

**SMOKING CESSATION SUCCESS  
AND LABOR MARKET PRODUCTIVITY**

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## **ABSTRACT**

This paper investigates the labor market outcomes of individuals classified by their past, present, and future cigarette smoking habits. By using NLSY panel data that span thirty-three years, I am able to track the smoking behaviors and income of individuals over the course of their careers. This paper is the first in the economics literature to use number of quit attempts as a way to distinguish different types of smokers. Those who successfully abstain from smoking after one attempt earn higher incomes throughout their lives than those who relapse. Additionally, those able to sustain longer periods of cessation earn more than those who relapse frequently. Therefore, number of quit attempts is negatively associated with future income. These findings suggest that smokers who are able to successfully quit during earlier attempts possess traits that are valued in the labor market and fixed over time.

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# I. Introduction

Consumption of cigarettes is not like consumption of most other goods; smoking is highly addictive and generally difficult to give up. There is a large research literature on the association between smoking and labor market performance, and while there appears to be consensus that smoking is linked to lower wages, there is no agreement about how to define a smoker.<sup>1</sup> Most research classifies smokers by their current smoking status. The implication of using only current smoking habits to classify smokers – and not considering past smoking habits – is that both former smokers and those who have never been smokers are treated as nonsmokers. However, former smokers differ from those who have never been smokers because they were once addicted to cigarettes, and perhaps more importantly, they have demonstrated the ability to give up the habit. These behavioral differences are worth considering; the traits that enable smokers to quit successfully may be valuable in the labor market and affect job performance. Labor research that groups former smokers into the same category as those who have never smoked is flawed if these two groups perform differently in the labor market.

To date, no research in economics has used number of quit attempts as a defining characteristic to distinguish different types of former smokers. I propose that there are important distinctions to make, not only beyond the binary designations of ‘smoker’ and ‘nonsmoker’, but also within the ‘former smoker’ grouping. Namely, difficulty quitting (represented by number of quit attempts) should be used to differentiate between relapsing quitters and quitters who achieve permanent abstinence.

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<sup>1</sup> See, for example, Levine et al. (1997), Hotchkiss and Pitts (2013), and Bockerman et al. (2014).

This paper focuses on number of quit attempts to proxy former smokers' difficulty in quitting smoking and relates this proxy to labor income. More generally, this paper shows that a more complex portrait of past, present, and future smoking behavior depicts an interesting and insightful view of how smoking influences labor market outcomes: those able to successfully quit smoking earn more than those who struggle to quit. I show that these divergent patterns in earnings persist throughout an entire career span, indicating that the noncognitive skills correlated with smoking and quitting behaviors may be time-invariant. My findings suggest that researchers should expand beyond the classifications of 'smoker', 'nonsmoker', and 'former smoker' – and account for dynamic smoking behaviors when using smoking to predict labor market outcomes.

## **II. Literature Review**

### **i) SMOKING AND LABOR MARKET OUTCOMES**

Cigarette smoking is among the leading risk factors for the global disease burden and one of the most important preventable causes of premature death (WHO Global Health Risks Report 2009). The amount of global healthcare expenditures due to smoking-attributable diseases totaled \$467 billion in 2012, and the economic cost of smoking from productivity losses totaled \$969 billion in 2012. In the United States, a smoking employee costs a private business an annual average of \$5,816 more than a nonsmoking employee due to absenteeism, smoke breaks, and health costs (Berman et al. 2014).

Economic theory predicts that these business costs should show up in earnings differentials, forcing smokers to ultimately bear these costs.<sup>2</sup> Researchers estimate that the wage gap between current smokers and current nonsmokers is anywhere between four percent to twenty-four percent (Levine et al. 1997; Ours 2004; Auld 2005; Grafova and Stafford 2009). The wage differential may be driven by both smoking per se and by non-causal explanations. Smoking may reduce worker productivity by interfering with workers' ability to carry out manual tasks (Conway and Cronan 1992; Hoad and Clay 1992; Andrenski and Breslau 1993). Smokers may take more breaks and sick days (Berman et al. 2014). In addition, the health complications related to smoking may lead smokers to take a compensating wage differential, choosing jobs that include employer-provided health insurance by forfeiting a higher wage (Viscusi and Hersch 2001). Moreover, as employers have become more aware of the costs associated with smokers, discriminatory employment practices against smokers may have emerged (Kristein 1983; Blake et al. 1988; Bertera 1991). Finally, as Levine et al. (1997) point out, smoking may indicate a high rate of time preference, which would be associated with fewer investments in human capital (Evans and Montgomery 1994) and hence, lower wages (Becker and Murphy 1988; Becker et al. 1994).

An issue with much of the research is that smoker status is usually based on current smoking behavior, leaving former smokers unaccounted for. Are the traits that current smokers possess not present to some degree in former smokers? Empirical studies on the wage penalties attached to smoking may have produced results that are significantly biased by failing to control

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<sup>2</sup> How do you best capture the labor market penalty of smoking? Little research on smoking behavior has employed annual individual income as a measure of labor market productivity; the vast majority of the literature focuses on hourly wages (Levine et al. 1997; Lee 1999; Ours 2004; Munasinghe and Sicherman 2006; Grafova and Stafford 2009; Neumann 2011; Hotchkiss and Pitts 2013; Bockerman et al. 2014). The drawback in using wages is that those employed in positions that receive pay on a longer time horizon are often excluded from the analysis. Because higher-income earners typically receive pay in large time increments, analysis of hourly wages may be naturally limited to lower-income workers. I propose that income should be considered as an alternative measure of labor market performance, as it presents a more comprehensive view of earnings than does hourly wage.

for the past smoking behavior of individuals. Individuals who recently stopped smoking have demonstrated a propensity to smoke and could relapse at any time. The inclusion of these former smokers in the pool of ‘nonsmokers’ creates a bias toward zero of any measured penalty by lowering the average nonsmoking labor market productivity estimate (Hotchkiss and Pitts 2013). Indeed, Anger and Kvasnicka (2010) estimate that the smoking wage penalty is adjusted by as much as a third when past smoking behavior is controlled.

Why don’t researchers distinguish former smokers from those who have never smoked? The answer probably lies in the available data, which is typically cross-sectional without information on past smoking history. Furthermore, the few exceptions in the economics literature that have controlled for past smoking generally only incorporate this behavior through a binary indicator (Lee 1999; Zagorsky 2004; Munasinghe and Sicherman 2006; Hotchkiss and Pitts 2013; Bockerman et al. 2014). Most studies fail to take into account dynamic changes in smoking behavior. Should a former smoker who quit successfully decades ago be grouped into the same category as one who stopped smoking just months ago, and has been regularly trying to quit but relapsing for years? I propose that the same traits that underlie differences in success at quitting may also drive differences in labor market productivities.

## **ii ) NONCOGNITIVE SKILL**

To an increasing extent, the literature considers noncognitive skills – namely, personality traits – as sources of individual differences in labor market productivity and other outcomes (Bowles et al. 2001; Heckman et al. 2006; Munasinghe and Sicherman 2006; Flossmann et al. 2007; Grove et al. 2011; Heineck 2011; Segal 2013; Thiel and Thomsen 2013; Fletcher 2014). Evidence suggests that many of the traits valued in the labor market are time-invariant (Carneiro

et al. 2007; Borghans et al. 2008; Cunha et al. 2010; Moffitt et al. 2011). These same traits may be correlated with social behaviors like smoking (Seltzer 1985; Heckman et al. 2006; Rondina et al. 2007). My honors thesis is based on the premise that certain personality traits that are fixed over time are correlated with both labor market productivity and smoking behavior. Therefore, these traits may produce differences in earning before differences in smoking habits emerge.<sup>3</sup>

My thesis supports the existence of time-invariant noncognitive skills that drive both earnings and smoking habits. Identification of what these particular skills are is beyond the scope of this paper. However, in order to better understand the rationale behind my classification of smoker status in this paper, it is helpful to review some key behavioral differences between smokers and nonsmokers.

Studies have linked earnings to various measures of noncognitive skill, such as motivation, persistence, confidence, assertiveness, and openness to experiences (Heckman et al. 2006; Grove et al. 2011; Heineck 2011; Fletcher 2014). Heckman et al. (2006) argue that many of these traits can help explain measures of personality that are more conventionally measured in economics and also correlated with smoking behaviors.<sup>4</sup> The expression of risk preferences among smokers has been well documented in the literature, and there is a general consensus that current smokers are less risk-averse than their nonsmoking counterparts (Leventhal and Cleary 1980; Viscusi and Hersch 2001; Arcidiacono et al. 2007; Khwaja et al. 2007; Ida and Goto 2009). This might explain why smokers pick up cigarettes in the first place (Reynolds et al. 2003), but why don't they quit? Two models of research regarding addictive behaviors can help

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<sup>3</sup> Research indicates that changes in smoking behavior do not drive short-term changes in earnings (Levine et al. 1997; Grafova and Stafford 2009).

<sup>4</sup> There is a substantial psychology literature regarding the personality traits of smokers, the majority of which links smoking status to expressions of extraversion and neuroticism (Munafò et al. 2007). Unfortunately, the lack of familiarity of economists with these personality measures is one reason for their omission from most economic studies (Borghans et al. 2008).

explain continued smoking: rational addiction and myopic addiction (Messinis 1999). The rational addiction model argues that smokers consider the future consequences of their current and past consumption of cigarettes, and make the choice to smoke today because the immediate utility derived from smoking outweighs the future costs (Becker and Murphy 1988). The myopic addiction model assumes that many smokers have self-control issues and regret their reliance on tobacco (Houthakker and Taylor 1966; Gorman 1967; Pollack 1970), suggesting that addiction may result from underestimating how difficult it is to cease a repeated behavior with adverse consequences (Orphanides and Zervos 1995; Orphanides and Zervos 1998).

The literature is inconclusive on which model is more representative of smoker behavior (Gruber and Mullainathan 2002; Goel 2007; Khwaja et al. 2007; Kang and Ikeda 2014), but national statistics seem to support the myopic model. In the United States, sixty-eight percent of smokers report that they want to quit, but annually only about seven percent of smokers succeed (Babb 2017). Evidence suggests that it takes the average smoker thirty or more quit attempts before being successful (Chaiton et al. 2007), and only a small minority of smokers successfully quit on their first attempt.<sup>5</sup> What sets the successful quitters apart? What traits do they possess that the relapsing quitters and persistent smokers don't, and how do these traits relate to the labor market productivity?

In a cohort study of smokers who had recently started to quit, Goto et al. (2009) observed that those who gave more importance to rewards that are certain (higher risk-aversion) were significantly more likely to continue to abstain from smoking. This implies that successful quitters are, on average, more similar to nonsmokers in their risk preferences than relapsing

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<sup>5</sup> Research suggests that the probability of a successful quit (at least one year abstinence) is highest on the initial quit attempt, with an eleven to fifteen percent success rate. The second attempt has a much lower success rate, at five percent, while subsequent attempts are even less likely to succeed (Best et al. 1998; Doran et al. 2006; Chaiton et al. 2007).

quitters are. It could also be the case that the relapsing quitters are more present-biased than the successful quitters; the literature documents a significant positive relationship between the amount of cigarettes smoked per day and a higher discounting rate (Bickel et al. 1999; Mitchell 1999; Odum et al. 2002; Baker et al. 2003; Reynolds et al. 2003; Ohmura et al. 2005), as well as a significant positive relationship between the amount of cigarettes smoked per day and difficulty quitting (Wilson et al. 1992).

Alternatively, it could just be that successful quitters are more price-responsive than the relapsing quitters. The negative health consequences of smoking may not be what deters successful quitters from going back to cigarettes, but rather tobacco tax increases may be the primary factor that motivates them to give up the habit for good. In the labor market, this price-responsiveness could translate to a stronger ambition to obtain high earnings.

A large body of evidence indicates that tobacco taxation is negatively correlated with smoking (Babb 2017). However, an issue with the majority of the reports on smoking and taxation is that the effect of the tax is measured either in cigarette sales or polls on smoking rates. It is difficult to know which individuals reduce their daily consumption of cigarettes, which quit smoking successfully, and which are deterred from trying cigarettes in the first place as a result of tax increases. Even if information about quit attempts is known, the data are usually collected at a macro level, and so resulting statistics only represent aggregate trends (Goel 2007).<sup>6</sup> Among the handful of studies that have employed micro-level data to examine the effect of tobacco taxation on individual smoking behavior, almost none consider long-term outcomes; indeed, the research is often focused on youth smoking (Douglas and Hariharan 1994; Chaloupka and

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<sup>6</sup> The literature is inconclusive about whether tobacco tax increases have a stronger effect on the number of quit attempts of lower income individuals, and whether taxation affects the cessation success rate of lower income individuals differently than higher income individuals (Becker et al. 1990; Hsieh 1999; Kidd and Hopkins 2004; Bader et al. 2011).

Grossman 1996; Chaloupka 1999; DeCicca et al. 2002; DeCicca et al. 2008; DeCicca and McLeod 2008; Franz 2008; Volpp et al. 2009). Long-term individual-level panel data are hugely lacking in the literature, and could offer important insights into the impact of tobacco taxation on lifelong smoking behavior, financial returns, and health outcomes.<sup>7</sup>

This paper employs a large micro-level panel data set that spans thirty-three years and includes detailed information on various smoking behaviors to understand how smoking relates to labor market outcomes, and to investigate the effect of tobacco taxation on individual cessation success. The model used in this paper is the first in the economic literature to categorize former smokers by number of quit attempts, and one of the first to capture the penalty in annual income rather than in wages.<sup>8</sup>

### **III. Data**

Data from the 1979 National Longitudinal Surveys of Youth (NLSY79) are ideally suited to investigate the relationship between smoking and labor market outcomes. The dataset includes information about the smoking behaviors and annual income of 4,098 individuals from the years 1979 (when the respondents were between the ages of fourteen and nineteen) through 2012 (when the respondents were between the ages of forty-seven and fifty-two). The panel nature of the data, including the respondents' entire work histories, allows tests of correlations between

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<sup>7</sup> Although primary prevention of smoking among teenagers is important, reducing adult smoking pays more immediate dividends, both in terms of health improvements and cost savings (Lightwood et al. 1997). Life expectancy among smokers who quit as late as age thirty-five exceeds that of continuing smokers by 6.9 to 8.5 years, and smokers who quit at age sixty-five gain an average of 1.4 to 3.7 years of life (Taylor et al. 2002).

<sup>8</sup> My results build on Grafova and Stafford (2009), who employed data spanning only fifteen years without any information about quit attempts; in addition, their analysis was restricted to male household heads employed full-time, and the smoking penalty was measured in wages.

various smoking behaviors and individual income over the course of many years. The NLSY also contains information on a variety of demographic, geographic, and work related characteristics.

The following individual characteristics are employed as controls in the regression analyses: gender, race (Hispanic, black, other), age, education (highest grade completed by respondent's mother as of 1979, highest grade completed by respondent's father as of 1979, highest grade completed by respondent as of 2008), and military status (whether the respondent is in the military sample).<sup>9</sup>

Information on smoking behavior is reported in seven waves (1984, 1992, 1994, 1998, 2008, 2010, 2012). Respondents are asked a number of questions about their smoking behaviors, and only individuals who respond to all the relevant smoking questions are included in the present analysis. In each year, they report whether they currently smoke daily, occasionally, or not at all. In most years, daily smokers report the average number of cigarettes they smoke per day; this information is used to determine the maximum number of cigarettes the respondent ever reported to have smoked daily.<sup>10</sup> In most years, respondents report the age at which they first started smoking daily. For every year except 1984, respondents who identify as former smokers in that year (used to smoke daily and currently do not smoke daily) report their own abstinence duration (how long it has been since they last smoked daily).<sup>11</sup>

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<sup>9</sup> Throughout the twentieth century, the U.S. military freely distributed cigarettes to overseas personnel and provided low-cost tobacco products on domestic military bases. Bedard and Deschenes (2006) show that a large fraction (thirty-five to seventy-nine percent) of the excess veteran deaths due to heart disease and lung cancer are attributable to military-induced smoking.

<sup>10</sup> Smoking intensity (number of cigarettes consumed per day) is commonly used as measure of addiction in the health literature.

<sup>11</sup> For the sake of consistency, in this paper, 'abstinence' is defined as forbearance from daily cigarette consumption. Thus, casual non-daily cigarette consumption is considered abstinence. The term holds different meanings in various research literature.

Because respondents do not directly report the number of times they have attempted to quit smoking, information on number of quit attempts is constructed from reports of abstinence duration. Abstinence duration could be reported in either years, months, or weeks; but for the present analysis, the unit of abstinence duration was converted to weeks for all respondents. This information allows the identification of respondents who have consistently abstained from daily cigarette consumption since their first reported attempt (abstinence duration increases from one year's report to the next) and respondents who have relapsed since their last reported attempt (abstinence duration does not increase from one year's report to the next). The advantage to having respondents report abstinence duration rather than number of quit attempts, is that the latter is difficult to recall and to define. Respondents surely would have various interpretations of a quit attempt. The expected measure imprecision in a respondent's estimation of abstinence duration is a limitation of this measure of cessation success.

In the years 2008, 2010, and 2012, respondents are grouped into categories based on their past and current smoking behavior. For each of these three years, smokers are assigned to one of four categories, which I will refer to as their 'primary category': *current smoker*, *relapsing quitter*, *permanent quitter*, *never smoker*. *Current smokers* are those who have smoked at least one hundred cigarettes in their lifetime, have smoked daily in the past, and currently smoke daily. There are two categories of quitters: *relapsing quitters* and *permanent quitters*. Both types of quitters have smoked at least one hundred cigarettes in their lifetime and have smoked daily in the past. Neither currently smoke daily. The two groups differ in past cessation success. *Relapsing quitters* are those who either currently smoke occasionally or currently do not smoke at all, and have relapsed at least once after trying to quit. *Permanent quitters* currently do not smoke at all and have completely abstained from smoking since their first quit attempt; in

other words, they were successful on their first try and have not smoked since that time. *Never smokers* are those who have never smoked daily; this group of people includes those who have never tried smoking, as well as those who are casual smokers (<1 cigarette per day) but have never been addicted to cigarettes.

In the years of 1992, 1994, and 1998, respondents are grouped into categories based on their past and current smoking behavior, as well as their 2012 smoker classification.<sup>12</sup> For the year 1984, it is not possible to identify past smokers (in this year, respondents were only asked whether they currently do or do not smoke), and so individuals are therefore categorized according to their current (1984) binary smoking status and their 2012 smoker classification.<sup>13</sup>

In addition to the individual characteristics mentioned above, the analyses make use of information about annual individual income (from wages, salaries, and tips in a given year) and state location<sup>14</sup> for the same seven years that smoking behavior data are collected. Reported zero incomes are included in the analysis, and individuals with non responses are excluded.

Descriptive statistics of selected variables are presented below. The distributions of income and demographic characteristics are reported in Table 1. The mean values for key variables are reported in Table 2.

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<sup>12</sup> For each of these three years, smokers are assigned to one of ten categories: *(year<sub>T</sub>) smoker / 2012 smoker*, *(year<sub>T</sub>) smoker / 2012 recidivating quitter*, *(year<sub>T</sub>) smoker / 2012 permanent quitter*, *(year<sub>T</sub>) quitter / 2012 smoker*, *(year<sub>T</sub>) quitter / 2012 recidivating quitter*, *(year<sub>T</sub>) quitter / 2012 permanent quitter*, *(year<sub>T</sub>) nonsmoker / 2012 smoker*, *(year<sub>T</sub>) nonsmoker / 2012 recidivating quitter*, *(year<sub>T</sub>) nonsmoker / 2012 permanent quitter*, *never smoker*. For the sake of simplicity, the *(year<sub>T</sub>) quitter* group across these three years is not divided into the subgroups of *(year<sub>T</sub>) recidivating quitter* and *(year<sub>T</sub>) permanent quitter*.

<sup>13</sup> Thus, the categories are: *1984 smoker / 2012 smoker*, *1984 smoker / 2012 recidivating quitter*, *1984 smoker / 2012 permanent quitter*, *1984 nonsmoker / 2012 smoker*, *1984 nonsmoker / 2012 recidivating quitter*, *1984 nonsmoker / 2012 permanent quitter*, *never smoker*.

<sup>14</sup> Yearly state tobacco taxation information comes from the annual compendium on tobacco revenue and industry statistics known as The Tax Burden on Tobacco (Orzechowski and Walker 2009).

**TABLE 1**  
**DISTRIBUTION OF SOCIOECONOMIC CHARACTERISTICS AND INCOME BY SMOKER TYPE**

	<i>All</i>	<i>Current Smoker</i>	<i>Recidivating Quitter</i>	<i>Permanent Quitter</i>	<i>Never Smoker</i>
N	4,098	716	724	527	2,131
Female	52.98%	51.82%	50.41%	55.22%	53.68%
Male	47.02%	48.18%	49.59%	44.78%	46.32%
Hispanic	17.64%	12.15%	20.86%	15.94%	18.82%
Black	23.89%	26.68%	23.62%	17.84%	24.54%
White/Other	58.47%	61.17%	55.52%	66.22%	56.64%
Income > \$50,000	33.89%	15.92%	34.67%	33.21%	39.84%
Income > \$10,000	73.47%	59.64%	70.30%	75.52%	78.70%
Income > \$0	79.31%	67.18%	77.21%	80.27%	83.86%

Notes: Smoker categories represent smoking status in 2012. Income represents individual income in 2012.

**TABLE 2**  
**MEAN VALUES OF KEY VARIABLES BY SMOKER TYPE**

	<i>All</i>	<i>Current Smoker</i>	<i>Recidivating Quitter</i>	<i>Permanent Quitter</i>	<i>Never Smoker</i>
2012 Income	\$47,662	\$25,901	\$44,876	\$47,030	\$56,077
1998 Income	\$27,386	\$19,652	\$25,650	\$26,276	\$30,849
1984 Income	\$6,933	\$6,058	\$6,742	\$7,491	\$7,155
Education	13.54	12.31	13.33	13.24	14.10
Age Became Smoker	17.01	16.41	17.95	16.82	X
Cessation Duration	799.92	X	713.36	907.72	X
Maximum Intensity	19.79	22.63	14.17	20.18	X

Notes: Smoker categories represent smoking status in 2012. Education is measured as the highest grade completed by the respondent as of 2008. Cessation duration is measured as the number of weeks since the respondent last smoked daily, reported retrospectively in 2012. Maximum intensity is measured as number of cigarettes smoked daily at peak intensity, reported on or before 2012.

## IV. Empirical Strategy

My model of labor market productivity rests on two claims: that noncognitive factors driving smoking habits are (a) correlated with labor market productivity, and (b) time-invariant. Under claim (a), individuals who fall into different smoker categories (but are otherwise similar) should have different labor market productivities. Furthermore, if I also accept claim (b), then differences in labor market productivity can be observed before differences in smoking

behaviors. The smoker categories of interest are the primary categories: *never smoker*, *permanent quitter*, *recidivating quitter*, *current smoker*. I hypothesize that the ordering of these categories as presented here reflects the ordering of the level of noncognitive skill, so that the highest level of skill is associated with the *never smokers*, the next highest level is found in the *permanent quitters*, the next highest in the *recidivating smokers*, and the lowest in the *current smokers*. I hypothesize that this ordering of skill will be revealed in relative income levels.

To evaluate these claims, I estimate income as a function of smoker category and socioeconomic characteristics through a least-squares framework. Claim (a) is modeled in Equation (1), where the real income<sup>15</sup> of an individual in a given year is a function of their primary smoker category in that year and a set of socioeconomic controls, which describe fixed characteristics of the individual. Claim (B) is modeled in Equation (2), where the real income of an individual in a given year is a function of their primary smoker category in a future year and a set of socioeconomic controls that describe fixed characteristics of the individual. The basic regression equations are of the form:

$$(1) \quad y_{i,t} = \alpha S_{i,t} + \beta X_i + \varepsilon_{i,t}$$

$$(2) \quad y_{i,t-k} = \alpha S_{i,t} + \beta X_i + \varepsilon_{i,t-k}$$

where  $y_{i,t}$  is the real annual income of individual  $i$  in year  $t$ ,  $y_{i,t-k}$  is the real annual income of individual  $i$  in year  $t-k$ ,  $S_{i,t}$  is the smoker category indicator for year  $t$ ,  $X_i$  is a vector of fixed individual characteristics, and  $\varepsilon_{i,t}$  and  $\varepsilon_{i,t-k}$  are error terms.

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<sup>15</sup> These regressions were also structured with log income and income growth as the outcome variable, but these models did not yield informative results.

Equation (2) can be altered so that smoker category variable represents both current and future smoking status (see notes 12 and 13). This is modeled in Equation (3), where the income of an individual in a given year is a function of their smoker category in that year and their smoker category in a future year, as well as a set of socioeconomic controls that describe fixed characteristics of the individual.

$$(3) \quad y_{i,t-k} = \alpha S_{i,t(t-k)} + \beta X_i + \varepsilon_{i,t-k}$$

where  $S_{i,t(t-k)}$  is the smoker category indicator that encompasses individual  $i$ 's smoking status in years  $t$  and  $t-k$ .

Covariates that describe the nature of the individual's past smoking behavior (age they first tried cigarettes, intensity of past smoking, abstinence duration) are also tested, so that Equations (1) through (3) become Equations (4) through (6):

$$(4) \quad y_{i,t} = \alpha S_{i,t} + \delta D_{i,t} + \beta X_i + \varepsilon_{i,t}$$

$$(5) \quad y_{i,t-k} = \alpha S_{i,t} + \delta D_{i,t} + \beta X_i + \varepsilon_{i,t-k}$$

$$(6) \quad y_{i,t-k} = \alpha S_{i,t(t-k)} + \delta D_{i,t-k} + \beta X_i + \varepsilon_{i,t-k}$$

where  $D_{i,t}$  and  $D_{i,t-k}$  represent continuous variables that characterizes facets of individual  $i$ 's smoking history (information reported on or before smoking status reference year  $t$  or year  $t-k$ ). I employ different combinations of these variables to understand how they impact the estimates on the smoker category covariates.

These OLS regressions can be reconstructed as logit models, where the dependent variable represents whether the individual's real annual income in a given year exceeds a certain level. Thresholds of \$100 000, \$50 000, \$10 000, \$2 000, and \$0 are used.

Another way to test my hypothesis regarding the relative levels of noncognitive skill between the different smoker categories, is to measure their respective degrees of achievement in channels that impact subsequent labor market outcomes. Economists studying the causal effect of education on earnings commonly look at the relationship between parental education and completed schooling. If I believe that educational attainment relative to parental education is a valid measure of noncognitive skill, then my hypothesis would predict that different smoker groups systematically differ in this capacity. I illustrate the relationship by graphing the average highest grade completed by each smoker group to that completed by their parents.

I measure the impact of state tobacco taxation on the decision to quit smoking at the aggregate level and at the individual level. Taxation is measured as the difference in each state's tobacco tax between January 1, 1984 and January 1, 2008; and this difference is measured nominally (in cents) and as a percentage change. At the aggregate level, an OLS model is used, and the impact is measured as the percent change in number of smokers in each state sample<sup>16</sup>, as such:

$$(7) \quad C_S = \lambda T^N_S + \varepsilon_S$$

$$(8) \quad C_S = \lambda T^P_S + \varepsilon_S$$

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<sup>16</sup> Keep in mind that this number doesn't account for younger smokers (outside of the sample of individuals being tracked by the NLSY) who will take up smoking during this time.

where  $C_S$  is the percent change in number of *current smokers* in state  $S$  between 1984 and 2008,  $T^N_S$  is the nominal change in the tobacco tax (measured in cents) for state  $S$  between those years,  $T^P_S$  is the percent change in the tobacco tax for state  $S$  between those years, and  $\varepsilon_S$  is an error term.

At the individual level, a logit framework is used. I restrict the sample to those who were categorized as a *current smoker* in 1984<sup>17</sup> and who live in the same state in 2008 as they did in 1984. The outcome indicator denotes whether the individual is no longer a *current smoker* in 2008 (*2008 recidivating quitter* or *2008 permanent quitter*). The variable of interest is the difference in each state's tobacco tax between January 1, 1984 and January 1, 2008; measured nominally and percentage-wise. I include the same set of socioeconomic controls used in models (1) through (6), as well as a control for past smoking intensity, and a binary indicator for whether the individual is in the top income quartile (over \$50,000).

$$(9) \quad Q_i = \lambda T^N_S + \delta I_i + \theta F_i + \beta X_i + \varepsilon_i$$

$$(10) \quad Q_i = \lambda T^P_S + \delta I_i + \theta F_i + \beta X_i + \varepsilon_i$$

where  $Q_i$  is an indicator for whether individual  $i$  was a smoker in 1984 and not a smoker in 2008,  $T^N_S$  is the nominal change in the tobacco tax (measured in cents) for state  $S$  between those years,  $T^P_S$  is the percent change in the tobacco tax for state  $S$  between those years,  $I_i$  is the maximum number of cigarettes the respondent ever reported to have smoked daily,  $F_i$  is a binary indicator for whether individual  $i$  has an annual income that exceed \$50,000 in 2008,  $X_i$  is a vector of fixed individual characteristics, and  $\varepsilon_i$  is an error term.

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<sup>17</sup> Thus, this sample includes the following three groups: *1984 smoker / 2008 smoker*, *1984 smoker / 2008 recidivating quitter*, *1984 smoker / 2008 permanent quitter*.

The goal of this thesis is to explore how noncognitive skill – as reflected in smoking behavior – may correlate with various economic factors. It capitalizes on the panel nature of the NLSY data to model associations between smoking behavior and other variables in the forms specified above. There is no intention to demonstrate causality, and the relationship between noncognitive skill and smoking behavior is implied but not tested here.

## V. Results

### i) 2000's INCOME AND CURRENT/PAST SMOKING BEHAVIOR

Appendix A Table A1 reports OLS estimates from regressions where the dependent variable is real income in 2008, 2010, and 2012. The primary smoker categories represent smoking status in that year, and smoking behaviors are reported on or before that year. The models are tested for three separate years to ensure consistency. Table 3 below presents the mean OLS-estimated coefficients for selected covariates across the three years under various model specifications. In all models, the following socioeconomic factors are controlled: gender, ethnicity, military status, age, own education, mother's education, and father's education. The reference group for all the models is male, non-Hispanic / non-black, not in the military, and *never smoker*. In model (a), aside from primary smoker category, no controls for characteristics of smoking behavior are used, as in Equation (1). Models (b), (c), and (d) each incorporate a single additional control that describes the nature of the individual's past smoking behavior. Model (b) includes current abstinence duration (measured in weeks); this variable only applies to those classified as a *recidivating quitter* or *permanent quitter*, as the current abstinence duration for a *current smoker* is non-existent. Model (c) controls for the age those classified as *current*

*smoker, recidivating quitter, or permanent quitter* first started smoking daily. Model (d) accounts for past smoking intensity through a variable that represents the maximum number of cigarettes the respondent ever reported to have smoked daily.

**TABLE 3**  
**INCOME GAP BETWEEN NONSMOKERS AND VARIOUS TYPES OF SMOKERS**  
**MEDIATED BY DIFFERENT SMOKING CONTROLS**  
*MEAN OLS ESTIMATES ACROSS 2008, 2010, AND 2012 MODELS*

	Income			
	a	b	c	d
Cessation Duration		4.2**		
Age Became Smoker			197.4	
Maximum Intensity				297.9***
Current Smoker	-14,122.5***	-14,216.8***	-11,192.2***	-7,876.9**
Recidivating Quitter	-6,458.9***	-8,712.9***	-4,033.4	-4,735.2**
Permanent Quitter	-2,861.1	-6,343.7**	-220.4	-300.8

Notes: The values presented here represent the mean coefficients across three sets of OLS models (2008, 2010, 2012). Control variables included in all models, but not shown are: gender (female, male), ethnicity (black, Hispanic, other), age, own years of schooling, parents' years of schooling (mother's education, father's education), and military status (in the military, not in the military). Income represents individual income in the given year. Smoker type (*Current Smoker, Recidivating Quitter, Permanent Quitter*) represents smoking status in the given year, and the effect of being a certain type of smoker is measured against being a *Never Smoker*. Cessation duration is measured as the number of weeks since the respondent last smoked daily, reported retrospectively from the given year. Maximum intensity is measured as number of cigarettes smoked daily at peak intensity, reported on or before the given year.

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01 (average p value across the three sets of models)

*Current smoker* status has the most negative impact on income among the smoker categories, and the results are significant at the one or five percent level, depending on the model and year. In models (a) and (b), results indicate that a *current smoker* earns about \$14,200 less annually than a *never smoker* does, ceteris paribus. When smoking intensity is controlled for in model (d), the gap shrinks to only about \$7,900. This less negative result reflects the income of a *current smoker* who smokes at a very low level (just one cigarette per day).

The results for *recidivating quitter* status are also significant at the one or five percent level across all years, and across all models except model (c). However, the magnitude of the

coefficient varies depending on the model specification. Without added controls describing smoking behavior, the loss is about \$6,450 compared to a *never smoker*, ceteris paribus. When abstinence duration is controlled for (model b), the gap widens to about \$8,700. This number represents the difference between a *never smoker* and a *recidivating quitter* who quit less than a week ago. The abstinence duration control allows us to distinguish between those *recidivating quitters* who have practiced abstinence for a long time, and those who were only recently regular smokers. The larger negative coefficient captures the income of the latter group, whose members probably possess many of the same behavioral traits as *current smokers*. However, the gap becomes smaller when smoking intensity is controlled: an income loss of only about \$4,700 in model (d). The smaller coefficient represents the income of *recidivating quitters* who were very light smokers, consuming an average of one cigarette per day at their peak intensity.

It is not clear exactly how much of an income loss is associated with being a *permanent quitter*. The results are only significant when abstinence duration is controlled for in model (b), in which case the income differential is estimated to be about \$6,300. As expected, this is a smaller loss than the estimated loss of income for *recidivating quitters* in this model.

The abstinence duration control variable is significant at the five percent level across all models and years, and the results estimate a return of about \$4.20 for each week of abstinence. Thus, someone who has avoided cigarettes for twenty-seven years has an income that is roughly \$5,900 higher than the same type of quitter who last identified as a regular smoker less than a week ago; this means a *permanent quitter* who quit twenty-seven years ago has, on average, about the same income as an otherwise identical *never smoker*. The smoking intensity control variable is significant at the one percent level across all models and years, and estimates an annual loss of about \$300 for every additional cigarette per day (reported as the maximum

number of cigarettes the person ever smoked daily). The CDC estimates that the average smoker smokes about twenty cigarettes per day (Babb 2017). A smoking intensity of twenty cigarettes per day would bring down average income by about \$6,000; this makes sense, as \$6,000 is roughly the difference between the lower coefficient on the *current smoker* indicator when the model doesn't control for smoking intensity, in model (a), and the higher coefficient when smoking intensity is controlled, in model (d). It does not appear that the age someone first started smoking is associated with future income in a meaningful way (model c).

Comparing across models, it appears that both model (a) and model (b) fit the data better than models (c) and (d). Model (b) yields more significant variables than does model (a), implying that the best way to define quitters is not only by number of quit attempts, but also by abstinence duration.

Mean coefficient values for selected covariates across the three years from the logit frameworks are presented below in Table 4. Appendix A Table A2 reports logit regression outputs by year (in which the dependent variable represents whether the individual's real annual income exceeds a certain level). The results add to the results from the OLS regressions, suggesting that certain types of smokers are clustered at the tail ends of the income spectrum, but that the smoking status variables follow a consistent rank order across all income levels.

**TABLE 4**  
**DIFFERENCE IN LOG-ODDS OF SURPASSING INCOME THRESHOLDS**  
**BETWEEN NONSMOKERS AND VARIOUS TYPES OF SMOKERS**  
*MEAN LOGIT ESTIMATES ACROSS 2008, 2010, AND 2012 MODELS*

	Income Threshold			
	> \$100,000	> \$50,000	> \$10,000	> \$0
Current Smoker	-1.187***	-0.690***	-0.557***	-0.583***
Recidivating Quitter	-0.243	-0.06	-0.380***	-0.383***
Permanent Quitter	-0.097	-0.037	-0.150*	-0.243*

Notes: The values presented here represent the mean coefficients across three sets of logit models (2008, 2010, 2012). Control variables included in all models, but not shown are: gender (female, male), ethnicity (black, Hispanic, other), age, own years of schooling, parents' years of schooling (mother's education, father's education), and military status (in the military, not in the military). Income thresholds represents individual income in the given year. Smoker type (*Current Smoker*, *Recidivating Quitter*, *Permanent Quitter*) represents smoking status in the given year, and the effect of being a certain type of smoker is measured against being a *Never Smoker*.

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01 (average p value across the three sets of models)

All else equal, being a *current smoker* significantly reduces the log-odds (compared to a *never smoker*) of passing every income threshold, particularly for the higher thresholds; in other words, being a *current smoker* is associated with very low incomes. The *current smoker* variable yields second strongest results among the smoking status variables, indeed among all the indicator variables tested it is only surpassed by the indicator for female gender as a predictor of a lowered income. Being a *recidivating quitter* decreases the likelihood of passing the lower income thresholds by about the same magnitude as does being black, but to a lesser degree than does being a *current smoker*. As with the OLS regressions, the results for *permanent quitter* status are somewhat ambiguous, but seem to imply that while it increases the likelihood of being a low income earner, the effect is not as strong as the effect of being a *recidivating quitter*.

## ii) 1990's INCOME AND FUTURE SMOKING BEHAVIOR

Mean results for the OLS estimates of the effects of smoking behaviors on income in 1998, 1994, and 1992 are reported below in Table 5. For OLS regression outputs by year, see

Appendix A Table A3. The regressors, the model specifications, and the reference group here are identical to those used in the 2012 OLS model (Appendix A Table A1); the difference here is the dependent variable. Whereas the dependent variables in the OLS regressions reported above were real income in 2008, 2010, and 2012, these models use smoking status in 2012 (and smoking behaviors reported on or before that year) to predict incomes fourteen to twenty years earlier. The model is outlined in Equation (2).

**TABLE 5**  
**INCOME GAP BETWEEN NONSMOKERS AND VARIOUS TYPES OF SMOKERS (2012 REFERENCE YEAR)**  
**MEDIATED BY DIFFERENT SMOKING CONTROLS**  
*MEAN OLS ESTIMATES ACROSS 1992, 1994, AND 1998 MODELS*

	Income			
	a	b	c	d
Cessation Duration (2012)		2.1***		
Age Became Smoker (2012)			67.2	
Maximum Intensity (2012)				-83.7**
Current Smoker (2012)	-5,218.3***	-5,255.8***	-4,226.7***	-3,478.7***
Recidivating Quitter (2012)	-2,657.7***	-4,005.0***	-1823.3*	-2,148.3***
Permanent Quitter (2012)	-1,834.7*	-3,714.1***	-942.2	-1,017.3

Notes: The values presented here represent the mean coefficients across three sets of OLS models (1992, 1994, 1998). Control variables included in all models, but not shown are: gender (female, male), ethnicity (black, Hispanic, other), age, own years of schooling, parents' years of schooling (mother's education, father's education), and military status (in the military, not in the military). Income represents individual income in 1992, 1994, or 1998. Smoker type (*Current Smoker*, *Recidivating Quitter*, *Permanent Quitter*) represents smoking status in 2012, and the effect of being a certain type of smoker is measured against being a *Never Smoker*. Cessation duration is measured as the number of weeks since the respondent last smoked daily, reported retrospectively from 2012. Maximum intensity is measured as number of cigarettes smoked daily at \*p<0.1; \*\*p<0.05; \*\*\*p<0.01 (average p value across the three sets of models)

Comparing the OLS results from Table 3 to the OLS results in Table 5, reveals strikingly similar patterns of income rank among the smoker categories. A *current smoker* in 2012 is estimated to earn about \$5,200 less in the 1990's than their *never smoker* counterpart, until smoking intensity is controlled, in which case the loss shrinks to about \$3,500. This decrease is similar in relative magnitude to what is found ten to twenty years later, for 2000's income. *Current smoker* status in 2012 is associated with the lowest income among the smoker

categories, both in these years and in the 2000's. *Recidivating quitters* in 2012 earn less than *never smokers* but more than future *current smokers* in these years, ceteris paribus. Estimations for *recidivating quitters* vary across models, but the patterns of variation are similar in magnitude and direction to the patterns for 2000's income. The coefficients for future *permanent quitter* status imply that this group, on average, earns more in the 1990's than future *recidivating quitters* and less in the 1990's than *never smokers*.

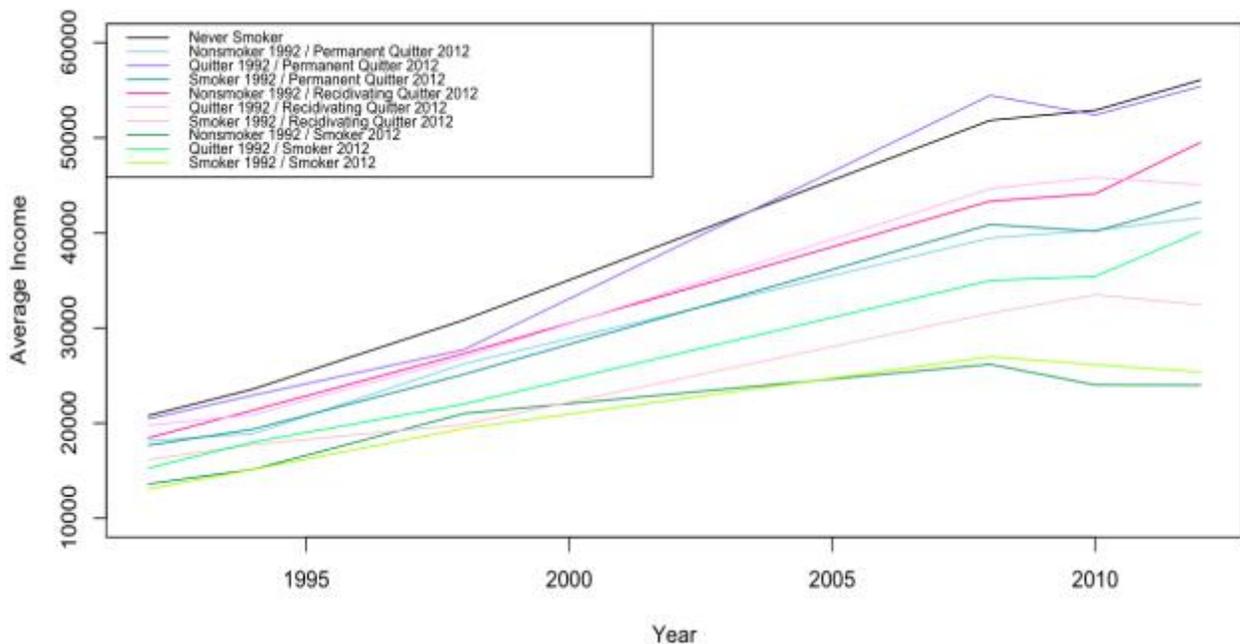
Results estimate a return of about \$2.09 in 1990's income for each week of future abstinence for the 2012 *recidivating quitters* and *permanent quitters*. The smoking intensity control variable is weakly significant, and a loss of about \$84 in the 1990's is estimated for every additional cigarette in the future. The age someone first started smoking is not correlated with 1990's income in a meaningful way. The demographic controls are associated with 1990's income in ways that are similar to their associations with 2000's income.

When the smoker indicators are expanded to represent both 1990's smoking status and 2012 smoking status, as in Equation (3), the regression outputs do not paint a clear picture of the income differences among the ten groups in the 1990's. However, what is consistent across the different frameworks is that among the ten smoker categories, those classified as *current smokers* in the 1990's and *current smokers* in the 2000's earn the least, and those classified as *never smokers* earn the most, all else equal.

Average annual incomes (for the years 1992, 1994, 1998, 2008, 2010, and 2012) according to 1990's and 2000's smoking status (1992 smoker classification / 2012 smoker classification) are plotted below in Figure 1. The *never smoker* group appears to compete with *1992 quitter / 2012 permanent quitter* group for the highest average income across the twenty-year span; the latter group consists of those who had given up smoking sometime before age

thirty-three, and were successful on their first quit attempt. There is a noticeable divergence in income growth between this group and the *1992 quitter / 2012 recidivating quitter* group; those who had also quit smoking sometime before age thirty-three, but had relapsed by this point and/or would relapse in the future. The *1992 quitter / 2012 permanent quitter* group also diverges from those who would eventually become *permanent quitters* but either had not started smoking yet or had not yet quit (the *1992 nonsmoker / 2012 permanent quitter* group and the *1992 smoker / 2012 permanent quitter* group). Perhaps the most striking pattern, though, is that all three *2012 smoker* groups have the lowest average 1990's incomes and the lowest 2000's incomes, and they experience the least income growth. This is consistent from the findings from OLS and logit regressions using the set of ten smoker classifications to predict 1990's income (regression outputs not reported), as well as the findings from OLS and logit regressions using the set of four smoker classifications to predict 2000's income (Tables 3 and 4).

**Table 1: Average Annual Income According to Smoking Status in 1992 / 2012**

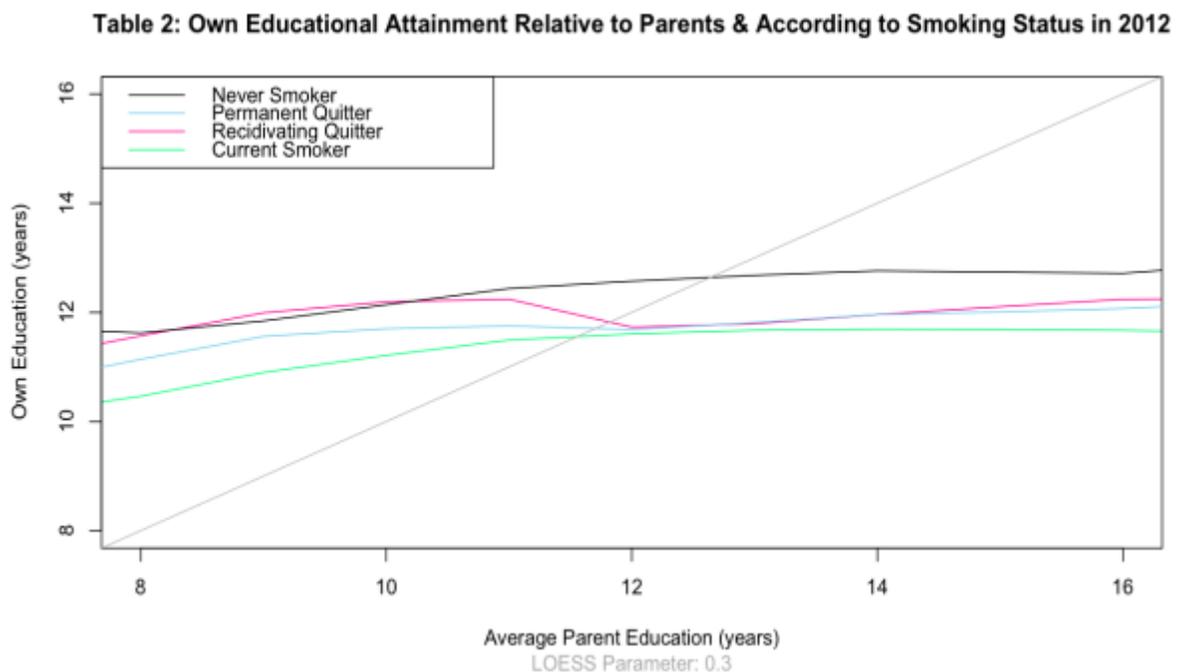


### iii ) 1984 INCOME AND FUTURE SMOKING BEHAVIOR

See Appendix Table A3 for OLS estimates of the 1984 income losses associated with future smoking behaviors. The results are similar to those discussed in parts i) and ii). All else equal, *current smokers* in 2012 earn the least in 1984, *recidivating quitters* earn the second least, followed by *permanent quitters*, and *never smokers* earn the most. The size of the coefficients depends on the controls used, particularly with respect to the abstinence duration control, which is the only smoking control that is statistically significant.

### iv ) EDUCATIONAL ACHIEVEMENT

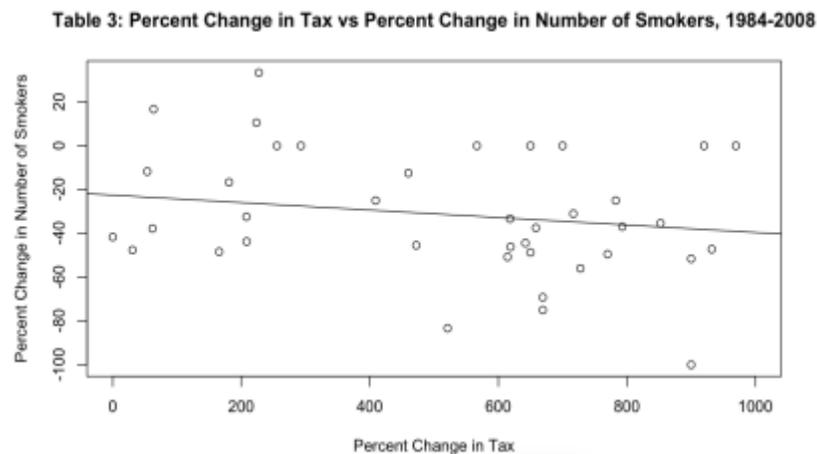
Figure 2 below plots average parent educational (measured in completed years of schooling, and weighted equally between mother and father) against own education. Individuals are grouped according to primary smoker category in 2012, and the curves are fitted using LOESS smoothing.



*Current smokers* consistently present the lowest educational attainment relative to their parents, and *never smokers* present the highest educational attainment. *Recidivating quitters* and *permanent quitters* fall somewhere in between and display similar patterns. There does appear to be a small gap between the two groups for lower levels of parent education; however, this is likely just noise in the data, and should not be over-interpreted.

### v ) TOBACCO TAXATION AND SMOKING CESSATION

Figure 3 below plots the percent change in state tobacco tax (between 1984 and 2008) against the percent change in the number of smokers in each state's sample. A univariate least-squares regression estimates a 0.11 percent decrease in smokers for every \$0.01 increase in tax, and a 0.017 percent decrease in smokers for every one percent increase in tax (See Appendix B Table B1).<sup>18</sup> Keep in mind that the average nominal tax increase between 1984 and 2008 across all states was ninety-two cents, and the average percent tax increase was seven hundred percent. A \$1.00 tax increase is expected to lead eleven percent of smokers to quit, and a one thousand percent tax increase is expected to lead seventeen percent of smokers to quit. These estimates are statistically significant at the one and five percent levels.



<sup>18</sup> See Equations (7) and (8)

When a logit framework is used to model the relationship between tax changes and the individual decision to quit smoking, estimates suggest that nominal changes in taxes do not have significant effects. However, percent changes in taxes do yield positive, significant coefficients. Outputs for a univariate and multinomial logit regression are reported below in Table 6.

**TABLE 6**  
**LOGIT ESTIMATES OF THE EFFECT OF STATE TOBACCO TAXATION**  
**ON THE INDIVIDUAL CESSATION DECISION**

	Quit Smoking 1984-2008	
	i	ii
Percent Tax Change	0.0003*	0.0004**
(SE)	-0.0002	-0.0002
Over \$50,000 Income		0.511**
(SE)		-0.205
Maximum Intensity		-0.098***
(SE)		-0.008
Female		-0.054
(SE)		-0.157
Hispanic		-0.131
(SE)		-0.256
Black		-0.342*
(SE)		-0.188
Age		0.059*
(SE)		-0.035
Education		0.037
(SE)		-0.041
Mother Education		0.005
(SE)		-0.034
Father Education		0.027
(SE)		-0.028
Military		0.546
(SE)		-0.558
Constant	-0.122	-0.368
(SE)	-0.116	-0.811
<i>N</i>	970	970
<i>Log Likelihood</i>	-669.874	-531.462
<i>Akaike Info Criterion</i>	1,343.75	1,086.92

Notes: The dependent variable here is a binary indicator of whether an individual who reported to be a smoker in 1984, was no longer a smoker in 2008. Percent tax change represents the percent change in state tobacco tax during this period. Over \$50,000 income is a binary indicator of whether an individual reported an annual income greater than \$50,000 in 2008. Maximum intensity is measured as number of cigarettes smoked daily at peak intensity, reported retrospectively from 2008.

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

It is estimated that person who lives in a state that experiences a one thousand percent tax increase between 1984 and 2008 (such as Rhode Island), faces an odds ratio of quitting (i.e. the probability of going from a *current smoker* in 1984 to either a *recidivating quitter* or *permanent quitter* in 2008 divided by the probability of staying a *current smoker*) that is nearly 1.5 times as large<sup>19</sup> as the odds ratio for a person who lives in a state that experiences no tax change (such as South Carolina), *ceteris paribus*. This estimate is statistically significant at the five percent level, and controls for smoking intensity and various socioeconomic characteristics.<sup>20</sup>

## VI. Conclusions, Limitations, and Implications

A broad summary of my results on the relationship between smoking cessation and labor market productivity is that number of quit attempts is negatively associated with income. My research indicates that those who are able successfully quit on their first attempt earn more than those who relapse. Those able to sustain longer periods of cessation earn more throughout their entire lives; however, it is unclear whether this cessation duration effect represents fewer relapses overall, or just successful cessation at an earlier age.

The relative ordering of income levels according to primary smoker classification (classification when the respondents are in their late forties to early fifties) confirms my hypothesis; *never smokers* earn the most, followed by *permanent quitters*, then *recidivating*

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<sup>19</sup>  $\exp(0.0004(1000)) = 1.491705$  odds ratio

<sup>20</sup> We can calculate the estimated probability of quitting if we assume values for the control variables. The odds ratio of quitting for a sample South Carolina resident (e.g. a white male born in 1965 who is not in the military, who earns less than \$50,000 in 2012, who has a maximum smoking intensity of twenty cigarettes daily, who has completed twelve years of school, and whose parents have each completed twelve years of school) is approximately 0.63, which translates to a thirty-nine percent probability of quitting. The odds ratio for an equivalent Rhode Island resident is 0.95, which translates to a forty-nine percent probability of quitting.

*quitters*, then *current smokers*. This ordering is evidenced over a twenty-eight-year period; however, it is unclear whether distinctive patterns in earnings are apparent before differences in smoking behavior emerge.

My results are inconsistent with the results presented in at least two similar papers: Grafova and Stafford (2009) find that former smokers' earnings are comparable to never smokers' earnings, and Anger and Kvasnicka (2010) find that former smokers earn more than current smokers and never smokers. However, both studies measure earnings through hourly wages rather than annual income, and only analyze wages over a short period of time.

There are five major weaknesses I have identified in the models and data used in this paper; oversimplification of tobacco policy, overrepresentation of individuals with zero income, infrequency of reports on smoking behaviors, inappropriate design of smoker categorization, and lack of information on life stressors.

In regards to the tax analysis, while the regression results do imply a positive relationship between tobacco taxation and smoking cessation, one should maintain a degree of skepticism about their external validity. There are likely many variables omitted from the analysis concerning non-tax tobacco policy measures, city-level tobacco taxes, and tax fluctuations within the twenty-four-year period. If anything, these results further the need for a thorough investigation into the role taxes play in the individual decision to change smoking behavior.

A large proportion of the NLSY respondents report very low incomes; more than twenty-six percent overall report a sub-poverty-level income or zero income in 2012 (See Table 1). This income distribution statistic is not nationally representative; census estimates show that only about fifteen percent of individuals between the ages of forty-five to forty-nine were not earning income in 2012, and only about three percent were earning less than \$10,000 (Bureau of Labor

Statistics 2012).<sup>21</sup> I choose to use nominal income rather than log income as a measure of earnings because, when zero incomes are included, an OLS framework proves to be a poor fit for log income. When individuals who report zero income in any year are excluded from the analysis, the log model does fit better, but the sample shrinks by almost one third and becomes overrepresentative of males and *never smokers*. Thus, I choose to include all income levels in my analysis and forgo the log model.

The smoker classifications used in this paper are far from ideal. The universe of smoking behavior is pooled from just seven reports, which leaves a lot of room for missed information. It is likely that some of those labeled *permanent quitters* actually have relapsed (which would technically make them *recidivating quitters*), but due to the structure of smoker classification used in this paper, the relapses were overlooked.<sup>22</sup> Furthermore, it is entirely possible that there are important distinctions to make among quitters beyond the *recidivating* and *permanent* subtypes. It could be that those *recidivating quitters* who still smoke occasionally behave differently in the labor market than those who do not touch cigarettes. It could also be that some *permanent quitters* were never truly addicted to cigarettes in the way other *permanent quitters* were; if they experienced relatively different levels of difficulty quitting, this could mean they possess different levels of noncognitive skill.

I choose to use number of quit attempts as a gauge for noncognitive skill because this approach is not commonly considered in the literature. My rationale stems from beliefs about smoking and addiction in general; because of my ideology, and also because of the data, I neglect to control for the isolated life events that prompt quit attempts and relapses. There is

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<sup>21</sup> The NLSY oversamples economically disadvantaged Hispanic and black civilians, which is why the proportion of respondents with very low incomes and zero income is larger than the national average.

<sup>22</sup> Those who relapsed before 1984 (and not after) would be classified as *permanent quitters*; those who relapsed in between response collection years but whose reported duration of abstinence increased from one year to the next would be classified as *permanent quitters*.

strong evidence that suggests workplace smoking bans are a major thrust behind the smoking cessation decision (Evans et al. 1996; Warner et al. 1996), and that job and financial stressors trigger relapse (Azagba and Sharaf 2011; Buczkowski 2014). For many, it may be that economic circumstances dictate smoking behavior, and not the other way around; this would create a reverse causality issue in my model.<sup>23</sup>

My results provide support for the unique predictive role of past smoking history on earnings. This paper adds to the small body of literature on the labor market outcomes of former smokers by underscoring the significance of cessation success and duration, and also by demonstrating that the relative income rankings of different types of smokers are apparent across the life span. Although my findings imply that addiction, noncognitive skill, and labor market productivity are related, further investigation is needed to understand the structure of these relationships.

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<sup>23</sup> Research has shown that smokers choose to continue smoking or resume smoking, in part, as a way to cope with economic insecurity: a one percent increase in the probability of becoming unemployed causes an individual to be over two percent more likely to continue smoking (Barnes and Smith 2009), and the onset of a financial strain increases probability of smoking relapse by eight to fourteen percent (Siahpush et al. 2009; Grafova 2011).

## APPENDIX A INCOME AND SMOKING BEHAVIOR

**TABLE A1**  
**OLS ESTIMATES OF THE EFFECT OF SMOKING ON INCOME IN 2008, 2010, AND 2012**

	Income 2008				Income 2010				Income 2012			
	a	b	c	d	a	b	c	d	a	b	c	d
Female (SE)	-27,860.2 <sup>***</sup> -1,434.30	-27,845.2 <sup>***</sup> -1,433.80	-27,817.5 <sup>***</sup> -1,434.30	-27,997.0 <sup>***</sup> -1,433.50	-27,960.9 <sup>***</sup> -1506	-28,051.4 <sup>***</sup> -1506.1	-27,925.0 <sup>***</sup> -1506.3	-28,131.9 <sup>***</sup> -1504.5	-32,057.6 <sup>***</sup> -1,672.70	-32,078.8 <sup>***</sup> -1,672.00	-32,032.0 <sup>***</sup> -1,672.50	-32,244.0 <sup>***</sup> -1,672.90
Hispanic (SE)	1,181.90 -2,198.50	1,122.70 -2,198.00	1,135.50 -2,198.40	441.6 -2,209.70	1784.1 -2309.8	1849 -2309.2	1757.9 -2309.8	881.6 -2319.7	2,515.10 -2,563.10	2,384.10 -2,562.70	2,436.90 -2,563.20	1,732.80 -2,577.80
Black (SE)	-9,803.3 <sup>***</sup> -1,771.20	-9,667.8 <sup>***</sup> -1,771.90	-9,834.4 <sup>***</sup> -1,771.00	-10,309.2 <sup>***</sup> -1,777.20	-10,959.3 <sup>***</sup> -1858	-10,760.0 <sup>***</sup> -1859.8	-10,990.7 <sup>***</sup> -1858.1	-11,578.9 <sup>***</sup> -1863	-12,234.2 <sup>***</sup> -2,063.80	-12,117.0 <sup>***</sup> -2,063.70	-12,272.0 <sup>***</sup> -2,063.70	-12,728.5 <sup>***</sup> -2,070.50
Age (SE)	122.9 -320.7	84.1 -321.2	130.2 -320.7	142.3 -320.5	-543.2 -336.5	-571.3 <sup>*</sup> -336.7	-536 -336.6	-529.1 -336.1	-623.6 <sup>*</sup> -373.6	-662.0 <sup>*</sup> -373.9	-611.6 -373.6	-616.9 <sup>*</sup> -373.3
Education (SE)	6,330.6 <sup>***</sup> -314.8	6,286.2 <sup>***</sup> -315.5	6,334.6 <sup>***</sup> -314.8	6,218.9 <sup>***</sup> -316.6	6,907.6 <sup>***</sup> -329.2	6,857.4 <sup>***</sup> -330	6,909.2 <sup>***</sup> -329.2	6,736.3 <sup>***</sup> -332.1	7,500.0 <sup>***</sup> -367.7	7,438.3 <sup>***</sup> -368.7	7,506.8 <sup>***</sup> -367.7	7,381.3 <sup>***</sup> -370.1
Mother Education (SE)	398 -317.4	389.8 -317.3	391.8 -317.4	384.1 -317.1	493.9 -333.3	496.5 -333.2	493.8 -333.3	494 -332.8	813.2 <sup>**</sup> -370.1	799.6 <sup>**</sup> -370	804.4 <sup>**</sup> -370.1	791.8 <sup>**</sup> -369.9
Father Education (SE)	709.5 <sup>***</sup> -246.3	707.6 <sup>***</sup> -246.2	715.5 <sup>***</sup> -246.3	710.4 <sup>***</sup> -246	617.2 <sup>**</sup> -258.6	621.7 <sup>**</sup> -258.5	622.7 <sup>**</sup> -258.6	619.4 <sup>**</sup> -258.2	810.2 <sup>***</sup> -287.2	815.8 <sup>***</sup> -287.1	818.3 <sup>***</sup> -287.2	808.6 <sup>***</sup> -287
Military (SE)	454.5 -5,183.20	147.8 -5,183.70	537.2 -5,182.70	569.2 -5,178.10	-3685.3 -5444.7	-4253.3 -5449.8	-3634.4 -5444.6	-3698.4 -5436.6	-9,067.80 -6,047.10	-9,403.50 -6,046.70	-8,979.70 -6,046.40	-9,076.70 -6,042.50
Current Smoker (SE)	-12,700.9 <sup>***</sup> -1,967.00	-12,786.2 <sup>***</sup> -1,966.80	-9,741.8 <sup>***</sup> -2,782.40	-6,690.3 <sup>**</sup> -2,786.20	-13,314.1 <sup>***</sup> -2086.1	-13,391.9 <sup>***</sup> -2085.7	-10,820.5 <sup>***</sup> -2937.5	-6,260.3 <sup>**</sup> -2845	-16,352.6 <sup>***</sup> -2,375.00	-16,472.3 <sup>***</sup> -2,374.70	-13,014.3 <sup>***</sup> -3,260.30	-10,680.2 <sup>***</sup> -3,183.60
Recidivating Quitter (SE)	-6,643.6 <sup>***</sup> -2,288.10	-8,469.3 <sup>***</sup> -2,469.30	-4,236.00 -2,792.60	-4,838.4 <sup>**</sup> -2,361.50	-6,261.0 <sup>***</sup> -2261.5	-8,316.2 <sup>***</sup> -2475.1	-4205.8 -2831.8	-4,560.9 <sup>**</sup> -2305.9	-6,472.1 <sup>***</sup> -2,292.60	-9,353.3 <sup>***</sup> -2,671.70	-3,658.40 -2,966.40	-4,806.2 <sup>**</sup> -2,374.10
Permanent Quitter (SE)	-2,774.00 -2,007.30	-5,953.9 <sup>**</sup> -2,579.20	-86.3 -2,687.70	-647.4 -2,123.50	-3024.7 -2211.3	-6,272.0 <sup>**</sup> -2724.3	-794.1 -2883.1	-137.4 -2346.1	-2,784.50 -2,604.50	-6,805.3 <sup>**</sup> -3,232.80	219.3 -3,289.70	-117.7 -2,787.20
Cessation Duration (SE)		4.3 <sup>**</sup> -2.2				3.8 <sup>**</sup> -1.9				4.5 <sup>**</sup> -2.1		
Age Became Smoker (SE)			-198.6 -132.1				-167.3 -138.8				-226.3 -151.4	
Maximum Intensity (SE)				-281.6 <sup>***</sup> -92.5				-339.3 <sup>***</sup> -93.2				-272.7 <sup>***</sup> -102
Constant (SE)	-34,664.8 <sup>***</sup> -7,319.50	-33,272.0 <sup>***</sup> -7,351.30	-34,855.2 <sup>***</sup> -7,319.50	-32,894.6 <sup>***</sup> -7,335.20	-29,984.0 <sup>***</sup> -7673.4	-28,870.3 <sup>***</sup> -7689.9	-30,201.9 <sup>***</sup> -7675.1	-27,214.7 <sup>***</sup> -7699.6	-36,927.2 <sup>***</sup> -8,518.30	-35,284.0 <sup>***</sup> -8,550.70	-37,215.1 <sup>***</sup> -8,519.20	-34,622.9 <sup>***</sup> -8,555.50
N	4098	4098	4098	4098	4098	4098	4098	4098	4098	4098	4098	4098
R2	0.231	0.232	0.232	0.233	0.232	0.233	0.232	0.235	0.241	0.242	0.241	0.242

Notes: Smoker type (*Current Smoker*, *Recidivating Quitter*, *Permanent Quitter*) represents smoking status in the given year, and the effect of being a certain type of smoker is measured against being a *Never Smoker*. Cessation duration is measured as the number of weeks since the respondent last smoked daily, reported retrospectively from the given year. Maximum intensity is measured as number of cigarettes smoked daily at peak intensity, reported on or before the given year.

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

**TABLE A2**  
**LOGIT ESTIMATES OF THE EFFECT OF SMOKING ON SURPASSING INCOME THRESHOLDS**  
**IN 2008, 2010, AND 2012**

	Income Threshold 2008				Income Threshold 2010				Income Threshold 2012			
	>100k	>50k	>10k	>0	>100k	>50k	>10k	>0	>100k	>50k	>10k	>0
Female (SE)	-1.61*** -0.15	-1.41*** -0.08	-0.74*** -0.08	-0.50*** -0.09	-1.64*** -0.14	-1.32*** -0.08	-0.66*** -0.08	-0.61*** -0.09	-1.56*** -0.13	-1.33*** -0.08	-0.77*** -0.08	-0.60*** -0.08
Hispanic (SE)	0.11 -0.21	0.06 -0.12	-0.20* -0.12	-0.24* -0.13	0.07 -0.2	0.11 -0.12	0.01 -0.12	-0.13 -0.13	-0.03 -0.19	0.14 -0.12	-0.06 -0.12	-0.13 -0.12
Black (SE)	-0.97*** -0.23	-0.35*** -0.1	-0.35*** -0.09	-0.29*** -0.11	-0.82*** -0.2	-0.27*** -0.1	-0.45*** -0.09	-0.41*** -0.1	-0.67*** -0.18	-0.35*** -0.1	-0.46*** -0.09	-0.49*** -0.1
Age (SE)	-0.02 -0.03	0.01 -0.02	-0.01 -0.02	-0.01 -0.02	-0.04 -0.03	-0.01 -0.02	-0.02 -0.02	-0.03* -0.02	-0.03 -0.03	-0.02 -0.02	-0.02 -0.02	-0.03* -0.02
Education (SE)	0.35*** -0.03	0.33*** -0.02	0.20*** -0.02	0.19*** -0.02	0.38*** -0.03	0.34*** -0.02	0.19*** -0.02	0.21*** -0.02	0.39*** -0.03	0.32*** -0.02	0.22*** -0.02	0.20*** -0.02
Mother Education (SE)	0.03 -0.03	0.03 -0.02	0.01 -0.02	0.03 -0.02	0.06* -0.03	0.02 -0.02	0.02 -0.02	0.02 -0.02	0.02 -0.03	0.03** -0.02	0.02 -0.02	0.02 -0.02
Father Education (SE)	0.04* -0.02	0.02 -0.01	-0.001 -0.01	-0.01 -0.02	0.02 -0.02	0.02 -0.01	0.003 -0.01	0.01 -0.01	0.06*** -0.02	0.02 -0.01	0.005 -0.01	0.02* -0.01
Military (SE)	0.15 -0.46	0.15 -0.25	0.34 -0.33	0.39 -0.38	-0.28 -0.5	-0.08 -0.26	0.11 -0.29	0.24 -0.34	-0.24 -0.46	0 -0.26	-0.14 -0.27	-0.19 -0.28
Current Smoker (SE)	-1.43*** -0.34	-0.61*** -0.12	-0.51*** -0.1	-0.53*** -0.12	-1.03*** -0.28	-0.61*** -0.12	-0.51*** -0.1	-0.53*** -0.11	-1.10*** -0.28	-0.85*** -0.12	-0.65*** -0.1	-0.69*** -0.11
Recidivating Quitter (SE)	-0.31 -0.23	-0.07 -0.12	-0.42*** -0.12	-0.37*** -0.14	-0.29 -0.2	-0.06 -0.11	-0.35*** -0.11	-0.43*** -0.13	-0.13 -0.16	-0.05 -0.1	-0.37*** -0.1	-0.35*** -0.11
Permanent Quitter (SE)	-0.21 -0.18	0.04 -0.11	-0.19* -0.11	-0.26** -0.13	-0.06 -0.18	0.02 -0.11	-0.21* -0.11	-0.32** -0.13	-0.02 -0.19	-0.05 -0.12	-0.05 -0.12	-0.15 -0.13
Constant (SE)	-7.32*** -0.7	-5.15*** -0.41	-0.56 -0.41	-0.19 -0.47	-7.34*** -0.67	-4.87*** -0.4	-0.66* -0.4	-0.11 -0.45	-7.44*** -0.64	-4.46*** -0.4	-0.98** -0.4	-0.51 -0.43
<i>N</i>	4098	4098	4098	4098	4098	4098	4098	4098	4098	4098	4098	4098
<i>Log Likelihood</i>	-797.2	-2070.9	-2011.0	-1632.4	-880.6	-2112.7	-2121.9	-1763.2	-959.6	-2134.4	-2145.4	-1902.9
<i>Akaike Info Criterion</i>	1618.3	4165.8	4046.1	3288.8	1785.2	4249.5	4268.0	3550.5	1943.3	4292.9	4314.7	3829.9

Notes: Income thresholds are measured in thousands of dollars. Smoker type (*Current Smoker*, *Recidivating Quitter*, *Permanent Quitter*) represents smoking status in the given year, and the effect of being a certain type of smoker is measured against being a *Never Smoker*. Cessation duration is measured as the number of weeks since the respondent last smoked daily, reported retrospectively from the given year. Maximum intensity is measured as number of cigarettes smoked daily at peak intensity, reported on or before the given year.

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

**TABLE A3**  
**OLS ESTIMATES OF THE EFFECT OF FUTURE SMOKING ON INCOME IN 1984, 1992, 1994, AND 1998**

	Early Career				Mid Career											
	Income 1984				Income 1992				Income 1994				Income 1998			
	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
Female	-2,755.0***	-2,758.1***	-2,759.6***	-2,768.5***	-10,151.5***	-10,162.1***	-10,146.2***	-10,194.6***	-12,180.4***	-12,189.5***	-12,155.2***	-12,200.8***	-17,603.8***	-17,613.0***	-17,599.6***	-17,691.8***
(SE)	-209.3	-209.2	-209.3	-209.5	-482.8	-482.1	-482.9	-483.1	-524.5	-524	-524.5	-524.8	-735	-734.6	-734.8	-734.9
Hispanic	0.4	-18.8	16.5	-56.4	-145.8	-211.4	-161.9	-326.5	-42.1	-98.5	-57.7	-208.4	-159.1	-220.8	-197	-531.7
(SE)	-320.8	-320.7	-320.7	-322.8	-739.9	-739	-740	-744.3	-803.7	-803.2	-803.8	-808.7	-1,126.10	-1,125.90	-1,126.10	-1,132.50
Black	-2,235.1***	-2,217.9***	-2,228.3***	-2,278.8***	-4,493.7***	-4,435.0***	-4,501.5***	-4,607.9***	-4,801.9***	-4,751.4***	-4,809.5***	-4,907.8***	-6,303.3***	-6,248.2***	-6,321.6***	-6,538.8***
(SE)	-258.3	-258.2	-258.2	-259.3	-593.7	-593.1	-593.8	-597.9	-647.1	-646.8	-647.2	-649.5	-906.8	-906.7	-906.7	-909.6
Age	1,124.6***	1,118.9***	1,122.4***	1,125.1***	372.8***	353.6***	375.3***	374.3***	507.3***	491.2***	510.1***	508.2***	478.3***	460.2***	484.1***	481.5***
(SE)	-48.8	-48.8	-48.7	-48.8	-107.8	-107.8	-107.9	-107.8	-117.1	-117.2	-117.2	-117.1	-164.2	-164.3	-164.2	-164
Education	-53.3	-62.4	-54.5	-51.9	1,590.4***	1,559.5***	1,591.8***	1,563.0***	1,892.1***	1,885.5***	1,893.4***	1,886.9***	2,385.2***	2,356.1***	2,388.5***	2,328.6***
(SE)	-46	-46.1	-46	-46.3	-106.1	-106.3	-106.1	-106.9	-115.3	-115.6	-115.3	-116.1	-161.6	-162	-161.5	-162.6
Mother Education	221.7***	219.7***	223.5***	220.1***	247.9***	241.1***	246.1***	242.9***	257.0***	251.2***	255.2***	252.4***	291.1***	284.8***	286.9***	283.9***
(SE)	-48.3	-48.3	-48.3	-48.3	-106.8	-106.7	-106.8	-106.8	-116	-116	-116.1	-116	-162.6	-162.6	-162.6	-162.3
Father Education	29.2	30.1	27.8	29.1	243.4***	246.4***	245.2***	243.2***	276.2***	278.6***	277.8***	275.8***	308.6***	301.2***	302.5***	301.9***
(SE)	-35.9	-35.9	-35.9	-35.9	-82.9	-82.8	-82.9	-82.9	-90.1	-90	-90.1	-90	-126.2	-126.1	-126.2	-126.1
Military	-3,347.1***	-3,396.2***	-3,363.6***	-3,347.8***	-4,196.9***	-4,264.9***	-4,176.7***	-4,199.0***	-3,654.4***	-3,799.0***	-3,636.7***	-3,656.3***	-3,343.70	-3,301.70	-3,311.00	-3,147.90
(SE)	-756.8	-756.6	-756.5	-756.7	-1,745.60	-1,743.60	-1,745.60	-1,744.80	-1,896.10	-1,895.10	-1,896.20	-1,895.60	-2,657.00	-2,656.60	-2,656.50	-2,654.50
Current Smoker 2012	-1,098.1***	-1,083.6***	-1,068.8***	-654.7*	-4,416.4***	-4,476.5***	-3,720.0***	-3,335.9***	-4,734.6***	-4,786.2***	-4,048.8***	-3,508.9***	-6,323.3***	-6,581.6***	-4,908.4***	-3,823.6***
(SE)	-297.2	-297.1	-297.9	-398.7	-689.6	-684.7	-641.2	-619.3	-744.7	-744.2	-622.40	-596.7	-1,043.50	-1,043.30	-1,432.40	-1,398.80
Reactivating Quitter 2012	-596.9**	-1,018.5***	-1,103.2***	-476.1	-1,777.6***	-2,219.9***	-1,197.50	-1,392.7**	-2,351.8***	-3,592.8***	-1,788.7*	-1,997.3***	-3,849.5***	-5,205.8***	-2,485.0*	-1,056.6***
(SE)	-266.9	-334.3	-371.1	-297.3	-661.8	-770.4	-856.4	-685.5	-718.9	-837.3	-830.3	-746.8	-1,097.50	-1,173.80	-1,383.50	-1,043.00
Permanent Quitter 2012	-83.2	-671.6*	-623.8	110.2	-1,018.20	-3,031.0***	-398.8	-802.1	-1,739.6***	-3,511.5***	-1,178.50	-1,212.70	-2,787.5**	-4,600.3***	-1,250.80	-1,437.30
(SE)	-326	-404.5	-411.6	-349	-751.8	-932.2	-648.7	-804.8	-816.7	-1,013.20	-1,031.70	-874.4	-1,344.40	-1,420.30	-1,445.30	-1,224.50
Cessation Duration 2012		0.7**				2.2***				1.9**				2.1**		
(SE)		-0.3				-0.6				-0.7				-0.9		
Age Became Smoker 2012			40.3**				-46.7				-45.3				-109.3*	
(SE)			-18.9				-43.7				-47.5				-66.5	
Maximum Intensity 2012				-19.8				-43.0**				-58.0*				-129.9***
(SE)				-12.8				-28.5				-32				-44.8
Constant	-12,501.0***	-12,200.6***	-12,448.2***	-12,333.9***	-10,470.2***	-9,647.7***	-10,529.6***	-8,937.9***	-10,124.7***	-9,416.9***	-10,182.3***	-9,634.9***	-10,228.3***	-9,454.8***	-10,368.6***	-9,138.9***
(SE)	-1,066.30	-1,049.90	-1,065.90	-1,071.30	-2,458.90	-2,465.60	-2,459.50	-2,470.40	-2,671.00	-2,679.90	-2,671.70	-2,683.90	-3,342.80	-3,356.70	-3,342.90	-3,358.50
N	4098	4098	4098	4098	4098	4098	4098	4098	4098	4098	4098	4098	4098	4098	4098	4098
R2	0.18	0.181	0.181	0.181	0.214	0.217	0.214	0.215	0.238	0.239	0.238	0.238	0.234	0.235	0.235	0.236

Notes: Smoker type (Current Smoker, Reactivating Quitter, Permanent Quitter) represents smoking status in 2012, and the effect of being a certain type of smoker is measured against being a Never Smoker. Cessation duration is measured as the number of weeks since the respondent last smoked daily, reported retrospectively from 2012. Maximum intensity is measured as number of cigarettes smoked daily at peak intensity, reported on or before 2012.  
 \*p<0.1, \*\*p<0.05, \*\*\*p<0.01

## APPENDIX B TAXATION AND SMOKING BEHAVIOR

**TABLE B1**  
**OLS ESTIMATES OF THE EFFECT OF STATE TOBACCO TAXATION ON  
CESSATION RATES**

	Percent Change in Number of Smokers 1984-2008	
	i	ii
Nominal Tax Change (cents)	-0.112 <sup>***</sup>	
(SE)	-0.041	
Percent Tax Change		-0.017 <sup>***</sup>
(SE)		-0.005
Constant	-24.209 <sup>***</sup>	-22.555 <sup>***</sup>
(SE)	-5.752	-5.363
<i>N</i>	46	46
<i>R</i> <sup>2</sup>	0.147	0.223

Notes: The dependent variable here is the percent change in the number of smokers within each state in the sample between 1984 and 2008. Nominal tax change is measured in cents (\$0.01) and represents the nominal change in state tobacco tax during this period. Percent tax change represents the percent change in state tobacco tax during this period.

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

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