taxation are concerned with the issue of addiction associated with cigarettes. Two economists who have studied the habits of consumption surrounding addictive goods are Gary Becker and Kevin Murphy. In their essay, *A Theory of Rational Addiction* (1988), Becker and Murphy assert that addictive behaviors can be studied in the context of neoclassical economics, as consumers of addictive goods are rationally maximizing their utility over time. The underlying assumption that consumers are acting rationally indicates that they not only have perfect information about their current and future consumption preferences, but that they also know the full costs of consuming an addictive and possibly harmful good. Thus, even though individuals recognize the full consequences of consuming cigarettes, they may still choose to smoke because the gains from smoking exceed any costs of future addiction (Botond and Köszegi 2000, 1).

According to their model, the utility an individual derives from current consumption of an addictive good is a function of his past consumption of that good.
The more of an addictive good an individual has consumed in the past, the greater his consumption in the current period will be due to the addictive nature of the substance and consumer “learning by doing.” Becker and Murphy thus conclude that a compensated price increase in an addictive good (keeping the marginal utility of wealth constant) will not only decrease current consumption because of the new price constraint and substitution effect, but future consumption will also be affected to a much greater extent. This is because the “stock” of consumption will be lower in each future time period following the initial reduction, causing future consumption to decrease at an increasing rate in each future period. Given this complementarity of consumption across time periods, even a permanent future tax increase will have an effect on current cigarette consumption. If consumers are perfectly rational, they will curtail current smoking in the face of an upcoming tax increase so that their future cigarette consumption will maximize utility given the new future price constraint (Becker and Murphy 1988, 685-689). If this type of behavior is actually exercised by consumers, cigarette consumption should decrease even before new excise taxes are put into effect.

From their model, Becker and Murphy claim that even though a tax increase on an addictive good may only generate a modest short-run reduction in its consumption, the long-run effects of the tax may be greater than if a non-addictive substance were taxed instead (Becker and Murphy 1988, 695). This finding implies that the short-run and long-run elasticities of addictive goods are inversely proportional, and that taxing addictive goods that are inelastic in the short-run is not the most efficient taxation principle because market disruptions avoided in the current
period will be realized to a greater extent in future periods. The arguments of Becker and Murphy are therefore in contrast with the Ramsey Rule of tax efficiency, which assumes the price elasticity of a good remains constant regardless of prior consumption. Following Becker and Murphy’s claims, cigarette taxes should not be levied with the intent of raising government revenues, but instead should only be imposed in a Pigouvian manner to correct for the gap between the public and private cost of cigarettes generated by interpersonal externalities (Gruber and Köszegi 2002, 4).

**VI. The Theory of Time-Inconsistent Preferences**

Although Becker and Murphy contend that taxing addictive substances such as cigarettes may not be efficient in the long-run, some have challenged the underlying assumptions of their model, particularly the assumption that consumers behave rationally. Economists Jonathan Gruber and Botond Köszegi argue that consumers of addictive goods do not act rationally, and instead have time-inconsistent preferences. Thus, even though individuals may want to curtail their consumption of cigarettes in the future, the fact that addicted consumers are impatient in the short-term implies that they will be unable to actualize their desired future levels of smoking (Gruber and Köszegi 2002, 17). Gruber and Köszegi claim that time-inconsistent behavior justifies taxing cigarettes beyond their externalities, because the internalities of smoking are harmful to consumers who are pursuing the activity in an irrational, uncontrolled manner. By this argument, cigarette taxes would benefit society by reducing individual harm incurred irrationally by smoking, and thus
generate greater utility for consumers while simultaneously raising government revenues (Gruber and Köszegi 2002, 35). The important policy implication suggested by Gruber and Köszegi is that the internal costs of smoking need to be considered alongside the externalities when discussing the taxation of cigarettes. If consumers are incapable of preventing harm to themselves because of the strong addictive qualities of cigarettes, it is the responsibility of a benevolent government to use taxation as a “self-control tax” (Gruber and Köszegi 2000, 27-31).

Despite the differences in assumptions held by Gruber and Köszegi, their findings are empirically similar to those of Becker and Murphy. The economists also agree on the forward-looking behavior of consumers and the impact of future tax increases, concluding that future taxation cause hoarding and decreased consumption of cigarettes in the present. The policy implications are quite different, however, between these two models. According to the Becker and Murphy model, since consumers are fully aware of the personal costs of their habit, cigarettes should only be taxed to account for any externalities they impose on society. From the previous discussion, this level of taxation would range anywhere from a discount of $0.32 per pack to a tax of $6.88 per pack. In the Gruber and Köszegi model, since consumers are incapable of understanding and realizing their desired future levels of smoking, government intervention is necessary to diminish the self-harm these consumers are irrationally perpetuating. According to their estimates, Gruber and Köszegi believe the internal costs of smoking to be approximately $35.64 per pack of cigarettes, and thus an appropriate cigarette tax would take into account the internal costs in addition to the external costs of smoking (Gruber and Köszegi 2002, 35). Sloan, Conover, and
Ostermann reach a similar conclusion that the internal costs of cigarettes are $32.78 per pack (Conover, et al. 2004, 257).

As can be seen, there is a large difference in the cigarette excise tax rates implied by the Becker-Murphy and Gruber-Köszegi models despite the similarities in their empirical findings. Because of their empirical similarities, it is difficult to run economic tests to determine which of these models accurately describes consumer behavior. Both theories do claim that past and future cigarette consumption will affect current consumption, however, and thus the underlying intuition behind these theories of addiction can be tested econometrically by determining what effects past and future cigarette consumption have on current consumption.

There is currently little economic analysis to support Gruber and Köszegi’s claim that consumers are irrational and have time-inconsistent preferences, and economists such as Viscusi have questioned the surveys used by Gruber to support his claim that smokers display time inconsistency. Even though a smoker may express the desire to quit smoking in the future, such a response may be automatic given the contemporary strong anti-smoking environment, or an inauthentic response generated temporarily by involvement in a long survey process enumerating the harms of smoking. Viscusi also argues that it is not appropriate for government to correct for intertemporal irrationality, and that such a responsibility would imply government intervention in marriage decisions, mortgage refinancing, car purchases, and every other aspect of individuals’ lives with a temporal dimension “because they fail to account properly for such long-term consequences themselves” (Viscusi 2002-2003, 61).
VII. The Theory of Cue-Triggered Decision Processes

A model introduced by economists Douglas Bernheim and Antonio Rangel in 2004 involves cognitive psychological failure in an attempt to explain the behavior of cigarette consumers. According to Bernheim and Rangel, a consumer can be in either a “hot” or “cold” decision-making state with respect to an addictive substance. In a “hot” decision-making state, a consumer displays cognitive failure where he will always consume the substance regardless of his underlying preferences. In a “cold” mode, a consumer is fully aware of his consumption choices and their potential consequences, as well as the effects of current choices on the likelihood of entering the “hot” mode in the future (Bernheim and Rangel 2004, 1559). The “cold” mode of Bernheim and Rangel would be comparable to an individual displaying the perfect rationality of consumption that underlies the Becker and Murphy model. Bernheim and Rangel assert that environmental cues and previous exposure to an addictive good can increase the probability of a consumer entering a “hot” mode, and thus leading an individual to consume irrationally. For instance, if an individual associates smoking cigarettes to being in a bar, being around friends who smoke, or with consuming alcohol, exposure to these types of environments may trigger cues that place an individual in a “hot” mode. Similarly to the models of rational and irrational addiction, an individual’s consumption history of an addictive good will influence present consumption behavior. Thus, the more cigarettes a person has smoked in the past, the greater the probability that he will enter a “hot” state in the present time period (Bernheim and Rangel 2004, 1565-1568).
The Bernheim and Rangel model of cigarette addiction has very different policy implications than the previous models discussed. According to their model, because visceral motivations (a short-circuiting of the rational decision making process) underlie the demand for addictive substances, irrational cigarette consumption should be insensitive to price changes (Deb, et al. 2009, 5). Taxation would thus be an ineffective and distorting method for trying to reduce the irrationality of cigarette consumption. By taxing an addictive substance, consumers’ choices will be altered in the “cold” mode where they are acting rationally, but consumption will not be influenced in the “hot” mode when individuals display price insensitivity in their consumption behavior (Bernheim and Rangel 2002, 34-35). Bernheim and Rangel instead suggest policy measures as a more effective means for improving social welfare. Policies like restricting smoking in public places and presenting images of the consequences of substance abuse would create minimal distortion for consumers in the “cold” state, while at the same time reducing potential environmental cues that would lead an individual to consume cigarettes irrationally (Bernheim and Rangel 2002, 37-39). Thus, according to this model of cognitive failures, a socially optimal measure would be to enact policies that reduce the probability of consumers entering “hot” modes that would lead them to conduct irrational behavior.

VIII. The Regressivity of Cigarette Taxes

The impact of cigarette taxes on consumers with different income levels is also a subject of interest for this study, particularly given recent increases in cigarette
excise tax rates. In his review of the impacts of different tax systems, Suits (1977) finds that excise taxes are the most regressive form of taxation in the United States. Cigarette excise taxes are believed to be particularly regressive, because lower income individuals often end up paying a greater portion of the tax than more affluent individuals (Evans, et al. 1999, 33). This is not only because each pack of cigarettes constitutes a greater portion of total income to less wealthy consumers, but the prevalence of smoking amongst lower classes is also greater than the rate of smoking for higher income individuals. If the consumption of cigarettes is inversely related to income, then an issue of equity arises when considering cigarette taxes. If lower income individuals do in fact pay a greater proportion of cigarette taxes, then it can be argued that such a tax system would be inequitable because it violates the “ability to pay principle,” which states that those with greater incomes should pay a greater share of government taxes (Chaloupka, et al. 1995, 384-385). In this light, cigarette taxes would be considered unfair because they fall the hardest on those who are the least able to pay them.

Even though cigarette taxes may be regressive, the degree of regressivity is difficult to determine. Studies in the United Kingdom have found that the price elasticity of demand for cigarettes is inversely related to income and social class (Chaloupka, et al. 1995, 384). This finding implies that faced with an increase in cigarette taxes, individuals with lower incomes will curtail their consumption of cigarettes more than relatively wealthier consumers. Thus, the result of a tax increase on cigarettes would be a distribution of health benefits that are actually advantageous for poorer citizens given the high internal costs of smoking per pack. These health
benefits are also difficult to evaluate, because there are some who claim that higher taxes cause consumers to switch from higher priced branded cigarettes to lower priced generic brands that often contain more nicotine and tar. If this is the case, cigarette taxes may not actually provide health benefits to poorer citizens, because the higher nicotine and tar consumed from smoking generic cigarettes may generate more serious long term health complications (Chaloupka, et al. 1995, 384-385).

Of course, if cigarette taxes are intended to internalize externalities, or control for inaccurate risk perceptions, then those who smoke the most should theoretically pay the most in cigarette taxes. Unfortunately, it is not always clear why certain jurisdictions raise their cigarette taxes, and if such a tax increase were not intended to account for increased externalities or inaccurate risk perceptions, then this increase would be regressive because poorer citizens would have to provide a greater portion of government revenues from the tax (Evans, et al. 1999, 36-37).

**IX. Additional Effects of Cigarette Taxes**

Similar to the impacts of cigarette taxation on consumers of different income levels, it is also believed that effects of cigarette taxes vary for individuals of different age groups. As previously stated, many economists believe that adolescents smoke irrationally, as they have incomplete information about the future health consequences of their actions. Although there might be a role for taxation to prevent adolescents from harming themselves irrationally, the response of youths to increased prices in cigarettes must first be examined. Recent studies have shown that although there is a large group of adolescents that is responsive to the price of cigarettes, there
is also a smaller group that does not curtail smoking habits given a price increase on cigarettes. Given this dichotomy in price responsiveness for adolescent smokers, Fletcher, Deb, and Sindelar posit that taxation may not be the most effective means for deterring youth smoking if such consumers do in fact smoke irrationally. According to their study, social welfare could be maximized if government policies other than taxation were used to deter youth smoking (Deb, et al. 2009, 12-13). Such measures could include tougher punishment for youth smoking, or increased imagery and advertising of the negative health effects caused by smoking. These normative implications are similar to those advanced by Bernheim and Rangel in their model of temporary cognitive failures, but depend upon the extent to which youths smoke irrationally and their responsiveness to price increases on cigarettes.

Economists have also discussed the effects of cigarette taxation on interstate smuggling and cross-border purchases of cigarettes. In his 2002 address to the American Legislative Exchange Council, Michael Lafaive talks about the “unintended consequences” of cigarette taxation, namely how consumers and smugglers take advantage of excise tax differentials between different states. According to Lafaive, 7.8 percent of all cigarettes purchased in the United States in 1997 were obtained through cross-border activity. Lafaive gives an example of smugglers caught in the summer of 2000 in Charlotte, North Carolina, where cigarettes were being transported from North Carolina where excise taxes were five cents per pack to Detroit, Michigan, where cigarette taxes were seventy-five cents per pack. It is estimated that each 13-hour trip netted the smugglers between $3,000 and $10,000, and that millions of dollars were made in profit between 1995 and 1999.
Not only were these smugglers able to profit from government imposed tax differentials between states, but it was also found that the smugglers had ties to the terrorist organization Hezbollah (Lafaive 2002, 2-3). Although Lafaive acknowledges that it may be a stretch to claim that by levying excise taxes on cigarettes the American government is helping to fund terrorist organizations, he does stress that such unintended consequences of cigarette taxation need to be taken into account before policymakers make any changes to existing tax rates.

In a similar study, economist Mark Stehr found that tax avoidance and interstate purchases accounted for 9.6 percent of all cigarette sales in the United States. Stehr used data on self-reported consumption of cigarettes at the state level and compared this to the documented sales of cigarettes per year in a given state (Stehr 2005, 277). Although a large portion of these interstate purchases may be attributed to smuggling, individual interstate purchases of cigarettes are important factors as well. Not only is it possible for consumers to cross state borders and purchase cigarettes in a neighboring state with a lower cigarette sales tax, consumers can purchase cigarettes online and avoid own state taxation with greater ease. According to Stehr, states with relatively high cigarette sales tax rates wishing to raise revenue or curb cigarette smoking should pair any increase in cigarette excise taxes with effective policies to halt smuggling or other measures of tax avoidance. If such measures are not possible, states should seek revenue from more efficient sources, and use anti-smoking legislation as a method to reduce smoking levels (Stehr 2005, 296). Thus, before a state decides to raise taxes on cigarettes, it needs to examine the potential “unintended effects” that such a tax increase would have, and whether
smuggling and interstate purchases would reduce the intended revenue and health gains from such a tax increase.

Since the late 1700s, the economic justifications and estimated effects of tobacco taxation and regulation have changed considerably. From being considered a “luxury” habit to one with negative interpersonal externalities, tobacco consumption in the United States has evolved socially, morally, economically, politically, and scientifically. With the recent increase in the federal cigarette tax rate, as well as increased government regulation restricting smoking in public venues, the intended and unintended effects of these policies need to be examined. In the next chapter of this thesis, the effects of cigarette taxation on cigarette consumption will be determined using econometric analysis, and the validity of the economic theories presented in this chapter will be assessed using these results.
Empirical Analysis

In this section, two econometric methods will be used to quantify the effects that cigarette excise taxes have on the demand for cigarettes, and the effect of taxes on smoking prevalence. The goal of these econometric models is to quantify the effects of cigarette taxation and regulation on smoking behavior. There are, however, many other factors that might affect the level of cigarette consumption and smoking rates in any state and time period, and these factors can be accounted for in a multi-regression framework. Using state-level panel data for all 50 states, this study will attempt to determine the true effects of cigarette taxation and regulation on smoking behavior by controlling for these other variables. This study will begin with regressions where cigarette consumption is the dependent variable, and then discuss regressions where smoking prevalence is the dependent variable.

I. Cigarette Demand Regressions

1. The Regression Model

To quantify the true effect that taxation and regulation has on the demand for cigarettes, this study will attempt to determine how consumers respond when a state increases the excise tax on a pack of cigarettes. Since it can be assumed that consumers are only concerned with the final price of a pack of cigarettes when making their purchasing decisions, the amount of impact a tax increase has on consumption is in large part determined by how much of the tax increase is passed on
to consumers in the form of a price increase per pack, and whether taxation has any effects on consumption separate from this price increase.

Evans, Ringel, and Stech (1999) find that the full amount of a cigarette excise tax is passed on to consumers as a price increase, and that any increase in the excise tax rate of cigarettes in a given state is a direct increase in the price per pack of cigarettes there. The assumption that cigarette supply is perfectly elastic, and that producers are able to pass the entire amount of a tax onto consumers, is consistent with the findings of Barzel (1976), Harris (1987), Sumner (1981), and Keeler, et al. (1996). These works have found that nearly all (and in some instances more) of an excise tax increase is passed on to consumers in the form of higher retail prices for cigarettes. If the only effect of a cigarette tax on consumption is through the form of a price increase, then the price elasticity of demand for cigarettes needs to be determined.

There is some disagreement with the position that cigarette taxes only affect consumption because of price increases. Licari and Meier (2000) suggest that when governments increase a tax to raise revenue and discourage consumption of a good, the effect on consumption habits may be due to a “signaling effect” in addition to the increase in price. A signaling effect occurs when governments communicate negative characteristics of a good to consumers through tax increases. Thus, a signaling effect might occur when governments increase the tax on cigarettes, because governments are publicizing the negative health consequences and externalities of cigarettes to their purchasers, and perhaps making smokers more wary of purchasing cigarettes.
If it is true that increases in cigarette prices and taxes have separate effects on cigarette demand, both of these explanatory variables need to be included in the regressions of this section. One problem with including price as an independent variable in the demand equation for cigarettes is that price is expected to be a function of cigarette demand. If this is the case, there will be endogeneity in the demand equation, which might cause bias in the estimates produced by the regressions. By running a Hausman test on the endogeneity of the real price per pack of cigarettes in the cigarette consumption model, this study finds that keeping the price variable directly in the regression will cause endogeneity. Thus, a model needs to be generated where the effects of a price increase on the per capita consumption of cigarettes can be determined without directly including price as an explanatory variable. A Two Stage Least Squares (2SLS) model where other explanatory variables are used as instruments for price solves this endogeneity problem, as long as the instruments chosen are highly correlated with the price variable, but not correlated with the error term in the regressions.

Thus, the primary empirical approach in this study is to determine the price elasticity of demand for cigarettes, which can then be applied to understanding how cigarette taxes affect cigarette demand. Other studies on this subject have uncovered a variety of estimates for the price elasticity of demand for cigarettes, most of which find cigarettes to be an inelastic good. Evans, Ringel, and Stech (1999) find the price elasticity to be in the range of -0.3 to -0.5. Chaloupka and Warner (2000) report that many studies have estimated the price elasticity of cigarette demand to be around -0.4,
despite the wide variety of approaches and methods that economists have used in their studies. In their analysis of 86 papers focused on demand for cigarettes, Gallet and List (2003) calculated that the mean price elasticity of demand for those studies was -0.48.

With help from previous literature by Baltagi and Levin (1986), and Baltagi, Griffin, and Xiong (2000), the regression model for cigarette demand can be expressed as:

\[ Q_{it} = \beta_0 + \beta_1 P_{it} + \beta_2 Y_{it} + \beta_3 B_{it} + \beta_4 L_{it} + \beta_5 A_{it} + \beta_6 Q_{i,t-1} + \beta_7 Q_{i,t+1} + \beta_8 W_{it} + \beta_9 B_{it} + a_i + a_t + e_{it} \]

where the dependent variable, \( Q_{it} \), is the state per capita cigarette consumption for state \( i \) and period \( t \). The independent variables are the real average price per pack of cigarettes in state \( i \) in time \( t \), \( P_{it} \), real disposable per capita income, \( Y_{it} \), an index which measures the incentive for residents to purchase cigarettes in a neighboring state, \( B_{it} \), an index representing the level of anti-smoking legislation, \( L_{it} \), the average age of residents over the age of 16, \( A_{it} \), per capita packs of cigarettes sold lagged by one year, \( Q_{i,t-1} \), per capita packs of cigarettes sold in the following year, \( Q_{i,t+1} \), the percentage of White residents in the population, \( W_{it} \), and the percentage of Black residents in the population, \( B_{it} \). The variable \( a_i \) represents any time-invariant state factors that might affect cigarette consumption, \( a_t \) denotes time-varying factors on a national level that might affect cigarette consumption, and \( e_{it} \) represents the error term in a given state and year.
Individual time-invariant state factors, denoted by $a_i$, are inherent qualities of a state that do not change over time, and affect the prevalence of cigarette consumption. For instance, if residents of one state are more prone to smoking than in others for cultural or geographical reasons, the failure to account for this in the model would cause the estimates to be biased. Since this study is running panel regressions using state-level data, the presence of individual state effects can be controlled for by using state fixed effects on the data. This will create dummy variables for each state in the regressions, and will clean out any distortions that these individual state effects might create, allowing better estimates to be obtained on the elasticities of the independent variables.

Time-varying national factors, denoted by $a_t$, are factors that influence cigarette consumption on the national level. Examples of time-varying national factors would be the release of information concerning the health consequences of cigarettes, such as the release of the Surgeon General’s Warnings. Another example of a time-varying factor would be general national sentiments about smoking, which could change with time depending on the social acceptability of smoking in different years. These time effects can be controlled for in this model by using time fixed effects, which will create a dummy variable for each year in the study and clear out any effects of changing national sentiments toward tobacco that might affect cigarette consumption.

To best quantify how many packs of cigarettes an individual consumes per year, this study will use per capita tax-paid sales of packs of cigarettes in each state as
the dependent variable. Per capita packs of cigarettes sold is used as the dependent variable representing cigarette demand for a number of studies, including Chaloupka (1988), Baltagi, Griffin, and Xiong (2000), Sissoko (2002), Evans, Ringel, and Stech (1999), and Huan, Yang, and Hwang (2004).

The legislation variable included in this model (denoted by Lit) is a measure of the level of restrictive smoking legislation in state $i$ during time $t$. Restrictive clean air laws began to be enacted in the 1970s, starting with the Minnesota Clean Indoor Air Act of 1975, and since then have been used to restrict smoking in private and public domains. Many of these laws were enacted in response to the Surgeon General’s Warnings in 1972 and 1986, which presented evidence of the link between smoking, second-hand smoking, and lung cancer. These anti-smoking laws not only increase the personal cost of smoking due to the inconvenience of having to smoke in other areas (such as leaving a dinner table to smoke outside), but may also contain a signaling effect that further alerts consumers to the negative externalities and health effects of smoking.

In this model, there are three ways in which a government can restrict smoking in a location: 1) The location must have designated areas for smoking and nonsmoking, 2) The building must have separate ventilated areas, or 3) Smoking is banned completely. Of these three options, banning smoking is the most restrictive policy, and having designated areas is the least restrictive policy. Using these legislative guidelines, a legislation index is used to quantify the level of restrictiveness associated with each type of law. In this index, a value of 0 denotes no
restrictive smoking legislation in a given area, a value of 1 denotes a location must have designated areas, a value of 2 represents separate ventilated areas, and a value of 3 signifies that smoking is banned entirely.

In this study, four areas are considered where smoking restrictions have been enacted in most states, and would likely influence the smoking behaviors of citizens: 1) Public transportation, 2) Private workplaces, 3) Restaurants, and 4) Bars. Using the values from the legislation index, the variable $L_{it}$ is the equally weighted sum of the restrictive measures enacted in each of these four locations in state i for a given year t. This legislation variable is similar to the legislation vector used by Tauras and Liang (2003), who used individual data on smoking habits over several years to determine that clean indoor air laws have a negative and statistically significant impact on cigarette demand. Thus, the legislation variable is:

$$L_{it} = PT_{it} + PW_{it} + R_{it} + BAR_{it}$$

where $PT_{it}$ represents smoking legislation concerning public transportation in state i and time t, $PW_{it}$ denotes legislation in the private workplace, $R_{it}$ represents smoking legislation in restaurants, and $BAR_{it}$ denotes legislation targeted at bars. Because $PT_{it}$, $PW_{it}$, $R_{it}$, and $BAR_{it}$ all range from 0 to 3 in value, the legislation index, $L_{it}$, ranges from 0 to 12 in value.

It might also be expected that cigarette demand is affected by bootlegging or cigarette purchases in neighboring states if the average retail price of cigarettes in a bordering state is lower (and conversely citizens from neighboring states purchasing
in one’s own state if neighboring cigarette prices are higher). Baltagi and Levin (1986) and Stehr (2005) find that this bootlegging effect is statistically significant, but the results of Baltagi, Levin, and Xiong (2000) find the effect to be statistically insignificant.

To define the variable for bootlegging, $B_{it}$, this study uses a similar construction as Stehr (2005). There are three factors that are expected to influence a consumer’s decision to purchase cigarettes in a neighboring state. The first factor is the price differential between packs of cigarettes in one’s own state and bordering states. The second factor is the border length between states; for pairs of states that share a longer border with one another, it can be anticipated that there are more opportunities for citizens to travel from one state to another. A third factor that would influence the probability of a consumer purchasing cigarettes in a neighboring state is the total area of his home state. A person living in a state with a smaller total area will have a greater probability of being close to a bordering state, and will thus be more inclined to purchase cigarettes elsewhere if the incentives are great enough.

To construct a variable that will accurately capture these qualities believed to influence the amount of cross-border cigarette purchases, a border index needs to be created which becomes more positive as the incentive for purchasing cigarettes in a bordering state increases, and likewise becomes more negative when there is increased incentive for consumers in neighboring states to purchase cigarettes in one’s own state. Thus, the variable should be inversely related to the area of a state, and should increase in absolute magnitude when the price differential and border
lengths are greater in relation to neighboring states. Using these guidelines, the bootlegging variable is constructed as follows:

$$B_{it} = \sum_{n=1}^{k} \frac{(T_{i}-T_{n})(X_{n})}{(AREA_{i})}$$

where \((P_{it} - P_{it})\) represents the difference between the cigarette excise tax rates in state \(i\) and its neighboring state \(n\). \(X_{in}\) represents the border length between state \(i\) and its neighboring state \(n\) denotes in miles, and \(AREA_{i}\) denotes the area of state \(i\) in square miles. Thus, the index sums this quotient for each state in relation to its \(k\) number of neighboring states, and quantifies the incentive for consumers in a state \(i\) to travel to a neighboring state to purchase cigarettes.

As mentioned earlier, running the cigarette demand model with the inclusion of \(P_{it}\) as an independent variable will lead to biased estimates, since it is expected that the quantity of cigarettes sold will affect the price of cigarettes through the forces of supply and demand. This creates a problem of endogeneity in the model, which can be controlled for by using a 2SLS regression. To find an appropriate instrument for price, other variables need to be found that are highly correlated with price, but do not suffer from the same endogeneity problem as the price variable with relation to per capita cigarette sales. Two variables that can be used as instruments for price are the real excise tax rate on a pack of cigarettes, \(T_{it}\), and the average real price per pack of cigarettes in the previous time period, \(P_{it-1}\). It can be expected that the excise tax on a pack of cigarettes in a particular state is correlated with the real average retail price per pack of cigarettes in that state, because the tax is a large component of the final
retail price that is charged for cigarettes. The excise tax rate is also not anticipated to
be a function of cigarette sales, because governments are expected to adjust the tax on
cigarettes in response to budgetary needs, not the popularity of cigarettes in a
particular time period. Since the excise tax rate, \( T_{it} \), is highly correlated with the
price variable, and should not be correlated with the error term in the regressions, this
variable is an appropriate instrument for \( P_{it} \).

Similarly, it is expected that the lagged real price per pack of cigarettes, \( P_{i,t-1} \),
is highly correlated with the current real price per pack of cigarettes, \( P_{it} \). Given the
cigarette prices in state \( i \) during year \( t \), it can be anticipated that the same state would
have similar cigarette pricing in the next period with slight fluctuations driven by
demand for cigarettes or changes in the real excise tax rate. Thus, state cigarette
prices in the previous period should be very similar to prices in the current period.
This study finds that the simple correlation between the price of cigarettes in the
current and lagged period is 0.9770, which is almost perfectly correlated. What
distinguishes \( P_{i,t-1} \) from \( P_{it} \) is that while current prices are expected to be influenced
by the current demand for cigarettes, cigarette prices in the lagged period should not
be a function of current demand. Thus, \( P_{i,t-1} \) can be used as an instrument for \( P_{it} \),
because \( P_{i,t-1} \) does not suffer from the endogeneity problem that encountered by using
\( P_{it} \) directly as an independent variable in the model. Since \( T_{it} \) and \( P_{i,t-1} \) are both
variables that are highly correlated with the current real price of cigarettes, \( P_{it} \), but are
not influenced by current per capita cigarette sales, these variables can be used as
instruments for \( P_{it} \). Using a 2SLS regression with \( T_{it} \) and \( P_{i,t-1} \) as instruments for \( P_{it} \)
will hopefully control for endogeneity in the model, and thus yield unbiased coefficient estimates.

A log-log model will be used in the cigarette demand regressions for this study, which is similar to the regressions run by Becker, Grossman, and Murphy (1994), and Baltagi and Levin (2001). Therefore, all of the variables will be in logged values, except for \( W_{it} \) and \( BL_{it} \) (the race variables measured in percentages). By using a log-log model, this study is forcing a particular functional form on the regressions, where the estimated coefficients will yield the constant elasticities of the independent variables with respect to cigarette demand.

2. Benefits of the Model

The cigarette consumption model allows several conclusions to be reached about the demand for cigarettes that are separate from the objective of determining the price elasticity of demand. One conclusion that the model allows to be tested is whether cigarettes are an inferior or normal good through the variable denoting real per capita disposable income, \( Y_{it} \). If cigarettes are a normal good, then having a higher income indicates that an individual will purchase a greater number of cigarettes in a given year. If cigarettes are an inferior good, then having more income indicates that an individual will purchase fewer cigarettes in a given year. The question of whether cigarette demand is affected by income is relevant to the discussion in the previous chapter concerning the equity of cigarette taxes. If
cigarettes are an inferior good, then individuals with lower income levels will in theory consume more cigarettes in a given year, and thus government revenues made by increasing the cigarette tax will be borne disproportionately by poorer citizens who are least able to pay them. The estimate of the coefficient on the income variable will signify what type of good cigarettes are; if the estimated coefficient on $Y_{it}$ is negative, then cigarettes are an inferior good because a higher level of income implies a lower level of cigarette consumption, and if the coefficient on $Y_{it}$ is positive, it can be concluded that cigarettes are a normal good on the aggregate level.

Another advantage of this model is that it allows the effectiveness of anti-smoking legislation in deterring cigarette consumption to be determined. The effect of legislation on the demand for cigarettes can be estimated by the coefficient on the legislation index variables, $L_{it}$. If the coefficient on this variable is negative, then it can be determined that legislative measures to prevent smoking are effective, and may be more equitable than taxation if the intentions of state governments are to reduce cigarette consumption in their state. Conversely, if the estimated coefficient of $L_{it}$ is only slightly negative or statistically insignificant, it can be concluded that legislative measures are not effective measures at the aggregate level to reduce the number of cigarettes smoked in a state annually. If this is the case, other measures would need to be sought if a government were trying to reduce per capita cigarette demand.
This model also allows the addiction theories proposed by Becker and Murphy (1988) and Gruber and Köszegi (2002) to be tested.\(^1\) As discussed in the literature review, both sets of addiction theories assert that consumers are not only influenced by past consumption of addictive goods, but also adjust their current consumption of these goods based on their future consumption and preferences for addictive substances. Thus, current demand for cigarettes is a function of both past and future demand for cigarettes according to the models proposed by Becker and Murphy and Gruber and Köszegi. The validity of these claims can be tested in the cigarette demand regressions with the inclusion of a variable for lagged per capita cigarette sales, \(Q_{t-1}\), and a variable representing future per capita cigarette sales, \(Q_{t+1}\). A similar method is used by Baltagi and Griffin (2001) and Becker, Grossman, and Murphy (1994), who also include variables for per capita packs of cigarettes sold one year in the past and future.

One complication with including \(Q_{t-1}\) and \(Q_{t+1}\) as exogenous variables directly in the demand regressions is that future and past consumption of cigarettes may be a function of current cigarette consumption under Becker and Murphy’s theory of rational addiction. If this is the case, then including these variables will yield inconsistent estimates because of endogeneity in the model. One way to control

\(^1\) Although comparable studies that have tested for the validity of these theories have used aggregate panel data on per capita cigarette consumption (Baltagi and Griffin (2001); Becker, Grossman, and Murphy (1994)), using aggregate data may not be the best method for testing these theories of addiction. It would be more appropriate to use individual panel data to determine individual habits and preferences rather than trying to extrapolate this from aggregate results. Although this may not be the best method for testing the validity of these theories, the results of this analysis may still provide a weak test for whether the underlying principles of addiction in Becker and Murphy (1988) and Gruber and Köszegi (2002) hold in reality.
for this is to add $Q_{i,t-1}$ and $Q_{i,t+1}$ to the list of variables that will be instrumented for in the regressions. In light of the earlier discussion about the endogeneity complications that are present when cigarette demand is modeled with respect to cigarette price, lagged and future prices cannot be used as instruments for lagged and future per capita cigarette sales. Instead, this study will have to use instruments that are still highly correlated with lagged and future demand for cigarettes (although possibly to a lesser extent than cigarette prices), but are uncorrelated with the error term in the regressions.

Two such variables that can be used as instruments for lagged and future cigarette sales are the lagged and future excise tax rate on packs of cigarettes, represented by $T_{i,t-1}$ and $T_{i,t+1}$ respectively. Since the excise tax rate makes up a large component of the per-pack price of cigarettes in any given state, the tax rate is likely to be highly correlated with the amount of cigarettes that are purchased per capita in both lagged and future periods. As mentioned previously when discussing the use of $T_{it}$ as an instrument for $P_{it}$, cigarette excise tax rates are not thought to be influenced by per capita cigarette demand in a state, as governments are theoretically only concerned with raising revenues from taxation and not exploiting changes in consumers’ preferences toward cigarettes. Because $T_{i,t-1}$ and $T_{i,t+1}$ are correlated with $Q_{i,t-1}$ and $Q_{i,t+1}$, and are not expected to be correlated with the error terms in the regressions, these variables can be used as instruments in the model to achieve unbiased estimates.
A final benefit of the model is the inclusion of the bootlegging variable, $B_n$, which allows the effect of bootlegging on the demand for cigarettes to be quantified. If the estimated coefficient on the bootlegging variable is statistically significant, then the difference between the real cigarette excise tax rates of a state and its neighbors influences the demand for cigarettes in that state. If this is the case, then state governments who have a target revenue from cigarette taxes must not only be aware of the excise tax that they impose on packs of cigarettes in their own jurisdiction, but must also be informed of any cigarette excise tax changes in neighboring states. In this scenario, if neighboring states are planning to raise or lower their tax rates, a state government would have to re-evaluate its own taxation policies to determine whether it could still raise the targeted amount of revenue from cigarette taxation. If the estimated coefficient on the bootlegging variable is statistically insignificant, then state governments do not need to be aware of excise tax changes outside of its borders, and instead only need to worry about the excise tax on cigarettes that it charges its own citizens.

3. Expected Results from the Regressions

Having reviewed similar studies completed on this subject, this section will discuss expectations for the coefficients derived from the regressions. Since the primary objective of these regressions is to determine the price elasticity of demand for cigarettes, the most important expectation relates to the coefficient on the price
variable $P_t$. Gallet and List (2003) studied 86 separate studies of cigarette demand, and found that the mean price elasticity of demand in these studies was -0.48, with a range of estimates from -3.12 to 1.41 (the standard deviation of 0.43 also shows the amount of variation in these studies). This price elasticity of demand supports the claim that cigarettes are price inelastic, since it is less than one in absolute magnitude.

The studies analyzed by Gallet and List vary widely, however, particularly in the years they were published. While many of the studies were conducted in the 1980s and 1990s, others date as far back as 1949 and as recently as 2001. Thus, the average price elasticity of demand for cigarettes of -0.48 might be representative of the average price elasticity from 1949 to 2001, but might not be an accurate indicator of the contemporary responsiveness of cigarette demand to price changes.

Therefore, although it may be expected that the price elasticity of demand for cigarettes is inelastic in the range estimated by Gallet and List, this study may find estimates outside of this range due to the more contemporary nature of the analysis. If smokers have become more sensitive to the health impacts and social consequences of smoking since the second half of the twentieth century, then price increases in cigarettes may have a greater effect on per capita demand for cigarettes. It would then be expected that the price elasticity of demand for cigarettes is greater in absolute magnitude (more negative) than -0.48, indicating that a tax increase on cigarettes will cause cigarette demand to decrease more than predicted by the findings of Gallet and List. On the other hand, it may be the case that smokers who were more sensitive to the physical and social consequences of smoking over the years have
already stopped smoking, leaving a class of contemporary smokers who are either indifferent to the negative externalities and health effects of smoking, or are more addicted to cigarettes. If this is the case, then the expected price elasticity of demand for cigarettes would be lower in absolute magnitude than -0.48, as more addicted smokers who are indifferent to the negative consequences of smoking will have a harder time quitting or smoking less despite an increase in the price per pack of cigarettes.

This second scenario may be more plausible, because even though smoking is less prevalent now than throughout the middle of the twentieth century, contemporary smokers have chosen to ignore the continued warnings that link smoking to lung cancer. It is reasonable to believe that if these consumers are either addicted enough to cigarettes or are indifferent to the health warnings associated with smoking, that there will be less change in demand for cigarettes amongst these consumers given an increase in the excise tax on cigarettes. Thus, it might be anticipated that the price elasticity of demand for cigarettes estimated in this study will be lower in absolute value than -0.48, because the analysis of this study is focused on a more contemporary time span (1970 to 2008) than that incorporated by Gallet and List, and would therefore capture this growing resistance of remaining smokers to alterations in their smoking habits. This conclusion is also reached by Goel and Nelson (2006), Baltagi and Goel (1987), and Huang, Yang, and Hwang (2004) who claim that demand for cigarettes is becoming more price inelastic over time.
There should also be some expectations about the estimated coefficient on the income variable, $Y_{it}$, which will help to determine if cigarettes are an inferior or normal good. In the same study by Gallet and List mentioned above, it was found that out of 86 reports on the demand for cigarettes, the mean income elasticity was 0.42 with a standard deviation of 0.49. Thus, even though it might appear that cigarettes are a normal good because of the positive mean income elasticity, the large standard deviation shows that this finding is statistically insignificant. The statistical insignificance of the income elasticity for cigarette demand is not an uncommon finding for studies on this topic; Baltagi and Levin (1986), Chaloupka and Saffer (1988), and Goel and Ram (2004) also find that the income elasticity of cigarette demand is insignificant. However, Becker and Murphy (1994) and Huang, Yan, and Hwang (2004), find that there is a slightly positive and statistically significant income effect with respect to cigarette demand. Huang, Yan, and Hwang also find that the income elasticity for cigarette demand is decreasing in absolute magnitude over time. If the income elasticity with respect to cigarette sales is truly decreasing over time, the inclusion of more recent years in this study than Huang, Yan, and Hwang will likely cause estimated the income elasticity to be lower than their findings. With these previous studies in mind, it can be expected that this study will find an estimated income elasticity that is either statistically insignificant, or slightly positive but statistically significant.

As for the estimated coefficient on the bootlegging variable, $B_{it}$, the results from these regressions are not directly comparable with other studies due to the
unique nature of the bootlegging index used. It can, however, be anticipated that the presence of bootlegging will have similar effects in this model when compared with other studies. Baltagi and Levin (1986), Chaloupka and Saffer (1988), and Baltagi, Griffin, and Xiong (2000) find that the effects of border crossing behavior in the United States on state cigarette purchases are small, but statistically significant. Stehr (2005) finds that this effect is much larger, and that from 1985 to 2001, 9.6% of all cigarettes were purchased without paying state taxes. Saba et al. (1995) give state specific estimates for the impact of border crossing and find that border crossing effects are statistically significant and increase the responsiveness of cigarette sales to price changes in a given state. Because the bootlegging variable is designed to be more positive if own state cigarette prices are higher relative to prices in neighboring states, and more negative if neighboring state prices are greater than own state prices, it can be expected that the estimated coefficient on the bootlegging variable will have negative effect on per capita cigarette sales given the findings of these other studies.

The legislation index in the demand model will help to determine the effectiveness of non-price smoking restrictions in curtailing cigarette consumption. Because laws prohibiting or limiting smoking in public and private areas create an added cost to smoking, it can be expected that the presence of more anti-smoking laws (a higher value for \( L_{it} \)) would lead to a lower per capita consumption of cigarettes. Thus, the estimated coefficient of \( L_{it} \) is expected to be negative. This conclusion is also reached by Tauras (2006), who found that although anti-smoking legislation does not decrease the total number of people who smoke, it does have a
statistically significant negative impact on per capita cigarette consumption. Thus, this type of legislation may not deter people from being smokers, but it will cause them to smoke less given the added inconvenience and social costs of smoking that are associated with such laws.

Some studies, however, have found that anti-smoking legislation, particularly in private workplaces, is not effective for reducing smoking. Farrelly and Evans (1998) find that there is little correlation between laws governing smoking in private workplaces and actual workplace smoking policies. Instead, the desire of an individual firm to reduce smoking on its premises is the most important factor driving cigarette consumption at work, rather than overarching legislation. Chaloupka and Saffer (1988) also find that smoking restrictions in the form of clean indoor air laws are statistically insignificant determinants of cigarette demand. Therefore, although laws restricting smoking are expected to be inversely related to cigarette consumption, it may also be the case that such legislation is ineffective policy for reducing smoking. If it is true that legislation has little effect on actual smoking behavior, the estimated coefficient for $L_{it}$ will be statistically insignificant. Due to the increased cost of smoking created by smoking restrictions, $L_{it}$ is not expected to be positively related to cigarette demand in this study.

The estimated coefficients on the variables $Q_{i,t-1}$ and $Q_{i,t+1}$ are measures of the addictive nature of cigarettes, and will not only determine how past consumption of cigarettes affects current consumption, but also how future cigarette consumption affects current smoking consumption. As discussed in the literature review, cigarettes
are addictive substances because they contain nicotine, which is rapidly absorbed into the bloodstream when cigarette smoke reaches the lungs. Given the highly addictive nature of nicotine, cigarettes are a good that individuals can be addicted to because they act as a vehicle for fulfilling nicotine addictions. In both the theories of rational addiction and myopic addiction, it is recognized that a higher past “stock” of cigarette consumption will lead to higher levels of current consumption. In this model, the “stock” of past consumption is represented by $Q_{t-1}$, which represents the level of per capita cigarette consumption in the previous time period. If it is true that greater consumption of cigarettes in the past causes more cigarettes to be smoked in the present, then a positive coefficient will be estimated for this variable. Baltagi and Levin (1986) find the elasticity of lagged cigarette demand to be close to 0.93, which indicates that a 10% increase in the number of cigarettes smoked in the previous period will lead to a 9.3% increase in the number of cigarettes consumed in the current time period. Becker, Grossman, and Murphy (1994) also find that past cigarette consumption is a positive and statistically significant determinant of current smoking behavior. Thus, the estimated coefficient on $Q_{t-1}$ is expected to be greater than zero, and statistically significant.

Becker, Grossman, and Murphy also find that future cigarette consumption is a statistically significant, positive factor determining current smoking behavior, although the effects of future consumption are less positive than the effects of past consumption. This finding upholds the Becker and Murphy (1988) theory of rational addiction, which claims that future consumption of addictive goods will positively
influence current consumption. Baltagi and Griffin (2001) reach a similar conclusion, and find that although both \( Q_{t-1} \) and \( Q_{t+1} \) are statistically significant determinants of \( Q_t \), that the effects of \( Q_{t-1} \) are greater overall. Baltagi and Griffin find that the elasticity of past cigarette demand is close to 0.456, while the elasticity of future cigarette demand is 0.248. The estimated coefficients for \( Q_{t-1} \) and \( Q_{t+1} \) should therefore be positive and statistically significant, but it should also be found that past demand for cigarettes has a greater effect on current demand than future cigarette consumption.

The inclusion of the variables for average age, \( A_{it} \), percent of the population that is Black, \( BL_{it} \), and percent of the population that is White, \( W_{it} \), is meant to control for demographic characteristics of a state that may be changing over time, and could possibly influence the demand for cigarettes. The inclusion of these demographic variables is not common amongst other studies of cigarette demand, and there is therefore little information with which to base expectations on for the estimated coefficients of these variables. The average age variable represents the average age of the state population that is above sixteen years old. If it is believed that younger individuals smoke more than older individuals, then the estimated coefficient on this variable is expected to be negative. Conversely, it may be the case that older citizens are more addicted to smoking based on the theory of rational addiction and their added years of building a consumption “stock,” and in this case a positive estimated coefficient for this variable would be expected.
If an individual’s race influences their demand for cigarettes, then the estimates for the race variables, BL_{it} and W_{it} should be statistically significant. It is unclear if these variables will have a statistically significant effect on cigarette sales, but they will be included in the regressions so as to have a greater amount of demographic information for each state. If one race is more prone to smoking than the other (perhaps through genetic or cultural characteristics) then it is important to include this information in the model. On the other hand, race may play no role at all in determining one’s taste for cigarettes, and if this is the case one or both of the race variables may be statistically insignificant.

4. Complications with the Model

There are several complications with the cigarette consumption model that need to be taken into account before the regressions can be run. The first complication is the presence of endogeneity if P_{it}, Q_{i,t-1}, and Q_{i,t+1} are directly included in the equation. As discussed earlier, these variables are expected to be functions of current cigarette demand, which means that these variables are endogenous in the demand equation and correlated with the error term in the regressions. 2SLS can be used to eliminate this problem of endogeneity in the regressions. The instruments that can be used to arrive at accurate estimates have already been discussed in the model and extensions sections. One complication with this set of instruments is that if P_{i,t-1} is used to instrument for P_{it}, the estimates from the regressions may be biased.
This is because $P_{i,t-1}$ is endogenous in the demand equation for $Q_{i,t-1}$, because price in the lagged period is likely a function of demand in the lagged period. To fix this, $P_{i,t-2}$ and $P_{i,t-3}$ (the average real price of cigarettes lagged two and three periods respectively) are used as instruments instead of $P_{i,t-1}$. Using the same logic that led to $P_{i,t-1}$ as an appropriate instrument for $P_{it}$, the current price of cigarettes is highly correlated to its lagged prices, even prices lagged two or three periods. Unlike $P_{i,t-1}$, however, $P_{i,t-2}$ and $P_{i,t-3}$ are not functions of $Q_{i,t-1}$, because the real price of cigarettes in past time periods are not expected to be influenced by cigarette demand in the present period. Thus, the problem of endogeneity will hopefully be controlled for if $P_{i,t-2}$ and $P_{i,t-3}$ are chosen as instruments for price rather than $P_{i,t-1}$.

Another complication with the demand model is that there may be heteroskedasticity. Because this study uses data over a span of thirty eight years, it is possible that the variance of these variables is not the same for different time periods, which would lead to heteroskedasticity in the model. Although the presence of heteroskedasticity would not cause the estimates in this study to be biased or inconsistent, it could cause the variance and standard errors of the coefficients to be underestimated (Wooldridge 2009, 264-265). Thus, if heteroskedasticity is not controlled for, there is a chance that the regressions could give too much significance to some variables, and falsely conclude that they are statistically significant determinants of cigarette demand. This study has attempted to control for the possibility of heteroskedasticity by using standard errors that are robust to heteroskedasticity. These standard errors are known as Huber-White standard errors,
and by employing them there can be greater certainty that the standard errors on the estimated coefficients in this study are the correct values.

The presence of autocorrelation is also a complication that must be dealt with before the regressions in this analysis can be completed. Autocorrelation occurs when the error term in different time periods are correlated, and is a common problem in time series and panel regressions. Similar to the problem of heteroskedasticity, the presence of autocorrelation by itself does not automatically mean that the estimated coefficients will be biased (as long as the explanatory variables are truly exogenous), but it does signify that the resulting standard errors and test statistics will not be valid (Wooldridge 2009, 408-409). A common form of autocorrelation is first-order autocorrelation, also denoted as AR(1) serial correlation. The Wooldridge test for serial correlation in panel data can determine whether first-order autocorrelation is present in a regression model. Running the Wooldridge test, this study finds that there is statistically significant autocorrelation that needs to be controlled for when running the regressions.

If the presence of autocorrelation is not controlled for, the resulting standard errors and test statistics will not be valid. To correct for this, serial correlation-robust standard errors can be used. These types of standard errors are also known as heteroskedasticity and autocorrelation consistent, or HAC, standard errors (Wooldridge 2009, 429). As indicated by their name, these standard errors will hopefully generate test statistics that are robust to heteroskedasticity and autocorrelation, which are both present in the regressions. Another potential
complication that autocorrelation could create is that if the independent variables are not strictly exogenous, the resulting estimates could be biased (Wooldridge 2009, 408-409). Fortunately, the variables that are believed to be endogenous have been instrumented for in the regressions by exogenous variables to correct for endogeneity. Since these variables have already been removed from being directly estimated in the demand equation, this study is less likely to have biased estimates from the regressions as a result of serial correlation.

A more general hindrance to the model in this study is the lack of available data for other variables that are thought to influence cigarette consumption. One such variable is the educational attainment for citizens of smoking age for high school and postsecondary education. It is commonly believed that the more education an individual has, the less likely he or she is to smoke (perhaps because more educated individuals are expected to have a higher awareness of the health consequences of smoking). If this were true, then it would be important to include a variable for state educational attainment each year for high school and different levels of collegiate attainment. Unfortunately, yearly data for this variable are not available for all 50 states before 1989, and are not available annually from the U.S. Census Bureau before 1993. To help determine whether education is a statistically significant determinant of cigarette demand, this study has included educational attainment as a variable in the second set of regressions where the dependent variable is smoking prevalence. Because these regressions regarding smoking prevalence only use data from 1998 to 2008, information regarding educational attainment can be included
without having to shorten the number of years and observations used in these regressions.

Another set of variables that cannot be included in the regressions because of lack of data is the percentage of individuals in a state with racial identities that are not Black or White. Such races would include Asian, Native American, and Pacific Islander. Unfortunately, data is not available in all 50 states from 1970 to 2008 on the percentage of individuals who identify with these other races, and although these other races are intrinsically accounted for in the model as being neither white nor black, they cannot be included as separate variables in the regressions.

5. Data

Most of the data used in this study were gathered from the Centers for Disease Control and Prevention (CDC), the Bureau of Labor Statistics, and the United States Census. The annual data for state per capita packs of cigarette sold from 1970 to 2008 is from the CDC State Tobacco Activities Tracking and Evaluation (STATE) system. The STATE system is a comprehensive database of information pertaining to tobacco and cigarettes at the state level dating back to 1970 for some datasets. The data for annual state cigarette excise tax rates and annual state average retail price per pack of cigarettes from 1970 to 2008 were also gathered from the CDC STATE system.
The data on legislation restricting smoking in bars, restaurants, public transportation, and private workplaces from 1995 to 2008 were also obtained from the CDC STATE system. As discussed in the section describing the cigarette demand model, these are the four categories of anti-smoking legislation that make up the legislation index, $L_{it}$. The CDC has four categories for the types of smoking restrictions that can be enforced in these domains: None, Designated Areas, Separate Ventilated Areas, and Banned. Using this classification system and the guidelines for each restriction as outlined by the CDC, this study extends the legislation data available from the STATE system by using the State Cancer Legislative Database Program. From this database, data on anti-smoking laws for each state are available dating back to 1970, and the CDC classification system was used to align the data from 1995 to 2008 from the STATE system with the data from 1970 to 1995 from the State Cancer Legislative Database Program. Thus, from the period of 1970 to 2008, this study has uniform data on legislation in all 50 states for smoking restrictions in bars, restaurants, public transportation, and private workplaces.

To convert many of the nominal dollar values in this study into real dollar values, the Consumer Price Index from the Bureau of Labor Statistics was used with 2007 as the base year. Using the CPI, this study converted the data for average price per pack of cigarettes, state excise tax rates, and per capita disposable income into real values. The Bureau of Labor Statistics also has data on per capita disposable income from 1970 to 2008, which is used for the per capita real disposable income variable, $Y_{it}$. 
Data on state average age levels and racial makeup were gathered from the Center for Disease Control’s WONDER system, which is a compilation of population data gathered from the U.S. Census. The WONDER system has state population data dating back to 1970, and this study was able to gather data on populations by age grouping, populations by race, and total populations for all 50 states from 1970 to 2008.

Information on state border lengths and state areas was also needed for the construction of the bootlegging variable, $B_{it}$. The data on the border lengths between each state and its neighbors are from a dataset created by Thomas Holmes, a professor of economics at the University of Minnesota, and also a consultant for the Federal Reserve Bank of Minneapolis. The border lengths are denoted in miles and the dataset is complete for all 50 states excluding Alaska and Hawaii. The state area values denoted in whole square miles are from Table 1 and Table 17 of the 2000 U.S. Census of Population and Housing.

Table 1 summarizes the data used in this study, giving a description of the variables used, as well as providing the means and standard deviations of the variables in parentheses.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition (mean, SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q&lt;sub&gt;i,t&lt;/sub&gt;</td>
<td>Per capita consumption in packs of cigarettes in fiscal year t, represented by tax-paid sales in state i (mean = 106.994, SD = 36.395)</td>
</tr>
<tr>
<td>P&lt;sub&gt;i,t&lt;/sub&gt;</td>
<td>Average real retail price per pack of cigarettes in fiscal year t and state i in 2007 dollars (mean = 2.647, SD = 1.024)</td>
</tr>
<tr>
<td>B&lt;sub&gt;i,t&lt;/sub&gt;</td>
<td>Index which measures the incentive to smuggle cigarettes from neighboring states in year t for residents of state i. The index is a weighted summation of differences between the excise tax in state i and the excise taxes in all neighboring states, weighted by the length of border shared between each neighboring state and the area of state i (mean = 0.329, SD = 0.139)</td>
</tr>
<tr>
<td>Y&lt;sub&gt;i,t&lt;/sub&gt;</td>
<td>Real per capita disposable income in state i during fiscal year t. Measured in 2007 dollars (mean = 29,194.45, SD = 6,911.648)</td>
</tr>
<tr>
<td>A&lt;sub&gt;i,t&lt;/sub&gt;</td>
<td>The average age of residents in state i over the age of 16 in year t (mean = 42.365, SD = 1.891)</td>
</tr>
<tr>
<td>L&lt;sub&gt;i,t&lt;/sub&gt;</td>
<td>Index which measures the level of non-price smoking restrictions in effect for state i in year t. The index is a sum of smoking legislation in private workplaces, restaurants, bars, and public transportation. For each of these four locations, the following values were used to represent a different type of restriction: 0 represents no smoking restrictions, 1 indicates designated smoking areas must be established, 2 indicates separate ventilated smoking areas must be present, and 3 denotes that smoking is banned completely (mean = 1.960, SD = 2.413)</td>
</tr>
<tr>
<td>W&lt;sub&gt;i&lt;/sub&gt;</td>
<td>The percentage of White citizens that make up the population of state i during year t (mean = 0.847, SD = 0.138)</td>
</tr>
<tr>
<td>BL&lt;sub&gt;i&lt;/sub&gt;</td>
<td>The percentage of Black citizens that make up the population of state i during year t (mean = 0.108, SD = 0.120)</td>
</tr>
<tr>
<td>T&lt;sub&gt;i&lt;/sub&gt;</td>
<td>The real excise rate per pack of cigarettes in state i during fiscal year t denoted in 2007 dollars (mean = 0.486, SD = 0.360)</td>
</tr>
</tbody>
</table>
6. Regression Results

The results for the cigarette demand model regressions are listed below in Table 2. The regressions include state and year dummy variables. Columns (i) and (ii) give 2SLS estimates with $P_{it}$, $Q_{i,t-1}$, and $Q_{i,t+1}$ treated as endogenous variables. The instruments in column (i) consist of the current tax rate, $T_{it}$, the tax rate in the lagged period, $T_{i,t-1}$, the tax rate one year in the future, $T_{i,t+1}$, a two-year lag of the price variable, $P_{i,t-2}$, plus the other explanatory variables in the model. Column (ii) adds a three year lag of the price variable, $P_{i,t-3}$, to the instruments.

As can be seen from the regression results, this model is a good fit of the data, as the value of R-squared is 0.9739. This means that the demand model explains 97.39% of the variation in the demand for cigarettes, and is thus a relatively good model for explaining the determinants of cigarette consumption. It can also be seen that many of the expectations have been fulfilled for the estimated coefficients on the variables. Most importantly, the estimated coefficient on the price variable, $P_{it}$, is statistically significant and has a value of -0.1748. Since this value is also the price elasticity of demand for cigarettes, the results indicate that cigarettes are price inelastic, because the price elasticity is less than one in absolute magnitude. This value implies that a 10% increase in the price of cigarettes will result in a decrease of 1.748% in the number of cigarettes consumed per capita. This price elasticity is smaller in absolute value than in other studies from earlier time periods, and is less negative than was expected. If it can be assumed by the findings of Evans, Ringel,
Table 2- Estimates of Cigarette Demand Equation, Dependent Variable = Q_{it}
(Robust Standard Errors in Parentheses)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>(i)</th>
<th>(ii)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_{it}</td>
<td>-0.159**</td>
<td>-0.178**</td>
</tr>
<tr>
<td></td>
<td>(0.071)</td>
<td>(0.075)</td>
</tr>
<tr>
<td>Q_{it-1}</td>
<td>0.584**</td>
<td>0.598**</td>
</tr>
<tr>
<td></td>
<td>(0.045)</td>
<td>(0.045)</td>
</tr>
<tr>
<td>Q_{it+1}</td>
<td>0.298**</td>
<td>0.276**</td>
</tr>
<tr>
<td></td>
<td>(0.066)</td>
<td>(0.067)</td>
</tr>
<tr>
<td>Y_{it}</td>
<td>0.025</td>
<td>0.024</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>B_{it}</td>
<td>-0.210**</td>
<td>-0.210**</td>
</tr>
<tr>
<td></td>
<td>(0.090)</td>
<td>(0.092)</td>
</tr>
<tr>
<td>L_{it}</td>
<td>-0.001</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
<td>(.0008)</td>
<td>(0.0008)</td>
</tr>
<tr>
<td>A_{it}</td>
<td>0.244</td>
<td>0.304*</td>
</tr>
<tr>
<td></td>
<td>(0.151)</td>
<td>(0.158)</td>
</tr>
<tr>
<td>BL_{it}</td>
<td>0.591**</td>
<td>0.609**</td>
</tr>
<tr>
<td></td>
<td>(0.285)</td>
<td>(0.300)</td>
</tr>
<tr>
<td>W_{it}</td>
<td>0.346*</td>
<td>0.379**</td>
</tr>
<tr>
<td></td>
<td>(0.182)</td>
<td>(0.188)</td>
</tr>
</tbody>
</table>

R^2: 0.9745 0.9739
N: 1,836 1,785

(*) Significant at 10%; (**) Significant at 5%.
and Stech (1999) that the full amount of any excise tax on cigarettes is translated fully into a cigarette price increase, the estimated price elasticity of demand for cigarettes can directly explain the impact of an excise tax increase on per capita cigarette demand. If an increase in cigarette excise taxes for a given state causes the real price per pack of cigarettes to increase by 10%, this will cause a subsequent decrease in the number of packs of cigarettes demanded per capita by 1.748%.

As discussed in the expectations section, many other studies have found the price elasticity of demand for cigarettes to be closer to -0.4, yet the price elasticity estimated in this study is lower than -0.4 in absolute value. There are a number of reasons why this may be true. One explanation is that this study is more contemporary than many of the other studies that have focused on the relationship between price and cigarette demand. A number of these studies were completed during the late 1980s through the late 1990s in response to information concerning the negative health consequences of smoking released by the Surgeon General, as well as the attention brought to the tobacco industry as a result of the Tobacco Settlement in 1998. The current analysis, however, extends the relevance of this discussion by including data from years up until 2008. If smokers have become more insensitive over time to price levels when determining their consumption of cigarettes, it would make sense that the estimated price elasticity of demand in this analysis is lower than in earlier studies on this topic. Because the data in this analysis is extended from 1970 to 2008, the estimate of a lower price elasticity of demand as compared with other studies is not unexpected.
As mentioned earlier, Goel and Nelson (2006), Baltagi and Goel (1987), and Huang, Yang, and Hwang (2004) reach a similar conclusion that the price elasticity of demand for cigarettes is decreasing over time. The findings of this study may reflect the possibility that smokers who were more sensitive to price changes in cigarettes have decided to stop smoking in recent years, leaving only those individuals who are more addicted to smoking and less sensitive to any price changes in packs of cigarettes. This is a plausible explanation given the large increases in cigarette prices over the past two decades, as well as the increase in information warning of the health consequences of smoking. If sensitive smokers have been “weeded out” in recent years by public announcements such as the Surgeon General’s Warnings and hikes in cigarette prices, the populous of smokers left would be less likely to change their habits given new price increases or information about the consequences of smoking. Despite the fact that the estimated price elasticity of demand in this study is highly inelastic, it is not completely inelastic, which indicates that there are still consumers who are sensitive to price changes in cigarettes, although to a lesser degree than other studies have found.

Another explanation for a lower estimated price elasticity of demand is that the regression techniques used in this analysis may have eliminated some potential biases present in other studies. One possible source of bias in other studies is the endogeneity created by including price in the demand equation for cigarettes. Many earlier studies have not considered this issue of endogeneity between price and demand, and directly include cigarette prices in their regressions. As discussed
earlier, the presence of endogeneity can bias the estimates in a regression, and this has hopefully been removed by using instrumental variable techniques that do not directly include the price variable in the regression model. As a result, the estimates in this study may be less biased than other studies by accounting for the presence of endogeneity, which gives greater credence to a relatively lower estimated price elasticity of demand for cigarettes.

The importance of this lower price elasticity of demand than in earlier studies is that cigarette price changes now have less of an effect on cigarette demand than was previously believed. This has several implications for governments depending on their goals concerning cigarette legislation. The first implication is that given the high inelasticity of cigarette demand with respect to price, governments seeking to raise large revenues can rely more on cigarette excise taxes through Ramsey’s argument of taxing goods with inelastic demand. A second implication is that if a government is attempting to use cigarette excise taxes as a tool for reducing per capita cigarette consumption, such taxes will have to be significantly higher than those implied by previous studies. Looking at the estimated coefficients on the other variables in the regressions, however, it can be seen that price is the only statistically significant variable that governments have control over which is inversely related to cigarette demand. Thus, a government seeking to reduce cigarette demand must rely significantly on making smoking more expensive by raising the excise tax on each pack of cigarettes. In order to do this, however, the present findings indicate that
large price increases must be instituted to see small decreases in per capita cigarette consumption.

A further result from the regressions in this study is that the coefficients on the lagged and future demand for cigarettes are both positive and statistically significant. This signifies that current demand for cigarettes is a function of both lagged and future cigarette demand, which support the theories of rational and myopic addiction asserted by Becker and Murphy (1988) and Gruber and Köszegi (2002). The elasticity of lagged demand on current demand is 0.5977, which implies that a 10% increase in the amount of cigarettes consumed per capita will result in a 5.977% increase in the number of cigarettes consumed per capita in the current period. The elasticity of future demand on current cigarette demand is 0.2758, which indicates that a 10% increase in future cigarette consumption will result in a 2.758% increase in the number of cigarettes consumed per capita in the current period. These estimates for elasticities of lagged and future demand on current demand are very similar to those estimated by Baltagi and Griffin (2001), who calculated that these values were 0.456 and 0.248 respectively.

The estimate of an elasticity of lagged demand that is greater than the elasticity of future demand is similar to the findings of other studies, such as Becker, Grossman, and Murphy (1994) and Baltagi and Griffin (2001), and reflects the fact that past consumption of cigarettes has a greater effect on current consumption than does future consumption. This may also reflect the fact that past cigarette consumption has greater implications for cigarette addiction than future smoking.
expectations. An individual who has physically smoked more cigarettes in the past has a greater “stock” of cigarettes consumed, and will be inclined to smoke more in the present due to a greater nicotine addiction than someone who is trying to align their current cigarette consumption with their future smoking expectations.

Another variable whose estimated coefficient meets earlier expectations is the bootlegging variable, $B_{it}$. The bootlegging variable has a statistically significant negative coefficient, which indicates that interstate purchases of cigarettes are a determining factor in state per capita cigarette demand. The elasticity of the bootlegging index on cigarette demand is $-0.2101$, which implies that a 10% increase in the bootlegging variable will result in a 2.101% reduction in the demand for cigarettes in a given state. By construction, states with smaller areas, longer borders with neighboring states, and higher excise taxes relative to neighboring states in period $t$ will have a higher value for $B_{it}$, and will thus lose sales of cigarettes to neighboring states because of the increased incentive to purchase cigarettes elsewhere. Intuitively, this estimate make sense, because rational consumers who have more incentive to buy cigarettes in a neighboring state will do so if there is chance of saving money on their purchases. These findings also comply with the results of Baltagi and Levin (1986), Chaloupka and Saffer (1988), Baltagi, Griffin, and Xiong (2000), Stehr (2005), and Saba et al. (1995) who find that the incentive for border crossing behavior and interstate purchases are inversely related to per capita cigarette consumption in a given state.
An important implication that can be derived from the statistical significance of this bootlegging variable is that governments attempting to lower per capita demand for cigarettes in a given state by increasing cigarette excise taxes may drive cigarette purchases to neighboring states, rather than actually decreasing the level of smoking in their jurisdiction. As discussed earlier, the regression results find that price increases are the only statistically policy measure that governments can use to reduce per capita cigarette demand, but by increasing cigarette prices through higher excise taxes, the bootlegging value for a state will also increase. This increase in the bootlegging variable implies that there will be an outflow of cigarette purchases to neighboring states, unless neighboring states adjust their own cigarette tax rates so that the tax differential between own and neighboring states remains constant. This would be accomplished by a state raising its cigarette taxes by the same amount as its neighbors, or by an increase in the federal tax rate that would institute the same price increase in all 50 states.

Thus, even though a state government might be tempted to increase its own cigarette excise tax rates to lower state smoking levels, such a tax increase may only result in lowering sales of cigarettes in the state without actually reducing the number of cigarettes that people smoke. Of course, this would depend on the ease with which consumers could purchase cigarettes in a neighboring state, as well as the number of neighboring states where a consumer could purchase cigarettes. The significance of this bootlegging variable implies that state governments need to be mindful of the potential border-crossing effects that an increase in the cigarette excise tax rate would
create. A higher cigarette tax unaccompanied by similar tax increases in neighboring states may only cause a decrease in income for businesses losing cigarette sales, while not significantly reducing per capita cigarette consumption. If this is the case, then governments will not generate as much revenue as intended from such a tax increase, state businesses will lose money, and the costs incurred by the state from smoking will not have changed. The results of this study show that governments seeking to effectively deter smoking through price increases must either collaborate with neighboring states to determine appropriate levels of excise taxation, or must place greater emphasis on restricting bootlegging and cross-border purchases of cigarettes if they intend to raise the excise tax rate to generate revenue or reduce state smoking.

The variable for real disposable per capita income is statistically insignificant. This indicates that an individual’s income level does not necessarily dictate their annual consumption of cigarettes. It may be the case that because of the addictive nature of cigarettes, consumers are willing to cut back on other expenditures before curtailing their consumption of cigarettes, and will thus continue to smoke the same amount regardless of their level of income. The statistical insignificance of the income elasticity of demand for cigarettes is also estimated by Gallet and List (2003), Baltagi and Levin (1986), Chaloupka and Saffer (1988), and Goel and Ram (2004). Although this finding implies that cigarettes are not inferior goods, it still lends support to the belief that cigarette taxes are regressive in nature. To be regressive, cigarette taxes would have to have a greater impact on poorer citizens. If consumers with different income levels smoke the same amount, ceteris paribus, then an excise
tax will make up a greater percentage of the poorer individual’s income. Thus, a poorer smoker will pay a greater portion of their income toward government revenues collected from cigarette taxes, and be more affected by any increase in cigarette excise taxes. Following this logic, it can be surmised from the statistical insignificance of the estimated coefficient on the income variable that cigarette taxes are regressive, as poorer smokers are paying a greater share of their total income toward government revenues collected from cigarette taxes.

The estimated coefficient on the age variable, $A_{it}$, is positive, but is not statistically significant at the 5% significance level (it is significant at the 10% level). This coefficient represents the age elasticity of demand for cigarettes. The 95% confidence interval for the coefficient of this variable ranges from slightly negative (-0.0055) to positive (0.6145). Thus, even though the age variable is not statistically significant at the 5% level, it is not very likely that age has an inverse relationship to cigarette demand given that the bottom range of the confidence interval is only -0.0055, which is very close to zero.

This estimate makes sense in the context of both the theories of rational and myopic addiction. Both of these theories argue that past consumption of cigarettes will increase current consumption, and thus smokers who have a greater past “stock” of consumption will smoke more packs of cigarettes per year. Since older individuals are more likely to have smoked a greater number of cigarettes in their lifetime because they have had more years to accumulate this “stock,” it is likely that older individuals will smoke more in current periods than younger individuals. The
estimated coefficients on the race variables, BL\textsubscript{it} and W\textsubscript{it}, are both positive and statistically significant. This signifies that individuals who are Black or White consume more cigarettes than citizens who are neither of these races, and that Black citizens consume more cigarettes per capita than White citizens.

From the regression results, the estimated coefficient on the legislation index is not a statistically significant determinant of cigarette demand, and the magnitude of the estimated coefficient is very small. Because the legislation variable is an index that takes into account smoking restrictions in public and private places, its statistical insignificance indicates that such restrictions do not affect per capita cigarette demand. This may signify that smokers can find ways around such legislation (perhaps by going outside or leaving a venue to smoke), or that such laws are not sufficiently enforced so as to be effective methods for reducing per capita cigarette consumption. Similar conclusions are reached by Farrelly and Evans (1998) and Chaloupka and Saffer (1988), who determined that laws governing workplace smoking and clean indoor air laws do not have a statistically significant impact on cigarette demand. This finding does contradict the conclusions of Tauras (2006), however, who found in his analysis that smoking restrictions have a negative and statistically significant impact on per capita cigarette sales.

If it is true that smoking restrictions do not alter the smoking habits of individuals, then this finding has important policy implications for state or national governments attempting to reduce the level of smoking in their jurisdiction. While smoking restrictions may reduce the exposure of non-smokers to cigarette smoke in
enclosed spaces (and thus reduce the level of annoyance this exposure creates for non-smokers), the effects of these restrictions may not reduce the overall demand for cigarettes. If the goal of a government is to reduce the externalities of smoking borne by non-smokers and this “annoyance cost” created by smoke exposure in enclosed areas, then smoking restrictions may still be appropriate policy measures. If, however, the goal of a government is to reduce aggregate cigarette consumption so as to reduce the external costs generated from smoking, then smoking restrictions alone may not be effective. As discussed earlier, the findings of this study indicate that increasing the price of smoking by instituting a higher excise tax per pack of cigarettes may be a more effective method for governments seeking to decrease the per capita demand for cigarettes, although such a tax increase would need to be quite large, and be accompanied by similar tax increases in neighboring states.

II. Smoking Prevalence Regressions

1. The Regression Model

The second set of regressions in this study is focused on determining how cigarette taxes influence the prevalence of smoking in a state. This is distinctly different from the regressions concerned solely with cigarette demand, because it may be the case that taxation affects the number of cigarettes consumed in a state per year, but has no effect on the number of individuals in a state who smoke. Thus, these regressions concerning smoking prevalence can help to determine which variables are
most important in determining smoking rates in a state, and whether excise taxes are an effective tool for decreasing the number of citizens who smoke. The estimated results may have important policy implications depending on a government’s goals in implementing anti-smoking policies in its jurisdiction. Because of the availability of state-level data for smoking prevalence, the time span of these regressions is limited to the years 1998 to 2008.

The model for these regressions is similar to the model for per capita cigarette demand, and many of the same independent variables are included. One difference in the independent variables is the inclusion of educational attainment rates for high school and bachelor degrees, denoted by HS_{it} and BA_{it} respectively. Although this data was excluded from the cigarette demand regressions because of the lack of available state data dating back to 1970, these statistics are available annually for all 50 states starting in 1993, and can thus be included in the model for smoking prevalence. Another difference between the two models is the exclusion of a variable for future smoking habits, in this case a variable representing smoking prevalence in the next year. A variable for future smoking prevalence does not make sense to include in these regressions, because the coefficient on this variable would capture the changes in current smoking prevalence given the future percentage of smokers in the state. Thus, this variable would capture how anticipated smoking participation affects the current decision to smoke or not. But if a person expects to quit or start smoking in the future, this choice would not affect current smoking, because the expectation is to stop or start in the future. Because of this, it can be assumed that
current smoking prevalence is only a function of past smoking behavior, not future smoking prevalence, and a variable for future smoking prevalence is therefore not included in the prevalence model.

The model determining smoking prevalence can thus be expressed as:

\[
S_{it} = \beta_0 + \beta_1 P_{it} + \beta_2 S_{i,t-1} + \beta_3 Y_{it} + \beta_4 A_{it} + \beta_5 B_{it} + \beta_6 L_{it} + \beta_7 W_{it} + \beta_8 B_{ilt} + \beta_9 H_{it} + \beta_{10} B_{ait} + a_t + a_i + e_{it}
\]

where \(S_{it}\) represents the prevalence of smoking in state \(i\) during time \(t\), and \(S_{i,t-1}\) represents the prevalence of smoking in state \(i\) for the lagged period \(t-1\). All other variables are the same as in the cigarette demand model, although the data for each variable only run from 1998 to 2008. Unlike the cigarette demand model, the smoking prevalence regressions will not be run as log-log regressions. The only variables that will be logged in the prevalence regressions are the price, \(P_{it}\), age, \(A_{it}\), and bootlegging, \(B_{it}\), variables.

2. Benefits of the Model

The primary goal of the model of smoking prevalence will be to determine whether price changes for cigarettes have an effect on the number of individuals who smoke. From the earlier demand regressions it was determined that increases in the price of cigarettes cause per capita cigarette demand to be lower, but this may only mean that smokers are choosing to smoke less, not stop smoking altogether. This
difference may have important policy implications depending on what a government is attempting to accomplish when it increases the excise tax on cigarettes. If a government is only attempting to raise revenues or decrease total demand for cigarettes in a state, then it may not be concerned with whether the increase actually causes fewer citizens to smoke. If a paternalistic government believed that it would be favorable for fewer of its citizens to smoke, and was trying to accomplish this through a tax increase on cigarettes, then the effects of a cigarette price change on smoking prevalence would be important knowledge for such a government.

The effects of education on smoking rates can also be determined in these regressions through the estimated coefficients on the variables HSit and BAit. This is an important benefit of the smoking prevalence model, because these variables could not be included in the earlier demand equations due to the lack of this data for years before 1989. If education has an effect on smoking prevalence, then governments aimed at reducing smoking rates may be able to accomplish this through policies aimed at providing more education to its citizens, rather than simply using tax increases or restrictive legislation.

A final benefit of this prevalence model is that it allows the income variable to be re-evaluated with regard to smoking prevalence. The results from the cigarette consumption regressions found that real per capita disposable income was a statistically insignificant determinant of per capita cigarette consumption. It may be the case, however, that once individuals start smoking they will continue to smoke regardless of their level of income. It may be the case that income is a statistically
significant factor in determining whether a person will start smoking or not, and the estimated coefficient on the income variable in these regressions will determine what effect, if any, real per capita disposable income has on smoking prevalence.

3. Expected Results from the Regressions

Before discussing the results from the regressions, there are certain expectations about the estimated coefficients on the variables in the model. To begin with, it might be expected that the real price per pack of cigarettes, $P_{it}$, is inversely related to smoking prevalence. If cigarette prices are higher, the higher cost of smoking will likely act as a deterrent to individuals that might otherwise start smoking if the price were lower. If this is true, then the estimated coefficient for $P_{it}$ should be negative. Although this expectation is consistent with the earlier finding that real cigarette prices are inversely related to per capita cigarette demand, it cannot be ruled out that this change in demand may only be realized through current smokers reducing their annual cigarette consumption, rather than quitting smoking altogether.

The variable for lagged smoking prevalence, $S_{i,t-1}$, is expected to capture the effects of cigarette addictiveness on smoking prevalence. Because of the addictive nature of nicotine and cigarettes, it is likely that someone who was a smoker in the past has a higher probability of being a current smoker. If this is the case, then the estimated coefficient on $S_{i,t-1}$ would be positive and statistically significant. This finding would be consistent with the earlier estimate from the demand model that
higher past cigarette consumption implies a greater consumption of cigarettes in the current period.

It might also be expected that the variable for real per capita disposable income, $Y_{it}$, should have a positive effect on smoking prevalence. Individuals with a greater amount of disposable income are able to better afford the costs of smoking, as opposed to lower income individuals who may not have the necessary resources to start an expensive smoking habit. This study may find, however, that people choose whether to smoke or not smoke regardless of their income level. If this is the case, the estimated coefficient on the income variable will be statistically insignificant. This would be somewhat consistent with the earlier finding that income is not a statistically significant determinant of individual cigarette demand, although it seems more likely that people will not start smoking unless they have enough available income to do so. In light of this assumption, a positive estimated coefficient on the income variable is expected.

The education variables cover both high school completion and bachelor degree attainment rates, and both of these variables are expected to have an inverse relation to smoking prevalence. One reason for this expectation is that it is generally believed education leads to greater awareness of the health consequences of smoking, and thus individuals with more years of schooling will be less likely to smoke in an attempt to avoid harming themselves. Another explanation may be that people with higher education value later years more given the time and money they have invested in their futures. If this is the case, then it is reasonable to believe that individuals with
more years of schooling will refrain from activities like smoking cigarettes that would shorten their lives or cause them to be sick in later years. Given these assumptions about the influence of education on smoking prevalence, it is expected that both of these variables will have negative coefficients in the prevalence regressions.

The degree of anti-smoking restrictions in a state can also be expected to have an inverse relation to the percentage of smokers there. Smoking restrictions increase the personal cost of smoking by adding an inconvenience cost to the act of smoking, such as having to go outside to smoke a cigarette when at a restaurant or private workplace. Although it may be expected that the sign of the coefficient on the legislation index, $L_{it}$, will be negative, there is a chance that this coefficient will not be statistically significant. In the cigarette demand regressions, it was determined that legislation did not have a statistically significant impact on per capita packs of cigarettes sold, and Tauras (2006) found that state anti-smoking restrictions did not decrease smoking prevalence. Thus, legislation variable is expected to be negatively related to smoking prevalence, but the estimate may or may not be statistically significant.

It is also unclear whether border-crossing effects will have a statistically significant effect on smoking prevalence. While it was found that bootlegging has a statistically significant influence on per capita sales of packs of cigarettes, it is likely that cross-state bootlegging is mostly undertaken by current smokers attempting to purchase cigarettes at a lower price in another state. A greater incentive to purchase
cigarettes in a neighboring state might have a positive effect on own-state smoking prevalence, but it is likely that this effect will be statistically insignificant.

It is uncertain what type of effects the demographic variables $A_{it}$, $BL_{it}$ and $W_{it}$ will have on state smoking prevalence, or whether the estimated coefficients on these variables will be statistically significant as well. Although it was found that $BL_{it}$ and $W_{it}$ were statistically significant determinants of cigarette demand, it is unclear whether race plays any part in an individual’s decision to be a smoker or not. If race does play a factor in determining smoking rates, then these variables may be statistically significant, although it is uncertain whether they will have negative or positive effects on smoking prevalence. More accurate predictions may be possible for the average age variable, $A_{it}$. If it is believed that younger individuals smoke at a higher frequency than older citizens, it may be the case that this variable is statistically significant and negative. If the reverse is true and older individuals have a higher smoking prevalence, then this variable will have a positive estimated coefficient.

If either the theory of rational or myopic addiction hold in reality, then it is true that past smoking behavior has a positive influence on current smoking behavior. The positive influence of past cigarette consumption on current cigarette consumption was confirmed for cigarette demand in the consumption regressions, and the assumption can therefore be made that smoking more cigarettes in the past will lead to a greater number of cigarettes smoked by an individual in the present. Following these assumptions, it might be expected that the coefficient on the average age
variable, $A_{it}$, is positive. An older individual has had more opportunities in his lifetime to smoke cigarettes than a younger individual, and this past behavior could create a higher frequency of smoking amongst older individuals who have had a greater probability of being exposed to nicotine during their lifetimes. It could be the case that age does not play a significant role in determining whether someone is a smoker or nonsmoker, in which case the estimated coefficient on $A_{it}$ would be statistically insignificant.

4. Complications with the Model

In the cigarette demand model, one important complication that could not be overlooked was the presence of endogeneity in the regressions. Fortunately, endogeneity is not present in the prevalence model given the dependent and independent variables. Running a Hausman test on the price variable in the prevalence model reveals that price can be treated as exogenous in the regressions here. Also, because current smoking prevalence should not be a function of future smoking prevalence, the lagged prevalence variable can also be treated as exogenous in this model. Thus, these regressions can be run using Ordinary Least Squares (OLS), rather than relying on 2SLS to correct for endogeneity in the model.

Other complications in this model concern autocorrelation and heteroskedasticity, and similar conclusions are reached as with the cigarette demand model. Running a Wooldridge test for first order serial correlation reveals that there
is AR(1) autocorrelation which needs to be controlled for before the test statistics in the prevalence regressions can be trusted. Heteroskedasticity also needs to be controlled for in the prevalence regressions, as it is likely that the variability in the error term is correlated with the independent variables given that the data is a panel set spanning ten years. The same methods will be used to control for autocorrelation and heteroskedasticity that were previously applied in the cigarette consumption model, namely that heteroskedasticity and autocorrelation consistent (HAC) standard errors will be used. By using HAC standard errors, the test statistics in this study should be more accurate and not give excessive significance to the independent variables.

5. Data

The state-level data for smoking prevalence from 1998 to 2008 in this study is from the CDC STATE system, which has compiled data for the CDC’s Behavioral Risk Factor Surveillance System (BRFSS) survey. The BRFSS survey is the world’s largest ongoing telephone health survey system, and contains annual information on smoking prevalence for all 50 states from 1998 to 2008. The survey asks whether someone has smoked in the past 100 days, and if the answer is yes, the individual is counted as a smoker in the survey. Although the data has information on the number of individuals who have smoked in the past 100 days, it does not distinguish between the number of cigarettes individuals have smoked.
The data for state educational attainment was obtained from a compiled dataset of annual educational attainment data by state created by Tom Mortensen of Postsecondary Education OPPORTUNITY, an online database for education statistics. The dataset is a compilation of educational attainment data published by the United States Census, and covers the period from 1989 to 2008 for all 50 states. From 1989 to 1993, the data is only available every other year, but after 1993 the data is available annually. This dataset not only has the percentage of individuals over the age of 25 who have graduated high school in each state, but also contains the percentage of individuals over the age of 25 who have a bachelor’s degree.

All other variables in the smoking prevalence model are the same as in the cigarette demand regressions, and are thus from the same sources as outlined in the previous sections. Because the number of years used in these secondary regressions is different, however, the means and standard deviations for these variables are different in this model. In Table 3, definitions of the new variables, as well as the means and standard deviations for all variables in the smoking prevalence regressions, are included.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition (mean, SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S_{it}$</td>
<td>Overall smoking prevalence in state $i$ during year $t$ measured as a percent (mean = 0.218, SD = 0.035)</td>
</tr>
<tr>
<td>$P_{it}$</td>
<td>Average real retail price per pack of cigarettes in fiscal year $t$ and state $i$ in 2007 dollars (mean = 4.035, SD = 0.796)</td>
</tr>
<tr>
<td>$B_{it}$</td>
<td>Index which measures the incentive to smuggle cigarettes from neighboring states in year $t$ for residents of state $i$. The index is a weighted summation of differences between the excise tax in state $i$ and the excise taxes in all neighboring states, weighted by the length of border shared between each neighboring state and the area of state $i$ (mean = 0.329, SD = 0.021)</td>
</tr>
<tr>
<td>$Y_{it}$</td>
<td>Real per capita disposable income in state $i$ during fiscal year $t$. Measured in 2007 dollars (mean = 36,022.39, SD = 5,989.938)</td>
</tr>
<tr>
<td>$A_{it}$</td>
<td>The average age of residents in state $i$ over the age of 16 in year $t$ (mean = 44.040, SD = 1.242)</td>
</tr>
<tr>
<td>$L_{it}$</td>
<td>Index which measures the level of non-price smoking restrictions in effect for state $i$ in year $t$. The index is a sum of smoking legislation in private workplaces, restaurants, bars, and public transportation. For each of these four locations, the following values were used to represent a different type of restriction: 0 represents no smoking restrictions, 1 indicates designated smoking areas must be established, 2 indicates separate ventilated smoking areas must be present, and 3 denotes that smoking is banned completely (mean = 3.831, SD = 3.116)</td>
</tr>
<tr>
<td>$W_{it}$</td>
<td>The percentage of White citizens that make up the population of state $i$ during year $t$ (mean = 0.823, SD = 0.135)</td>
</tr>
<tr>
<td>$BL_{it}$</td>
<td>The percentage of Black citizens that make up the population of state $i$ during year $t$ (mean = 0.115, SD = 0.116)</td>
</tr>
<tr>
<td>$HS_{it}$</td>
<td>The percent of citizens over the age of 25 in state $i$ that have completed four years of high school in time $t$ (mean = 0.860, SD = 0.040)</td>
</tr>
<tr>
<td>$BA_{it}$</td>
<td>The percent of citizens over the age of 25 in state $i$ that have a bachelors degree in time $t$ (mean = 0.266, SD = 0.056)</td>
</tr>
</tbody>
</table>
6. Regression Results

The resulting estimates from the prevalence regressions are listed in Table 4. The first detail that should be noticed is that the R-squared value for this regression is lower than in the previous regressions, although it is still fairly high at 0.7057. Thus, this model has accounted for 70.57% of the variation in smoking prevalence from 1998 to 2008, which is impressive given that the panel data set only spans ten years with 510 observations. Secondly, this model has estimated that the effects of price on smoking prevalence are statistically insignificant. Thus, individuals do not change their decision to smoke or not smoke when cigarette prices rise or excise taxes on cigarettes are increased. This is not inconsistent with the earlier findings that cigarette prices have a significant inverse relation to cigarette demand. It may be the case that individuals choose to be smokers or nonsmokers regardless of the real price per pack of cigarettes, but will alter the amount they smoke given fluctuations in cigarette pricing.

Even though prices are not a statistically significant determinant of smoking prevalence, income has a positive and statistically significant impact on smoking prevalence. Because the income variable, $Y_{it}$, is a logged value in this regression, for every extra real dollar of per capita disposable income in state $i$ during time $t$, the smoking prevalence in that state increases by 0.00061%. Although this amount may appear to be small, given the high values of real per capita disposable income in the model, income can have a very large effect on smoking prevalence in a given state.
Table 4- Estimates of Cigarette Prevalence Equation, Dependent Variable = $S_{it}$
(Robust Standard Errors in Parentheses)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>(OLS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_{it}$</td>
<td>-0.003 (0.002)</td>
</tr>
<tr>
<td>$S_{i,t-1}$</td>
<td>0.160** (0.063)</td>
</tr>
<tr>
<td>$Y_{it}$</td>
<td>0.061** (0.018)</td>
</tr>
<tr>
<td>$HS_{it}$</td>
<td>0.039 (0.050)</td>
</tr>
<tr>
<td>$BA_{it}$</td>
<td>-0.034 (0.033)</td>
</tr>
<tr>
<td>$B_{it}$</td>
<td>0.022 (0.024)</td>
</tr>
<tr>
<td>$L_{it}$</td>
<td>-0.0001 (.0002)</td>
</tr>
<tr>
<td>$A_{it}$</td>
<td>0.001 (0.003)</td>
</tr>
<tr>
<td>$BL_{it}$</td>
<td>0.028 (0.137)</td>
</tr>
<tr>
<td>$W_{it}$</td>
<td>0.018 (0.041)</td>
</tr>
</tbody>
</table>

$R^2$: 0.7057
N: 510

Notes: Regressions include state and year dummy variables. 
(*) Significant at 10%; (***) Significant at 5%. 
The statistical significance of the income variable in these regressions is different from the findings in the cigarette demand model, but not incompatible. It may be the case that individuals with higher incomes are more prone to becoming smokers because they can generally afford the cost of picking up an expensive and addictive habit. Higher income jobs may also contain more stress than lower income jobs, which may give individuals with higher incomes more incentive to smoke cigarettes which are often seen as a commodity with stress-relieving qualities. Once these individuals have started to smoke, the theories of rational and myopic addiction assert that individuals will change their cigarette consumption based on past and future cigarette demand, which will respond to price changes in cigarettes based on constant income constraints. Income is removed from these models of addiction, and thus even though higher income individuals may have a higher frequency of being smokers, they will not necessarily adjust their cigarette demand given any changes in their income through the assumptions of these addiction theories.

As was expected, past smoking prevalence has a positive and statistically significant effect on current smoking prevalence, which reflects the fact that cigarettes are addictive goods. According to the regression estimates, a 1% increase in past smoking prevalence will increase current smoking prevalence by 0.16%. This makes intuitive sense, because cigarettes are vehicles for nicotine consumption, and nicotine is a highly addictive substance. Thus, if an individual smoked cigarettes in the lagged period, there is a greater chance that he will also smoke in the current period due to this increased exposure to nicotine.
The education variables are not significant in the prevalence equation, and have small overall effects. This finding goes against the expectation that both high school education and bachelor degree attainment would have statistically significant negative effects on the smoking rate in a given state. Because of the statistical insignificance of the estimated coefficients of HS_{it} and BA_{it}, it can be concluded that education does not have an effect on smoking prevalence, and that ultimately citizens will decide to smoke regardless of the amount of education they have completed. One implication of this finding is that governments may not be able to reduce smoking prevalence by increasing funding or availability for education, which may have been an option if either of these variables were significant determinants of state smoking prevalence. As expected, the state demographic variables, A_{it}, BL_{it}, and W_{it}, are not statistically significant either in the prevalence regressions. Thus, age and racial characteristics do not influence a person’s choice to be a smoker or nonsmoker, and instead personal characteristics such as past smoking behavior and personal disposable income are more important influencing factors for this decision.

The final two variables in the secondary regression, L_{it} and B_{it}, are also not statistically significant in the prevalence model. The finding that anti-smoking legislation is insignificant is consistent with the studies done by Tauras (2006), Farrelly and Evans (1998), and Chaloupka and Saffer (1988). The statistical insignificance of this variable may reflect that smokers may not choose to quit given tougher smoking restrictions in their state, but will instead either find ways to avoid the restrictions or ignore them altogether. It is also not surprising that the bootlegging
variable, $B_{it}$, is statistically insignificant. Although it might make sense for current smokers to travel out of state to purchase cheaper cigarettes, having lower priced cigarettes in a neighboring state does not seem likely to be a sufficient incentive by itself for someone to pick up the habit of smoking.

Thus, in the smoking prevalence model, it is found that the only two statistically significant determinants of smoking prevalence are the variables for lagged smoking prevalence, $S_{i,t-1}$, and real personal disposable income, $Y_{it}$. Given that neither of these two variables can be directly influenced by government policy, it can be seen that there is little governments can do using the variables in this model to influence state smoking prevalence. This is different from the conclusions from the cigarette demand model, where it was identified that governments could effectively use large tax increases to have a significant effect on reducing per capita cigarette consumption. Therefore, it may be an unreasonable goal for a government to expect to reduce the number of smokers in its jurisdiction through tax increases or greater smoking restrictions. A more reasonable goal for a government seeking to reduce smoking levels might be to instead reduce per capita cigarette consumption, which, as discussed earlier, can be accomplished through cigarette excise tax increases which governments have complete control over.
Conclusions and Implications

From being considered a “luxury good” in the eyes of Adam Smith, to an addictive product generating negative externalities in the form of cigarettes, tobacco has evolved dramatically as a consumer product throughout the history of the United States. Consequently, the economic justifications for taxing and regulating tobacco have evolved as well, and as seen in the literature review there have been many arguments throughout the centuries for why tobacco and cigarettes should or should not be taxed. Using the results from the econometric analysis in the second chapter, the validity of these econometric arguments can be assessed, and policy implications can be made.

Because this study has estimated a price elasticity for cigarettes that is inelastic and lower in absolute value than previous studies, the claim can be made that cigarettes taxes are justified by Ramsey’s theory of taxation. In fact, if it is true that the price elasticity of demand for cigarettes is decreasing over time, then cigarette taxes should continue to increase in future years through Ramsey’s theories. Of course, a government using Ramsey’s economic arguments to justify increases in cigarette excise taxes must be wary of becoming an extorting “Leviathan” as described by Brennan and Buchanan. If used to raise finite levels of government revenues, the low price elasticity of demand for cigarettes implies that cigarette taxes could be very effective means for reaching set levels of revenue without creating large market distortions, and could become more effective in future years.
The equity of such a tax policy, however, can be called into question with the findings in this study, particularly because of the statistical insignificance of the estimated coefficient on the income variable, $Y_{it}$, in the demand regressions. If individuals with different income levels consume the same number of cigarettes, ceteris paribus, then consumers with lower levels of income are more affected economically by higher cigarette taxes. This is because any increase in the cigarette tax will be paid equally by high income and low income smokers, but the tax makes up a larger portion of poor smokers’ incomes. Thus, a government seeking to generate revenues by increasing cigarette excise taxes needs to consider the tradeoff between raising money and levying a regressive tax that could be detrimental to citizens in lower income brackets.

This study has also shown that the underlying preference assumptions in the addiction theories of Becker and Murphy (1988) and Gruber and Köszegi (2002) hold in reality with respect to demand for cigarettes, as the econometric analysis in the second chapter has proven that both past and future consumption of cigarettes affects current consumption. Because both estimated coefficients on $Q_{i,t-1}$ and $Q_{i,t+1}$ are positive and statistically significant in the cigarette demand regressions, this study has shown that both past and future cigarette consumption are determinants of current cigarette consumption. The results, however, do not allow specification of whether consumers display rational or time-inconsistent preferences, as the empirical findings for both theories would be similar according to the explanation of time-inconsistent behavior hypothesized by Gruber and Köszegi (2002).
From the regressions for cigarette consumption, the results of this study show that excise taxes appear to be the only effective policy tool that governments can use to affect smoking behavior. As witnessed in the results for the per capita consumption model, taxes have a statistically significant inverse relation to cigarette consumption, although it was also determined in the prevalence regressions that taxes do not cause people to stop smoking. Although it has been suggested that policies such as smoking restrictions in public and private areas or programs increasing the education of individuals may help to reduce aggregate smoking behavior, the results of this study indicate that neither of these suggestions are true. In both regression models, it is found that the legislation index, $L_{it}$, is not statistically significant, and thus smoking restrictions neither reduce the number of cigarettes smoked per capita nor cause people to quit smoking. Similarly, in the smoking prevalence regression it was found that greater educational attainment did not significantly influence state smoking prevalence. Therefore, a government attempting to reduce per capita cigarette consumption in its jurisdiction must rely heavily on cigarette taxes, as this policy tool is the only effective deterrent for cigarette consumption that governments have complete control over.

A final policy implication that can be extracted from the results of this study is the importance of border-crossing effects on per capita cigarette consumption. In the cigarette demand regression, it was found that the bootlegging variable, $B_{it}$, was negatively related to cigarette consumption. Thus, states considering an increase in their cigarette excise tax rates may need to consider these effects when estimating
revenues from the tax. The significance of this variable also implies that when implementing a tax increase, greater enforcement may need to be in place to prevent border-crossing behavior so as to yield the most revenue out of such an increase. Rather than causing cigarette sales to be forfeited to neighboring states, greater enforcement to prevent cigarette bootlegging would allow governments to earn the full amount of a tax increase while not generating a loss in sales to own-state businesses. Also, greater enforcement to prevent cigarette bootlegging might make an increase in cigarette excise taxes a more effective tool for reducing per capita cigarette consumption, as some consumers may be forced to smoke less if they are unable to purchase cheaper cigarettes in neighboring states in the face of a price increase.
Suggestions for Future Research

This study has contributed to the existing literature surrounding cigarette regulation in several ways. Not only has this study yielded more contemporary results for the effects of cigarette taxation and regulation by extending the years in the model to 2008, but this study has also utilized various econometric techniques in an attempt to improve the accuracy of estimates for the effects of cigarette regulations. One such technique is instrumenting for the price variable in the model, which was found to be endogenous in the cigarette demand model. This technique was not used in similar studies, and may be a potential source of bias in the estimates of comparable studies on the effects of cigarette taxation and regulation. Despite the measures taken in this study to provide accurate estimates of the effects of cigarette regulation, there are a few ways in which this study could be improved in future research.

For one, to provide truly accurate estimates of the effects of cigarette taxation and regulation, individual panel data should be used as opposed to aggregate state-level data for cigarette consumption. Not only would this yield more accurate information concerning individual smoking habits, but it would also provide better grounds for testing the theories of addiction proposed by Becker and Murphy (1988) and Gruber and Köszegi (2002).

Another potential source of improvement in estimating the effects of regulation would be to include additional layers of regulation at town levels rather
than simply using state-wide data on smoking restrictions. In many states, local jurisdictions such as counties and municipalities have stricter smoking restrictions than at the state level, and including this information in an improved regression model would yield more accurate estimates about the effects of smoking restrictions on cigarette consumption.

Finally, there are also several ways of avoiding cigarette taxes that were not taken into account in this study, such as the possibility that consumers might purchase cigarettes at tax-free Indian reservations, online to avoid taxation, or through wholesale smuggling and the black market. All of these scenarios could potentially be utilized by a consumer attempting to bypass federal taxation and controls for cigarettes. An improvement to the models used in this thesis would be to include information that accounts for these possible avenues for cigarette purchases, as more comprehensive results could then be obtained about the effects of cigarette regulation on consumer preferences.

The effects of cigarette taxation and regulation are interesting and relevant topics for contemporary government policy decisions, and will continue to be important in future years. This study has updated the existing literature on the effects of cigarette taxation and regulation, and has provided fruitful grounds and suggestions for further research in this field.
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