EMPLOYMENT FLUCTUATIONS AND TOBACCO: HOW CHANGING EMPLOYMENT CONDITIONS IMPACT SMOKING BEHAVIOR AND CIGARETTE TAX POLICY

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A dissertation submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Public Policy.

Chapel Hill
2013

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ABSTRACT

SHELLEY D. GOLDEN: Employment fluctuations and tobacco: How changing employment conditions impact smoking behavior and cigarette tax policy
(Under the direction of Krista M. Perreira)

In the last 35 years, the United States has experienced periods of extraordinary job growth, as well as four economic recessions, one of which was the longest downturn since the Great Depression. Although cyclical variation triggers questions about economic and housing stability, changing labor market conditions may also impact population health through financial and psychosocial mechanisms. This dissertation assesses the impact of both aggregate and individual level employment conditions on smoking, the leading preventable cause of death in this country. Understanding relationships between employment and smoking can help policymakers and health professionals design targeted health promotion programs, enhance tobacco control policies, and plan for future healthcare needs.

In the first essay, I use nationally representative data to examine the influence of state labor market conditions on smoking behaviors, finding that smoking probabilities decline as state unemployment rates rise, but only in relatively strong economies. In the second essay, I assess how individual employment changes impact smoking status and intensity. Analyses of repeated observations of individuals over time suggest that people smoke more when they are unemployed than when they are working, but smoke less when they are out of the labor market altogether. In the third essay, I use thirty years of data from all 50 states to explore predictors of higher state cigarette tax rates, which are

associated with lower smoking prevalence. My results demonstrate little support for claims that high state unemployment rates drive higher cigarette tax rates.

As the economy continues to recover from recent downturns, the results presented here illustrate several opportunities to enhance progress toward national smoking-related goals. In these analyses, economic growth and employment are associated with greater smoking risks, underscoring the need for continued workplace programs and policies that discourage or prohibit smoking. Looking for work also appears to be a smoking risk factor; pairing smoking prevention resources with unemployment assistance programs could help ameliorate this risk. Finally, while economic and employment conditions are not key predictors of cigarette excise taxes in my analyses, other political or regional factors may create policy windows that advocates can leverage to foster tobacco control policy.

To my children, Maya and Cian Bodenheimer,

and their peers around the world,

in hope that our efforts today are used to build a healthier, happier tomorrow

ACKNOWLEDGEMENTS

This dissertation, like most research done in public policy, would not have been possible without the willingness of members of the public to respond to government and institutional surveys. These participants will never be known to me, but I am grateful for the time they dedicate to building the foundations of our public knowledge.

Many individuals were instrumental in guiding my doctoral studies and dissertation research. As my primary policy mentor and dissertation committee chair, Krista Perreira was equal parts cheerleader and constructive critic, and she is responsible for much of my growth as a researcher. Christine Durrance has been a steadfast supporter and sounding board, whose willingness to discuss everything from null results to childcare kept me afloat through some difficult moments. Other dissertation committee members gifted me with necessary tools, including: the omitted variable bias formula drilled into me by Ashu Handa; crash courses on the PSID and spatial regression from Kyle Crowder; and orientation to the world of tobacco control from Kurt Ribisl. I would also like to acknowledge the Royster Society of Fellows, for providing financial support throughout my training and exposing me to scholars from diverse disciplines.

I was privileged to share the challenges and joys of doctoral training with Kevin Bastian, Shanyce Campbell, Jade Marcus Jenkins and Rod Rose. Their willingness to study, laugh and celebrate with me, despite our disciplinary differences (i.e., my limited knowledge of education policy!), kept me from descending into the isolation that characterizes many higher education experiences. In addition to my cohort, I am

particularly grateful to Jessica Pearlman and Liana Richardson for discussing the intersections of health and society, offering feedback, forcing me to be productive, and answering detailed statistical questions (occasionally with the help of a cocktail napkin!).

I would not be where I am today without the students, staff and faculty of the Health Behavior Department, who gave me a space to park my backpack, opportunities to teach and learn, and a place to call home. Special thanks go to Jo Anne Earp, who always made time to talk, edit, and support me, despite her own crazy schedule – I hope I can one day mentor others with the kind of dedication she has given me.

I count myself lucky to be surrounded by women who are successfully balancing academic careers and family life – thank you to Audrey Pettifor, Clare Barrington, Nina Yamanis and Beth Moracco for being role models and compatriots in that endeavor. In addition, I am indebted to a number of people for keeping me grounded in the "real world" when graduate school threatened to consume me: Chimi Boyd and Frederick Isasi, whose commitments to social justice inspire me every day; Claire Cusick, who fed me chocolate, and Ashley Henderson, who woke up before dawn to help me burn it off; Susan Jackson and Debbie Grammar, who made sure I celebrated the Super Bowl, Valentine's Day and other "big" events; and Cindy Soloe and Heather Altman, for embodying every possible form of social support during out 16 year friendship. Thanks also to the staff and volunteers of the Orange County Rape Crisis Center and Frank Porter Graham Elementary school, for their daily efforts, and for affording me opportunities to contribute meaningfully to my community.

For my crafty, food loving, planning-obsessed "sisters" Suzanne Dolina and Wendy Sarratt, a simple "thank you" is not enough. Whether babysitting my children, co-

hosting dinner events, holding me accountable to my goals, or getting me out of town (with supplies to clothe and feed my family), they went far beyond the call of friendship.

To Sylvia and Boyce Bodenheimer, I owe a debt of gratitude, not only for raising a warm and caring son, and driving down whenever we needed help, but also for enhancing my understanding of the rewards and stresses of hard work. My ideas on the relationships between employment and health are more sophisticated thanks to them. I am thankful to my own parents, Kendra and Jim Golden, for instilling in me an appreciation for difference and a sense of responsibility to the collective, values that led me to both public health and public policy. They are also responsible, whether through nature or nurture, for any analytic, organizational or writing talents I may possess. Even now, when age, education, employment, marriage and a mortgage have theoretically conferred independence on me, they continue to selflessly offer their emotional support, time, and sweat equity to keep my household afloat, and I cannot thank them enough.

Last, but not least, I want to thank the people who lived with me through this process. When I was overwhelmed at work – and had no good answer to their questions about why I spent so much time with my computer – my children responded by drawing me robots, making up songs, chattering in Spanish, inviting me to the park, and otherwise reminding me to smile and enjoy the moment. My husband Tom took on extra parenting duties, bit his tongue when I agreed to new volunteer roles, lent his programming skills to the data gathering and analysis, and proofread the final dissertation. Most importantly, he was my unwavering champion, even when my studies interfered with his job or our family life. At least half of this degree really belongs to him.

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CHAPTER 1: EXECUTIVE SUMMARY

Conventional and political wisdom suggests that poor economies marked by high rates of unemployment are undesirable. During bad economic times, individuals are less satisfied with their lives and experience higher stress levels (Catalano & Dooley, 1979; Fenwick & Tausig, 1994; Hibbing & Alford, 1981). One concern for the public and policymakers is the potential impact of economic downturns on health. Recessions are usually associated with rising rates of unemployment, and a significant body of individual level research suggests that losing work and being unemployed is bad for your mental and physical health (Bartley, 1994; Catalano et al., 2011; Dooley, Fielding, & Levi, 1996; Jahoda, 1982). In contrast, recent aggregate-level research finds that when the economy worsens, overall population health improves. During economic downturns, mortality rates and incidence of certain diseases decline (Laporte, 2004; Neumayer, 2004; Ruhm, 2000; Ruhm, 2003; Ruhm, 2007; Svensson & Kruger, 2012).

Rapid modifications to health behaviors that are triggered by lost work and poor economic climates may account for some observed changes in mortality and morbidity, and serve as early indicators of future health needs. Smoking, a leading cause of preventable death, increases for individuals during unemployment, but declines for populations, on average, during recessions (Falba, Teng, Sindelar, & Gallo, 2005; Prochaska, Shi, & Rogers, 2013; Ruhm, 2005; Weden, Astone, & Bishai, 2006). The mechanisms through which smoking behaviors are modified, and the populations most impacted, however, remain understudied.

In this dissertation, I assess the impact of both aggregate and individual level employment conditions on smoking, incorporating key financial, psychosocial, demographic and political considerations in my analyses. In the first essay, I use nationally representative data to examine the influence of state unemployment rates on smoking behaviors, and investigate whether income, tobacco taxes or emotional distress mediate those relationships. In the second essay, I assess how individual movement in and out of work impacts smoking status and intensity. In the third essay, I use thirty years of annual data from all 50 states to explore whether state economic conditions, as well as key political and regional characteristics explain variation in state cigarette excise tax levels.

As the economy continues to recover from recent downturns, the results presented here illustrate several opportunities to enhance progress toward national smoking-related goals. Some of the research indicates that economic growth and employment may heighten smoking risks, underscoring the need for continued workplace health promotion programs, and workplace policies that limit or prohibit smoking on the job. Looking for work also appears to be a smoking risk factor; pairing smoking prevention resources with unemployment assistance programs could help ameliorate this risk. Finally, while economic and employment conditions are not key predictors of cigarette excise taxes in my analyses, other political or regional factors may create policy windows that advocates can leverage to foster effective tobacco control policy.

I. Essay One

Previous research on the impact of labor market cycles on smoking suggests that when state unemployment rates rise, smoking rates fall. These studies, however, assume

the impact of a change in employment conditions on smoking is consistent, regardless of the strength of the economy in which the change occurs. In this essay, I match state unemployment data from 1996-2010, when the country experienced periods of both strong growth and severe recession, with reports of smoking behavior from participants in the Behavioral Risk Factor Surveillance System during the same period. Regression analyses confirm previously established procyclical smoking patterns, but also indicate that these relationships are attenuated in poor labor markets. Whereas a one percentage point increase in a relatively low rate of unemployment is associated with a 0.12 percentage point drop in smoking prevalence, a similar labor market shift when unemployment is already high produces only a statistically insignificant 0.03 percentage point drop in prevalence. Further analyses suggest that this attenuation may be due to a curvilinear relationship between unemployment rates and emotional distress, in which unemployment rates and emotional distress are negatively correlated in strong economies, but positively correlated in weak ones. If the economy continues to recover, additional programs may be needed to ensure that growth does not unintentionally inhibit progress toward national smoking goals. In particular, health officials should consider working with new and growing industries to institute tobacco prevention measures in workplaces.

II. Essay Two

The volatile economic conditions of the last two decades have resulted in high rates of both job loss and hiring, with additional movement in and out of the labor market altogether. For individuals, changing employment status could result in financial and psychosocial shocks that impact health. Demonstrating a causal relationship between

employment changes and health, however, is difficult because effective analysis must account for the possibility that less healthy people may be more likely to be unemployed, and the fact that most prevalent health problems generally arise following a build-up of risk factors and behavior over an extended time period. In this essay I use individual fixed effects methods with six waves of nationally representative data to analyze changes in smoking, a rapidly modifiable health risk factor, following employment transitions. I find that when individuals stop working, their smoking behaviors change; how they change, however, depends on whether former workers leave the labor market altogether. People are more likely to smoke when they are actively searching for work than when they are working, but when they leave work to instead retire, go to school, or otherwise exit the labor market, their smoking behaviors decline. Although recent experiences with involuntary or any job loss does not appear to strengthen the impact of employment changes on smokers, current workers who experienced such losses smoke more often than their more continuously employed peers. My analyses indicate no differences in smoking reactions to employment changes based on gender or household income level. Higher levels of household wealth, however, attenuate the smoking declines that otherwise follow labor market departure. These results suggest that smoking prevention programs should target both the newly employed and the unemployed, by enhancing workplace policies, community-based campaigns, and unemployment assistance programs.

III. Essay Three

Cigarette excise taxes are considered one of the most effective strategies for reducing cigarette use because they are associated with decreased consumption and are

sometimes used to fund tobacco control programs. Little is known about what motivates changes in state cigarette excise tax levels. Tobacco control professionals have suggested that economic contractions may drive states to raise cigarette taxes to generate revenue, but political scientists argue that economic characteristics are only one of several factors that drive tobacco policy innovation. Political factors, like legislative control, election cycles, and public opinions about potential or related policies, as well as pressures from neighboring states, may also be important policy predictors. Using thirty years of annual data from all 50 states, I explore the magnitude and strength of the associations between key economic, political, and regional characteristics and state cigarette excise tax levels.

Between 1981 and 2011, average nominal rates of cigarette excise taxes increased from $0.13 to $1.38, an increase nearly six times the rate of inflation. While taxes are generally higher when state unemployment is high, this relationship appears confounded by other factors. Once politics, attitudes and regional variation are considered in multivariate regression models, any relationship between state unemployment rates and cigarette taxes disappears. Instead, higher cigarette taxes in neighboring states and concerns about high federal income tax rates are each correlated with higher referent state rates, whereas a history of tobacco growing and Republican party control are negatively associated with cigarette tax rate growth. Tobacco control advocates could consider targeting cigarette tax initiatives in states that border others where excise taxes have recently increased and distinguishing cigarette taxes from other taxes in their campaigns.

CHAPTER 2: EXAMINING AND EXPLAINING THE INFLUENCE OF EMPLOYMENT CONDITIONS ON SMOKING

I. Introduction

Between 1996 and 2010, the United States experienced periods of extraordinary job growth, as well as two economic recessions, one of which was the longest downturn since the Great Depression. According to data from the Bureau of Labor Statistics (BLS), national unemployment rates during this period fluctuated from a low of 3.8% in April of 2000 to a high of 10.0% in October of 2009.[1] Although cyclical variation often triggers questions about economic and housing stability, previous research suggests that changing labor market conditions may also impact population health. Understanding the impact of strong and weak employment conditions on health can help policymakers plan for future health and healthcare needs. Furthermore, identifying the mechanisms that tie labor markets to health, and the populations most impacted by these relationships, is necessary to better inform and target health promotion programs.

Counter to conventional wisdom, previous research finds that when labor market conditions worsen, overall mortality rates and the prevalence of many diseases actually decline (Laporte, 2004; Neumayer, 2004; Ruhm, 2000; Ruhm, 2003; Ruhm, 2007; Svensson & Kruger, 2012). Such "procyclical" patterns, however, are not found for diseases like cancer, perhaps because cancer diagnoses and deaths typically occur following years of exposure to risk factors. It may therefore be difficult to ascertain

[1] Data retrieved from online Labor Force Statistics produced by BLS from the Current Population Survey. Monthly unemployment data are available at: http://www.bls.gov/data/#unemployment.

impacts from short-term employment shocks on cancer and other diseases that unfold over time. Yet cancer is one of the leading causes of death in the United States (Hoyert & Jiaquan, 2012), and both cancer incidence and costs are projected to increase over the next several decades (Mariotto, Yabroff, Shao, Feuer, & Brown, 2011; B. D. Smith, Smith, Hurria, Hortobagyi, & Buchholz, 2009).

Cancer risk factors, such as smoking, can serve as better indicators of how economic declines may ultimately impact morbidity and mortality because they are more rapidly modifiable in the face of changing economic conditions. In addition to cancer, smoking is associated with heart disease, stroke, chronic pulmonary disease, and other health problems, and is considered the leading preventable cause of mortality in the United States (Adhikari, Kahende, Malarcher, Pechacek, & Tong, 2008; Mokdad, Marks, Stroup, & Gerberding, 2004). Smoking-related mortality risks accumulate over time and are correlated with total exposure (Peto et al., 2000; US Department of Health and Human Services [HHS], 2004), suggesting that modifications to both smoking status and amount smoked can have broad health implications. Currently, about 20% of adults smoke in the United States, a prevalence rate that remains above the 12% goal of Healthy People 2020 (HHS, Healthy People 2020, 2012).

Aggregate-level research has examined the impact of changing labor market conditions specifically on smoking, finding that as the economy worsens, smoking rates, like general mortality, decline, particularly among heavy smokers (Charles & DeCicca, 2008; Okechukwu, Bacic, Cheng, & Catalano, 2012; Ruhm, 2005). This research, however, is limited in several ways. Most analyses assume the impact of a change to employment conditions on smoking is consistent, regardless of the strength of the

economy in which a change occurs. Yet an uptick in unemployment rates during a healthy economy could impact different parts of the labor market, or be viewed differently by consumers, than a similar uptick in the midst of a recession. Additionally, the data employed in previous analyses derive from surveys conducted in the 1990s and early 2000s, and therefore fail to include the periods of particularly high unemployment observed recently. While the 2001 recession was relatively minor, the 2007-2009 Great Recession was characterized by the strongest increases in the unemployment rate in the last several decades (BLS, 2010). If non-linear relationships between employment conditions and smoking do exist, data from periods of both economic boom and severe recession are most likely to uncover them. Since high unemployment rates are persisting well beyond the official close of the Great Recession, determining whether previously observed patterns apply during difficult economic times will help the healthcare system anticipate long-term smoking trends.

Furthermore, to effectively craft smoking prevention programs, it is necessary to understand not only the direction of the relationship between economic conditions and smoking, but also the reasons the relationship exists. Although theories about the mechanisms explaining the observed relationships have been offered, they have been limited in scope, and not well-supported in empirical work. For expensive behaviors like smoking, explanations for procyclical effects tend to focus on individual changes in income, hypothesizing that weak economies result in depressed incomes, leaving individuals with fewer resources to purchase tobacco products.

The ability to purchase cigarettes, however, is a function of product price as well as income, and the potential role for prices as a mediator has not been fully explored.

This may be a critical issue to consider currently, since taxes on tobacco products have been levied at increasingly different rates across states in recent years, resulting in substantial state variation in tobacco product prices (Jemel et al., 2008).

Changing economic conditions may produce stress effects in addition to financial effects, and high stress levels are associated with increased smoking rates (Bosma, Peter, Siegrist, & Marmot, 1998; Kubzansky et al., 1997; McEwen, 1998; McKee, Maciejewski, Falba, & Mazure, 2003; Thoits, 1995). Economic contractions could produce higher stress levels, if individuals fear job loss or feel income anxiety, or lower stress levels, if stress produced by long work hours and fast working paces are alleviated (Catalano et al., 2011). No study, however, has analyzed distress or other mental health measures in the context of economic conditions and smoking.

Finally, efforts to ameliorate the impact of changing economic conditions on smoking patterns can be targeted if we improve our understanding of the people whose smoking behavior is most strongly impacted by these conditions. Certain groups, including young adults, men, individuals with less education, and Blacks and Hispanics, face higher risk of unemployment, especially during recessionary periods (Allegretto & Lynch, 2010), and may therefore be particularly susceptible to income, price and stress effects. In addition, previous research suggests that the younger adults, Blacks and Hispanics are particularly sensitive to changes in cigarette price (Farrelly, Bray, Pechacek, & Wollery, 2001).

The pathways linking macroeconomic conditions and health are likely complex (Catalano et al., 2011), and could be influenced by the severity of recent downturns. In this study, I examine the influence of state employment conditions on smoking behavior

between 1996-2010, and test whether the initial employment conditions from which growth or contraction occurs modify observed relationships. In addition to extending previous research through recent economic downturns, I consider the potential impact of income, tobacco taxes and emotional distress in the relationship between employment conditions and smoking, and whether the relationship varies by population group.

II. Background

A. Previous Studies

Previous research about the relationship between macroeconomic conditions and smoking suggests that smoking is pro-cyclical, rising with employment rates. In the most extensive national study to date, using data from the 1987-2000 waves of the Behavioral Risk Factor Surveillance System, Ruhm (2005) found that a one percentage point drop in state employment rates was associated with 0.13 percentage point decrease in smoking prevalence (a 0.6% decline) among current smokers, with the strongest effect among heavy smokers. Additional studies partially confirm these results among specific population groups, using either employment rates, or unemployment rates, as a measure of labor market conditions. Using cross-sectional data from men in the 1997-2001 National Health Interview Surveys, Charles and DeCicca (2008) find procyclical relationships between local area unemployment rates and smoking for most men in their sample. Okechukwu and colleages (2012) demonstrate procyclical impacts on the number of cigarettes smoked, but not smoking status among construction workers who participated in the Tobacco Use supplement to the waves of Current Population Survey (CPS) administered between 1992 and 2007. These results, however, were limited to periods of construction industry decline; the relationship shows evidence of reversing

when the industry performed better than expected.

B. Variation in Effect by Level of Unemployment

Most studies of the effect of labor market conditions on smoking either assume the relationship is linear, such that the influence of a one percentage point change of an unemployment rate is consistent, regardless of whether the change occurs during a period of relatively low unemployment (e.g. from 4% to 5%) or high unemployment (e.g., from 8% to 9%), or report the marginal effect of a one percentage point change at the average level of employment in the sample. In one exception, Okechukwu and colleagues (2012) tested a quadratic association of labor market conditions and smoking of construction workers, finding some evidence for this model, especially for smoking magnitude in general, and smoking status among the employed. No previous work explicitly tests a quadratic relationship between employment conditions and smoking in a national sample of adults.

There are several reasons that higher levels of initial unemployment could alter the impact of a rate change on smoking status. Many people lose work in both strong and poor economies, but they face more barriers to returning to work during recessions. Analyses of recent labor market conditions suggest high unemployment rates during recessions result more from decreases in work opportunities and new hires than from increases in involuntary job losses (deWolf & Klemmer, 2010; Falba et al., 2005). Some evidence suggests that increases in unemployment, especially in the most recent downturn, might produce more emotional distress than similar changes occurring under stronger economies (Ayers et al., 2012). If the prospect of losing work is particularly dire during bad times, triggering stronger stress-related smoking responses, procyclical effects

could be muted. Alternatively, smoking-related policy changes, like increases in tobacco taxes to generate revenue, may only be triggered once labor market conditions deteriorate to extreme levels, suggesting that if purchasing power is a key mechanism, procyclical relationships could strengthen during periods of peak unemployment.

The relative volatility of the U.S. economy during the past two decades provides an opportunity to explore the possibility that the role of the labor market in producing smoking could vary based on the employment circumstances in which changes occur. In the 15 years between 1996 and 2010, the United States experienced both its lowest and highest levels of unemployment in nearly 30 years. Previous examinations of the relationship between employment conditions and smoking rely of reports of behavior prior to 2007. Therefore, they fail to include the relatively high, and sustained, rates of unemployment during what is now called the Great Recession. Moreover, recent economic swings may have more strongly impacted income than previous cycles. According to data from the CPS, the drop in median household income in the year following recession was stronger in the last two recessions (2001 & 2007-2009), than the two preceding recessions (1981-1982 and 1990-1991) (DeNavas-Walt, Proctor, & Smith, 2011). Additionally, variation in cigarette excise taxes grew during this period as well (Orzechowski & Walker, 2011). Any effects from changing purchasing power underlying the relationship between employment conditions and smoking may therefore be easiest to identify using recent data. Similarly, recessions in the last decade also occurred in the context of declining job security and safety nets, and increasing income inequality. Long-term unemployment, in which individuals are unable to find work for at least 27 weeks, reached record highs during the Great Recession (Allegretto & Lynch, 2010). Mental

health effects of labor market conditions might therefore be more identifiable during this period (Ayers et al., 2012).

C. Mechanisms Explaining Procyclical Smoking

Previous studies of procyclical smoking fail to explain why smoking rises as the economy grows, and unemployment rates decline. Three potential mechanisms, in particular, deserve further attention. Hypothesized pathways linking state unemployment conditions with smoking through 1) household income, 2) cigarette tax rates and 3) emotional distress are illustrated in Figure 2.1. The empirical and theoretical rationales for these relationships are described below.

Income as a Mechanism

Recessionary periods have previously been associated with lower average household incomes (Michel, 1991). Relationships between income and smoking, however, are likely complex. As individuals lose income or anticipate income loss, economic theory suggests they decrease their purchase of all normal goods, including cigarettes. Cigarette consumption, however, may be relatively income inelastic, or relatively insensitive to changes in income. A wide variety of income elasticities for cigarettes have been reported in the literature; a meta-analysis summarizing nearly 400 estimates suggests that a one percent loss of income is associated with only a 0.28 percent decrease in cigarette demand in the short run, and a 0.39 percent decrease in cigarette demand in the long run (Gallet & List, 2003). Additionally, individuals might choose to substitute generic cigarette brands or cheaper forms of tobacco, like chewing tobacco or snus, when faced with an income loss, in order to maintain their consumption levels. Although work on cross price-elasticities for tobacco products is limited (van Walbeek,

2010), some research suggests that when cigarette prices increase, individuals switch to cigarettes that are higher in tar and nicotine (Farrelly, Nimsch, Hyland, & Cummings, 2003), but do not substitute snus for cigarettes (Bask & Melkersson, 2003).

Previous research on the role of income in procyclical smoking is mixed. Ruhm (2005) finds little evidence of an impact of income on the relationships between state employment rates and smoking. On the other hand, Xu and colleagues (2010) use local area level unemployment rates as instrumental variables for wages and income, and find that wage and income declines brought about by changes in macroeconomic conditions are associated with decreases in smoking. Their sample, however, is restricted to men with lower levels of education.

Taken together, empirical and theoretical work suggests that poor employment conditions result in lower incomes, which might decrease smoking prevalence, but also may not explain changes in smoking. In Figure 2.1, income is posited as a potential mediator, even though the support for this hypothesis is tenuous.

Tax as a Mechanism

Individual consumption decisions are also impacted by the price of a product. As with changing income, changing cigarette prices impact purchasing power, so that when cigarette prices rise, a consumer can purchase fewer cigarettes for the same price. Additionally, other goods become less expensive relative to cigarettes, so consumers may opt to substitute other goods for cigarettes, if there are comparable goods that can provide them the same perceived benefit. Previous research suggests that a one percent increase in the price of cigarettes is associated with a 0.4 percent decrease in cigarette demand (Gallet & List, 2003), with some evidence that the influence of price may be even

stronger among individuals of low socioeconomic status (Townsend, Roderick, & Cooper, 1994).

One of the key components of increasing cigarette prices is government sponsored taxes on tobacco prices. The market share weighted average price of a pack of cigarettes increased from $3.12 in 2000 to $5.61 in 2011; the percent of that price derived from cigarette excise taxes grew from about 24% to 44% (Orzechowski & Walker, 2011). Tobacco tax increases have been associated with declines in smoking, both among youth (Chaloupka & Wechsler, 1997) and the general population (Chaloupka et al., 2000; Chaloupka, Straif, & Leon, 2011; Levy, Chaloupka, & Gitchell, 2004). Tobacco control advocates have suggested that economic contractions may drive states to raise tobacco taxes to generate revenue, noting spikes in the number of states passing hikes following the national recessions of 1981, 1990 and 2001 (Campaign for Tobacco Free Kids [CTFK], 2012b). State –based cigarette tax response to macroeconomic decline, therefore, provides another theoretical explanation for the procyclical effects of smoking. Although three previous studies include a measure of tobacco prices or taxes in their analyses (Charles & DeCicca, 2008; Okechukwu et al., 2012; Xu & Kaestner, 2010), two only include it as a control variable and report no results specific to it. The authors of the final study urge caution in interpreting the slight positive, rather than negative, correlation between prices and smoking they find, due to the limited time period and price range examined (Okechukwu et al., 2012).

As illustrated in Figure 2.1, I hypothesize that periods of high unemployment result in higher cigarette taxes, which in turn depress cigarette smoking prevalence.

Emotional Distress as a Mechanism

Purchasing power may not be the only pathway linking labor market conditions and smoking. Changing employment conditions could provoke psychosocial responses in the people who experience them, and high stress is positively associated with smoking, increases in smoking levels, and perceived barriers to quitting smoking (Cohen & Lichtenstein, 1990; Morissette, Tull, Gulliver, Kamholz, & Zimering, 2007; Ng & Jeffery, 2003). Whether high unemployment rates are positively or negatively correlated with stress levels, however, is unclear. In addition to providing material benefits, work is a key social institution that facilitates social contacts and provides a sense of personal identification and meaning (Jahoda, 1982). Poor economic conditions may produce stressors in the form of job insecurity or loss, income anxiety and strain on social relationships (Catalano et al., 2011; Zivin, Paczkowski, & Galea, 2011), suggesting high unemployment rates may be associated with higher stress levels. On the other hand, work can be a source of stress, particularly if working environments require long hours and allow little autonomy (Clougherty, Souza, & Cullen, 2010; M. J. Smith, Cohen, Stammerjohn, & Happ, 1981). Strong economies characterized by low unemployment rates may therefore be associated with higher stress levels than depressed economies.

Previous work has not directly examined the role of emotional distress in the relationship between employment conditions and smoking, but several studies have explored related ideas. Ruhm (2005) finds a one hour increase in the average number of hours worked per week is associated with a slight (<1%) rise in smoking, and argues this may reflect higher job-related stress during periods of high employment. On the other hand, Barnes and Smith (2009) recently examined whether increases in an individual's economic insecurity increased the likelihood that men who smoked in 1983 remained

smokers in 1998. Specifically, they find that a 1% increase in the probability of unemployment is associated with a 2.4% increase in the likelihood of continued smoking; a 1% increase in the probability of falling into poverty is associated with a 1.1% increase in the likelihood of continued smoking; and each 10% drop in real income is associated with more than a 17% increase in continued smoking likelihood. In addition, Charles and DeCicca (2008) found that men's mental health generally worsened as local labor markets deteriorated, with effects particularly pronounced among those least likely to be employed. Although this study also considered smoking as an outcome, measures of emotional distress and smoking were not considered in the same model.

Based on this review, I hypothesize that increased stress levels are correlated with higher smoking prevalence, but do not specify the type of correlation between employment conditions and stress levels (Figure 2.1). If strong economies produce high levels of work-related stress, procyclical smoking should be attenuated when measures of stress are included in models. On the other hand, if declining employment conditions produce stress from job insecurity and loss, procyclical smoking should appear stronger when stress levels are controlled in analyses.

D. Differential Impacts on Population Groups

Some groups may be more strongly impacted by changing labor market conditions than others. Job loss produces declines in income and increases in mental distress (Jacobson, LaLonde, & Sullivan, 1993; Paul & Moser, 2009; Ruhm, 1991), suggesting that if procyclical smoking is mediated through these processes, smoking among unemployed individuals could be impacted through both. Similarly, changes in income and mental health brought about by changing employment conditions may have

the least impact on individuals not in the labor force.

Certain population groups are more likely to be unemployed and lose work, especially during recessions. In 2009, for example, the unemployment rate for individuals without a high school degree was more than three times the rate of those who had graduated college, and unemployment among Blacks and Hispanics was nearly twice that among Whites or Asians. Men and younger adults also suffered relatively high rates, compared to women or older adults, respectively (BLS, 2012). Although the tight labor markets of the Great Recession impacted all population groups more strongly than previous recessions, age, race and educational disparities are similar to those from previous recessionary times (Allegretto & Lynch, 2010). With the exceptions of Blacks, whose smoking rates are lower than those of Whites, members of each of these groups are also more likely to smoke than their female, more educated and older peers (Agaku, King, & Dube, 2012). The smoking behavior of each of these groups may therefore be more strongly impacted by changing employment conditions, when compared to the population overall.

Finally, the smoking behavior of some groups may be more sensitive to changes in income or price than others. In particular, previous research suggests that younger adults, men, Blacks and Hispanics are particularly sensitive to changes in cigarette price, and smoking behaviors of younger adults may be especially sensitive to changes in income (Farrelly et al., 2001; Gallet & List, 2003; Townsend et al., 1994).

Previous research on differential smoking responses to changing labor market conditions, however, is inconclusive. Ruhm (2005) finds that smoking patterns do differ by population group, but not always in the expected ways. For example, in his analysis,

although individuals with less education experience stronger smoking responses as employment conditions change, women and Whites are more strongly impacted than men and other racial groups, respectively. In addition, employed individuals experience slightly higher effects than the full population sample. On the other hand, Charles and DeCicca (2008) found that while men most likely to be employed smoke less during poor economic times, those who are least likely to be employed smoke more. Using employment propensity scores, they find that a one percentage point decrease in the employment rate is associated with a 2.3 percent decrease in smoking for individuals in the top decile for employment probability, but a 2.7 percent increase in smoking for individuals in the bottom decile.

E. Contribution

In this study, I use nationally representative data covering recent periods of low and high unemployment to examine the influence of state employment conditions on smoking behavior. Different from previous nationally representative research (Ruhm, 2005), I explicitly test whether the relationship between state unemployment rates and smoking is non-linear in nature. I then investigate the potential impact two unexplored theoretical explanations for procyclical relationships, tobacco taxes and emotional distress, in addition to household income, in those relationships. Finally, I consider whether relationships between employment conditions and smoking vary across key population groups.

III. Methods

A. Data and Sample

Data about smoking behaviors, as well as individual measures of gender, age,

race, ethnicity, and marital status are drawn from the annual iterations of the Behavioral Risk Factor Surveillance System (BRFSS) implemented between 1996-2010 (Centers for Disease Control and Prevention [CDC], 1996-2010). The BRFSS is a state-based system of health surveys that collects regular information about health outcomes and health behaviors, including adult smoking behavior. During the analysis period, all 50 states and the District of Columbia collected smoking information from a sample of their residents. BRFSS data are merged with monthly state level indicators of employment conditions available from the BLS. The BLS Local Area Unemployment Statistics captures key indicators of economic conditions for different geographic areas, including states. BLS data used in this analysis are generated from the Current Population Survey, the Current Employment Statistics program, the State Unemployment Insurance System, and the decennial census, and primarily consist of monthly and annual estimates of unemployment and employment in each state.

Analytic Sample: Between 1996 and 2010, 4,134,163 individuals aged 16 or over who resided in one of the fifty U.S. states or the District of Columbia participated in a BRFSS survey, with annual totals ranging from 121,384 in 1996 to 444,906 in 2010. Of the total participants, smoking information is missing for 16,876 (0.4%), and other covariate information is missing for an additional 90,044 (2.2%). Dropping these cases results in a final analytic sample size of 4,027,243 (97.4% of all participants).[2] In some mediation analyses, sample sizes decrease due to missing information about income group (n=14, <0.01% of full analytic sample) or mental health days (n=125,826, 3.1% of

[2] Although the loss to the analytic sample due to complete case analysis was minor, the dropped participants did differ from those who remained in the sample in several ways. Dropped individuals were less likely to smoke, older, more likely to be non-white, more likely to have either high or low levels of education, less likely to be working, and more likely to live in states with higher levels of unemployment and cigarette taxes during their survey year.

full analytic sample). When sampling weights are employed, the sample is 51% female and 73% White. The majority of sample participants were married, had attended at least some college, and were employed at the time of survey. Detailed demographic characteristics of the analytic sample are presented in Table 2.1.

B. Measures

Outcome variable: The primary outcome variable measures an individual's smoking status as a binary indicator. A BRFSS participant is considered a smoker if he or she answered "yes" to the survey question, "Have you smoked at least 100 cigarettes in your entire life?" and answered, "every day" or "some days" to the question, "Do you now smoke cigarettes every day, some days, or not at all?" In additional analyses, I focus on daily smokers, coding individuals who currently smoke every day as daily smokers.

Explanatory Variables: The primary proposed measure of macroeconomic conditions is the state civilian unemployment rate averaged across the three months[3] preceding the respondent's BRFSS survey date, including the survey month. The unemployment rate measures the percentage of people in the labor force who are unemployed within a specific geographic area. A person is considered unemployed if he or she is not currently working, is available to begin working, and has actively looked for work in the past four weeks. The labor force is made up of individuals age 16 or older who are employed and unemployed. The unemployment rate, however, may provide an underestimate of true demand for work, as it does not capture discouraged workers who leave the labor market due to difficulty finding work. In sensitivity analyses, the average

[3] In choosing three months, I follow Ruhm (2005) in estimating the immediate labor market conditions faced by an individual at time of survey. In addition to capturing impacts of the recent market, this allows for comparison of estimates with Ruhm's work with data from earlier years. In sensitivity tests, I use annual unemployment rates for the 12 months prior to, and including, the survey month.

employment rate, also called the employment to population ratio, for the three months ending with the survey month is substituted for the unemployment rate. The employment rate measures the percent of working aged individuals living in a specific area who are employed. An individual is considered employed if he or she worked for pay or profit in the past week (BLS, 2009a).

Mediating Variables: To consider potential explanations for any demonstrated relationship between economic conditions and smoking, I employ three variables measuring income, cigarette excise taxes and mental health status, respectively. The BRFSS asks participants to indicate their household income, from all sources, using categories of income ranges. The minimum income category is $10,000 or less, and the maximum is $75,000 or more; in between category sizes range from $5,000 at the lower levels (e.g., between $15,000 and $20,000) to $25,000 at higher levels (e.g., between $50,000 and $75,000). The relationship between income and smoking is likely bidirectional, with smokers earning less than non-smokers (Auld, 2005). Individual income may therefore be endogenous, predicted by smoking status, rather than labor market conditions. To address this concern, I follow Ruhm (2005) by assigning each individual the weighted average of the incomes of all individuals living in the same state, of the same gender, age group and education level. Through this process I track changes in income likely brought about by labor market shifts, taking into consideration key demographic categories. Averages are calculated using the midpoint of the income range, adjusted for inflation, and measured in 2010 thousands of dollars.

The cigarette excise tax variable is designed to capture the tax faced by a consumer in a given state at the start of the year of BRFSS response, and is therefore a

combination of the federal excise tax and the state excise tax. Excises taxes are adjusted for inflation using the Consumer Price Index-Urban, produced by the BLS,[4] and measured in 2010 cents per pack of 20 cigarettes. Annual state and federal cigarette excise taxes are available from the 2011 edition of *The Tax Burden on Tobacco*, a publication produced by the economic consulting firm Orzechowski and Walker, with financial support from leading cigarette manufacturers, and cooperation of the tobacco tax administrators in all 50 states and the District of Columbia. During the analysis period, the federal government raised taxes three times, from 0.24 cents to $1.01, and changes in state tobacco tax rates occurred in 123 of the 765 state-year combinations. State taxes ranged from less than three cents per pack in Virginia in 2003 and 2004 to almost $3.50 in 2010 in Rhode Island.

The BRFSS includes two questions which capture numbers of "unhealthy days" the respondent experienced in the past month due to poor physical health or poor mental health. Specifically, the mental health question asks, "Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?" and the physical health question asks, "Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?" (HHS, 2000)**.** When used in combination, a number of studies finding that the healthy days measure had acceptable criterion validity when compared to several other clinical assessment tools, could distinguish groups with various health ailments, and had good test-retest reliability among most populations (Moriarty, Zack, & Kobau, 2003). Although the mental health question has not been individually subjected to a wide range

[4] Current measures of the CPI-U are available at: ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt

of validation tests, researchers often report trends in mental health using responses to only the mental health question (Moriarty et al., 2003; Zahran et al., 2005). Furthermore, previous research indicates that individuals report substantially different numbers of physical and mental unhealthy days (HHS, 2000). Because the theoretical basis for the analyses focuses on changes in emotional state brought about by changing labor market conditions, I measure emotional distress using the single indicator of mentally unhealthy days. As with income, however, the relationship between emotional distress and smoking may be bidirectional, as individuals believe smoking will alleviate anxiety, and some evidence suggests chemical components of cigarettes may alter mood states (Kassel, Stroud, & Paronis, 2003; Morissette et al., 2007). Emotional distress indicators are also missing for nearly 5% of the analytic sample. As with income, I therefore assign each individual the weighted average of the mental unhealthy days of all individuals living in the same state, of the same gender, age group and education level.

Control Variables: To account for sociodemographic factors likely correlated with labor market participation and smoking, I include a dichotomous indicator of female gender, continuous measures of respondent's age (linear and quadratic), as well as binary variables for education level (some high school, high school graduate, some college, college graduate), and marital status categories (married, divorced, widowed, single). In addition, I include four mutually exclusive categories capturing race/ethnicity (Non-Hispanic White, Non-Hispanic Black, Other Non-Hispanic and all Hispanic) based on two BRFSS questions assessing participant race and Hispanic ethnicity.

C. Analytic Approach

All analyses are conducted using probit models on pooled data, employing

techniques to account for clustering of data. Because smoking status is measured dichotomously, the dependent variable may be poorly predicted in linear analysis, which allows predictions of any value. Probit models instead employ the inverse of the cumulative distribution function associated with the standard normal distribution, which ranges from 0 to 1, when modeling the dependent variable. Estimation is done through maximum likelihood, in which those probit model parameters that best predict the existing data are identified. Models include cluster-robust standard errors to account for the possibility that observations collected within a state in a given month are not independent. Specifically, I model smoking probability as a function of state, individual, and time characteristics, according to the following econometric specification:

$$\Pr(S_{ijmy}=1) = \Phi(X_{ijm}\beta + E_{mjy}\,\gamma + \alpha_j + \delta_m + \lambda_y + \varepsilon_{ijmy})$$

where S_{ijm} measures smoking status (any or daily) for individual *i* in state *j* during month *m* in year *y*; X_{ijm} is a vector of individual or family sociodemographic characteristics; E_{mjy} captures state employment conditions; α_j, δ_m, and λ_y represent unobserved determinants of smoking associated with state of residence *j*, calendar month *m*, and survey year *y*, respectively. Labor market conditions vary by geographic area, time of year, and across years (Allegretto & Lynch, 2010; Zolnik, 2011). Although smoking prevalence has decreased over time, these trends include spikes and troughs, and vary regionally (CDC, 2011a). Smoking also fluctuates seasonally, with higher rates in the summer, and lower rates in the winter (Chandra & Chaloupka, 2003). Inclusion of the state, month, and year dummy variables controls for some potential bias in estimates due to correlation of both employment conditions and smoking with space and time. Most dummy variables are statistically significant at the 0.05 level when modeled, and a

Hausman test comparing the coefficients from a model employing all fixed effects with one that employed no fixed effects was significant (χ^2=5673.48, p=0.000), suggesting that the dummy variables inclusion may be required to prevent some omitted variable bias.

To assess the shape of the relationship between employment conditions and smoking, I included a linear and quadratic measure of state unemployment rates in initial models, and examined the statistical significance of the coefficient on the quadratic term with a t-test. Because probits are non-linear models, the coefficient values are not directly interpretable as marginal effects, though the sign of the coefficient is consistent with the direction of variable correlation. To report the impact of changing unemployment rates under different economic conditions, I calculate the weighted average marginal effect (AME) of a one percentage point increase in the state unemployment rate for all sample members, using three different initial unemployment rates. Specifically, I calculate AMEs at the mean level of unemployment (5.6%), at one standard deviation above the mean (7.6%) and at one standard deviation below the mean (3.7%).

Following Baron & Kenny (1986), I assess the potential mediating role of household income, cigarette excise taxes, and emotional distress using two additional models for each mediator. First, I estimate the impact of unemployment rates on the mediating variable using linear regression. Second, I add the mediating variable to the original reduced-form probit equation. To account for possible non-linear associations between mediators and smoking, I considered linear and quadratic forms of each mediating variable, ultimately including quadratic measures of income and emotional distress, as each are statistically significant at the 0.05 level.

Using the any smoking outcome variable, I analyze the unmediated, reduced form

model, as well as the fully mediated, direct effects model, which includes measures of income, taxes and emotional distress, on various sub-groups of the participants. Specifically, I conduct stratified analyses to examine effects within specific gender, race/ethnicity, age, educational level, marital status and labor market participation groups. AMEs are calculated for both low and high unemployment conditions.

In addition to these primary analyses, I consider several other models to ensure that results are not sensitive to the choice of employment condition measure, or the probit estimation technique.

All analyses are conducted using regression techniques and the margins post-estimation command in STATA 12 (Statacorp, College Station, Tex).

IV. Results

A. Trends in Unemployment and Smoking in the Analytic Sample

During nine of the fifteen years between 1996 and 2010, state unemployment rates experienced by BRFSS participants are below 5.5%, but in the three years during and following the two recessionary periods in 2001 and 2007-2009, rates are higher, including average rates above 9% in both 2009 and 2010 (Figure 2.2). Across the entire time period, smoking prevalence among adults in the BRFSS sample declined from 23.4% to 17.3% overall (Figure 2.2). While prevalence rates drop between most years, annual rates of decline were not uniform over the time period, and smoking prevalence increased by half a percent between 2000 and 2001. During and following the more recent recessionary period, however, smoking declines somewhat consistently. Daily smoking prevalence also declined from 19.1% to 12.4% during the same time period, with a similar small prevalence uptick between 2000-2002, and a steady decline between

2007-2010.

B. Unemployment Rates and Smoking Behavior

To assess the impact of short-term unemployment rates on smoking behavior, while accounting for other important covariates, I turn to the results of the probit regression models. Results of these analyses indicate that smoking behaviors are procyclical, but that these relationships attenuate as the economy worsens. The coefficients on the linear unemployment term in both the any smoking and daily smoking models are negative, but the coefficients on the quadratic terms are significant and positive (Table 2.2). Calculations of AMEs indicate that a labor market change at average levels of unemployment, from 5.6% to 6.6%, is associated with a 0.08 percentage point decline in any smoking and a 0.09 percentage point decline in daily smoking. AMEs calculated at one standard deviation above and below the mean unemployment rate reveal the curvilinear nature of the relationship between employment and smoking. A one percentage point increase in unemployment from a starting point of 3.7% is associated with a 0.12 percentage point decline in any smoking and a 0.11 percentage point decline in daily smoking, but a similar increase starting from 7.6% is associated with no statistically significant change in smoking prevalence, and a 0.06 percentage point decline in daily smoking rates (Table 2.2).

C. Income, Taxes and Emotional Distress as Mediators

Tables 2.3 and 2.4 present the unemployment rate coefficients (Table 2.3) and AMEs (Table 2.4) from models used to test mediation of the unemployment rate-smoking relationships by income, taxes or emotional distress. Traditional tests of variable mediation require significant associations between the independent variable and theorized

mediators, and the attenuation of the effects in the unmediated models once the mediating variables are added. For each proposed mediator in Table 2.3, Column 1 presents the coefficients derived from the linear regression of the mediator on unemployment rates; Columns 2 and 4 present the coefficients from the probit models of any and daily smoking that do not include the mediators (the models presented in Table 2.2), and Columns 3 and 5 present the coefficients from the same probit models of any and daily smoking, with the mediator added. Table 2.4 lists the AMEs of a one percentage point increase in unemployment rate on smoking at low, average and high unemployment rate starting points for the unmediated model, models that add each mediator separately, and one model that incorporates all proposed mediators. To illustrate effects, Figure 2.3 provides a graphical depiction of the predicted prevalence of any (Panel A) and daily (Panel B) smoking for both unmediated and mediated models.

Income: As hypothesized, the unemployment rate is negatively associated with income (Table 2.3, Model A1). Specifically, an increase in the unemployment rate from average levels 5.6% to 6.6% is associated with an average decline in income of $4,818. The significant, negative value of the quadratic unemployment term suggests that at higher levels of unemployment the negative correlation strengthens.

Also as hypothesized, income is positively associated with any (b=0.02) and daily (b=0.02) smoking. However, the significant negative signs on the squared income terms suggest these effects diminish at high income levels (Table 2.3, Models A3 & A5). In calculations of AMEs for income (not shown), increases in income are positively associated with any and daily smoking at income levels one standard deviation below the mean, but negatively associated with smoking at average levels of income, or levels one

standard deviation above the mean. Specifically, a $10,000 increase in household income from an initial income of $37,000 is associated with a 0.15 percentage point *increase* in any smoking and a 0.16 percentage point *increase* in daily smoking. The same increase from an initial income of $59,000 is associated with a 0.02 and 0.01 percentage point *decline* in any and daily smoking prevalence; from $71,000 the AMEs are -0.12 for any smoking and -0.11 for daily smoking.[5]

The coefficients on unemployment remain relatively unchanged when comparing the unmediated and income-mediated models (Model A2 vs. Model A3 for any smoking; Model A4 vs. Model A5 for daily smoking). These results are underscored in Figure 2.3 and Table 2.4, in which the predicted probabilities of smoking and the average marginal effects from the unmediated and smoking mediated models are very similar, although income appears to slightly accentuate the relationship between unemployment rates and any smoking, especially at low levels of unemployment, and slightly mediate the relationship with daily smoking at high levels of unemployment, though primary effects remain significant.

Cigarette Excise Taxes: Increasing unemployment rates are correlated with higher cigarette excise taxes, such that a one percentage point increase in unemployment starting from the mean level of 5.6% is associated with a 3.4 cent increase in tax levels (results calculated from coefficients in Table 2.3, Model B1). Although this relationship is curvilinear, with smaller impacts at higher unemployment levels, it remains positive even when unemployment rates reach the highest observed rates in the sample (results not shown), and therefore conforms to the hypothesized relationship. Also as hypothesized,

[5] Reference point income levels were chosen based on the 25%, 50% and 75% levels of the income distribution in the sample population.

both any smoking and daily smoking decline as cigarette taxes rise (Table 2.3, Models B3 & B4). Although the magnitude of the coefficients on the unemployment rate terms do decrease when taxes are added to smoking models, the predicted probabilities of any or daily smoking from the tax mediated models are barely distinguishable from the unmediated models (Figure 2.3). Average marginal effects decline slightly when taxes are added, though remain well within a standard error of the unmediated AMEs (Table 2.4, Models C & H).

Emotional distress: The results presented in Model C1 of Table 2.3 indicate that emotional distress *declines* as unemployment grows at low levels of unemployment. The significant negative sign on the coefficient on the quadratic term, however, predicts that these anti-cyclical impacts on emotional distress would wane and eventually reverse direction during periods of higher unemployment. Based on the coefficients in this model, I calculate that a one percentage point increase in unemployment rates from a low starting point of 3.7% is associated with a 0.02 day *decline* in the average number of reported days in poor mental health, and a similar labor market change under average unemployment conditions (5.6% unemployment) is associated with 0.01 *fewer* poor mental health days. Under high unemployment conditions, however, a one percentage point increase in unemployment from 7.6% to 8.6% is associated with almost a 0.01 day *increase* in poor mental health days.

The complexity of the relationship between unemployment and stress is apparent in the mediation analysis. As hypothesized, emotional distress is positively associated with any smoking, as well as daily smoking (Table 2.3, Models C3 & C5). At lower levels of unemployment, therefore, the positive association between unemployment and

stress works to slightly mediate the relationship between unemployment and smoking. The 0.12 percentage point decrease in the probability of any smoking and the 0.11 percentage point decrease in the probability of daily smoking that is associated with an increase in unemployment from 3.7% to 4.7% drops slightly to 0.11 and 0.10 when emotional distress is included (Table 2.4, Models D & I). At higher levels of unemployment, however, the negative association between unemployment and stress enhances the unemployment-smoking relationship. Whereas a one percentage point increase in unemployment starting at 7.6% results in 0.03 percentage point decline in any smoking, and a 0.06 percentage point decline in daily smoking, these marginal effects increase to 0.05 and 0.08 in the model that includes stress effects. These effects are illustrated in Figure 2.3, in which the predicted prevalence curves in the stress mediated models become steeper than the unmediated model curves as unemployment increases.

When all mediators are included in the models (Table 2.4, Models E & J), AMEs of unemployment are relatively unchanged under strong employment conditions. Specifically, a one percentage point increase in low levels of unemployment is associated with a 0.12 percentage point increase in any smoking and a 0.11 increase in daily smoking. In poor employment conditions, however, a suppression effect is illustrated. A one percentage point increase in unemployment from a high level of 7.6% unemployment is associated with a 0.06 and 0.07 percentage point increase in any or daily smoking probability, respectively when all mediators are included. These AMEs are 0.03 and 0.01 percentage points higher than those derived from the respective unmediated models.

D. Effects on Sub-Populations

Procyclical smoking effects are particularly pronounced for men, Blacks and

Hispanics, and people who were employed at the time they were surveyed (Table 2.5). Even under poor labor market conditions, men's smoking prevalence is predicted to drop by between 0.11-0.12 percentage points when unemployment rises by one percentage point, depending on the inclusion of potential mediators. Under stronger labor market conditions, the marginal effect remains negative, but increases to 0.15-0.17 percentage points. Women's marginal effects, on the other hand, are never larger than 0.10.

During periods of low unemployment, AMEs for Blacks (-0.41) and Hispanics (-0.38) are about three times higher than those of Whites (-0.13). During periods of high unemployment higher effects remain for Blacks (AME=-0.24), but appear diminished for Hispanics (AME=-0.02), and Whites (AME=-0.05). However, relatively large standard errors, perhaps due to smaller Black and Hispanic samples, suggest caution is required when interpreting these results.

Finally, stratified analyses illuminate few differences in the impact of changing employment conditions on smoking by education, age or marital status, although the smoking behavior of participants who are married or who have at least some college education appear slightly more susceptible to increases in unemployment during strong economies, when compared to their unmarried or less educated peers. None of the sub-group analyses provide evidence for mediation of procyclical smoking by income, taxes or emotional distress.

E. Sensitivity Tests

Analyses of both the unmediated and fully mediated models are relatively insensitive to the choice of estimation approach, as probit, logit and linear probability models all produce similar marginal effects, averaged across the population (Table 2.6,

Models1-3). Other measures of employment conditions produce slightly different marginal effects when substituted for the three month unemployment in probit models (Table 2.6, Models 4-5). A one unit change in the three month employment rate produces a slightly smaller change in smoking prevalence than a one unit change in the three month unemployment rate, whereas a shift in the unemployment rate for the 12 months prior to, and including, the survey month produces slight stronger changes in smoking. These effects, however, remain within one standard error of each other.

V. Discussion

Although analyses presented here appear to confirm previously established procyclical smoking patterns, they also suggest such patterns are stronger in strong economies, especially for any smoking. Whereas a one percentage point increase in a relatively low rate of unemployment is associated with a 0.12 percentage point drop in smoking prevalence (a 0.6% drop from the average prevalence rate of 21.1%), a similar labor market shift when unemployment is already high produces no statistically significant change in prevalence. Similar but slightly muted patterns in marginal effects emerge when examining daily smoking. The characteristics of weak economies that might reduce procyclical smoking may operate by changing the patterns of non-daily smokers, rather than those who smoke every day.

Because measures of labor market conditions and smoking outcomes differ across studies, it is difficult to directly compare the results presented here to previous research. In the most similar study, Ruhm (2005) finds that between 1987 and 2000, a one percentage point increase in the employment rate was associated with a 0.13 percentage point increase in smoking prevalence, or a 0.6% increase in the 23% average smoking

prevalence rate during that time period.[6] These analyses suggest that a similar impact from a one percentage point increase in the unemployment rate, but only when unemployment is low to start. The average employment rate reported in the Ruhm study was 64.1%; in the sample used here, the average employment rate was only 62.6%. It is possible, therefore, that the effect previously reported reflects the relatively stronger economy of the analysis period.

The mediation analyses lend insight into one possible reason for declining procyclical effects during poor economies. I documented a curvilinear relationship between unemployment rates and emotional distress. During relatively strong economies in the analysis period, unemployment rates and emotional distress are *negatively* correlated, suggesting that relief from work-related stressors like long hours on the job and exposure to workplace hazards resulting from incremental economic declines ease stress. These same reliefs, however, may be offset by stress associated with job insecurity and loss during weak economies, resulting in the *positive* correlation between unemployment rates and emotional distress I documented at high levels of unemployment. Because emotional distress was positively correlated with smoking as hypothesized, inclusion of it in smoking models resulted in *stronger* procyclical effects under conditions of high unemployment than was observed in unmediated models. As a result, the difference in AMEs under conditions of high vs. low unemployment were smaller in the stress effects models compared to the unmediated models, resulting in a more linear relationship between unemployment rates and predicted smoking prevalence overall.

[6] In sensitivity analyses (Table 6), I calculate a marginal effect of a one percentage point increase in the employment rate, averaged across all individuals, of 0.054, which reflects a 0.3% increase in the 21% smoking prevalence in this sample.

On the other hand, evidence for the role of household income or cigarette taxes as either mediators or suppressors of the relationship between unemployment rates and smoking behaviors was relatively weak. Although changing employment conditions significantly predict changes in household income and cigarette taxes in the hypothesized directions, inclusion of these variables in regression models did not attenuate the unmediated effect of unemployment rates on smoking. In the case of cigarette taxes, taxes were negatively associated with both any and daily smoking, as predicted, in the mediated models. Lack of demonstrated mediation by taxes therefore suggests that the people most likely to change their smoking behavior as a result of changing employment conditions are not the same people as those most likely to change their smoking behavior as a result of a tax change. Tobacco prices, while an important predictor of smoking consumption, may not drive the relationship between labor market changes and smoking.

Household income, on the other hand, may have limited value as a mediator because of its limited average impact on smoking. In these analyses, the relationship between income and smoking is curvilinear. For low income individuals, income gain is associated with more smoking, as would be predicted for a normal good. Individuals with average or higher incomes, however, respond to increasing incomes by becoming less likely to smoke. Previous work has documented income differentials in smoking likelihood, finding that smoking prevalence is higher among lower income groups. Data from the 2011 National Health Interview Survey indicate that 29% of individuals living below the federal poverty level were current smokers, compared to only 18% of those at or above this level (Agaku et al., 2012). One group of researchers, hypothesizing that anti-tobacco campaigns have succeeded in attaching a negative stigma to smoking, found

that smoking-related stigma is stronger among people with more, compared to less, education (Moffitt, 1983; Stuber, Galea, & Link, 2008). Previous economic research has documented costs associated with engaging in stigmatized activities, and argued those costs explain certain behaviors like lack of welfare program participation (Moffitt, 1983). Perhaps as moderate to high income individuals gain income, they perceive greater and greater social costs of smoking, especially if the income gain has shifted their social class upward where smoking is less normative. The additional smoking their new income would afford them may not then be worth the social costs it would occur. As a result, the relationship between income and smoking could become negative.

Despite the potential insights into relationships among the variables derived from these analyses, changes in income, cigarette taxes and emotional distress fail to provide strong explanation for procyclical smoking. Changing employment conditions may influence smoking through other mechanisms that remain unstudied. The stronger impact of employment conditions on men, Blacks, Hispanics and the employed, all groups that are strongly attached to the labor market, or particularly susceptible to changes in it, suggest that trends at work should be examined. Catalano and colleagues (2011) note that as employment conditions deteriorate, some theorists argue that employees may feel increased pressure to avoid any behaviors possibly perceived as negative, including smoking or other substance use, for fear of job loss. This line of reasoning suggests that job insecurity, often believed to trigger smoking, might instead prompt individuals to quit or reduce their consumption, at least in good economies. During particularly poor labor market conditions, job insecurities may be tied to fear of full plant closures or massive layoffs that workers perceive as unrelated to their individual performance. Smoking-

responses to concerns about performance-based job loss could attenuate, or at least be offset by other stressors in hard times. Few long term studies measure job insecurity, workplace anxiety and smoking behaviors; more research is needed to examine employee reactions to stressors and insecurities in the workplace under variable labor market conditions.

The role of occupation in procyclical smoking has also not been explored in the literature. Economic downturns impact some professions more strongly than others; in the recent Great Recession, for example, the construction and manufacturing industries were particularly hard hit, whereas education and health services jobs grew slightly (BLS, 2012). Smoking also varies by occupation, with construction workers among the most likely to smoke, and teachers among the least (Bang & Kim, 2001). If tough economies force workers to find work in industries or occupations where smoking is less normative, or more likely to be regulated on the job, occupational shifts could mediate some procyclical relationships. The BRFSS does not consistently measure occupation of all participants throughout the analysis period, so other data is required to examine this possibility empirically.

A. Strengths and Limitations

Although a few previous studies have examined relationships between labor market conditions and smoking behaviors, this is the first national study to consider this relationship using data that spans the recent Great Recession, when unemployment rates rose to their highest level in nearly three decades. The differences in predicted effects under conditions of low, average, and high unemployment enhance our understanding of procyclical smoking, and suggest that the mechanisms connecting employment

conditions and smoking may be impacted by the strength or weakness of the economy in which they operate.

This study was also the first to directly consider a measure of emotional distress as a mechanism linking employment conditions and smoking. Previous theoretical work on this topic has been inconclusive, with some researchers arguing that poor economies raise stress levels and smoking responses, and others positing that stressors on the job are maximized during good times, resulting in higher smoking rates. These analyses suggest that in robust economies, declines in employment conditions relieve emotional distress, but in depressed economies, the reverse is true. As a result, procyclical smoking relationships appear relatively weak during periods of high unemployment, unless emotional distress is included in the models.

Because the BRFSS is a repeated cross-sectional survey design, respondents are not tracked over time. Methodologically, this presents a limitation to these analyses if unmeasured characteristics of individuals, including their previous job and smoking experience, are associated with the labor market conditions in which they live. This relationship is plausible if individuals move in response to changing economies, perhaps seeking better work opportunities. In order for this to explain observed procyclical smoking, however, individuals more likely to smoke would have to be more likely to move to stronger economies than those less likely to smoke. Although patterns may be shifting somewhat, well educated individuals are more likely to move than their less educated peers (Frey, 2005), and education is negatively, not positively associated with smoking (Agaku et al., 2012). Moreover, some demographers have noted that in recent years, especially during the Great Recession, migration within the United States overall

has slowed (Frey, 2009). While previous movement may influence the relationship between labor market conditions and smoking observed in the cross-section, biases from selection into stronger state economies may diminish, rather than magnify true effects, and are likely to be relatively small.

Even though the cross-sectional nature of the data may not overly bias the results of these analyses, the BRFSS does present other limitations. Measures of income and emotional distress in the BRFSS are less sophisticated than those employed in other survey research. Income is measured categorically, making slight shifts in income difficult to distinguish. Similarly, emotional distress is measured through a single question. It is possible that better measures of each would produce different relationships or illuminate mediation effects masked by measurement error. However, each of these variables was significantly correlated with smoking behavior, and significantly predicted by changing unemployment conditions, suggesting some specificity of their measurement.

The influence of employment conditions on smoking may depend not only on the short-term volatility of the labor market, but on an individual's long term exposure to strong or poor conditions. It is possible that living in weak economies for extended periods may cause the stressors of job insecurity and loss to mount, eventually reversing smoking patterns to be counter-cyclical. Without information in the BRFSS about residential histories, this cannot be considered, but trends toward no or counter-cyclical effects under high rates of unemployment suggest the possibility warrants exploration. Although the size and representativeness of the BRFSS data makes it a valuable tool for examining changes in smoking prevalence over time, under different conditions and

among sub-populations, panel data that track individuals, their employment conditions, and their smoking behavior over time may be needed to complement BRFSS analyses.

B. Policy Implications

Even without full understanding of the mechanisms at work, the analyses here suggest that as the U.S. economy continues to recover, previous declining smoking trends could attenuate. While unemployment rates remain high, improving conditions may have a relatively small effect, perhaps because alleviation of recession-related stressors offsets procyclical smoking responses, especially among lighter smokers. Once the economy returns to pre-recession strength, however, additional programs may be needed to ensure progress toward national smoking goals (HHS, Healthy People 2020, 2011). Tested policy approaches, such as increasing tobacco excise taxes, are effective strategies to curtail smoking throughout the population, impacting smoking behaviors much more strongly than changing labor market conditions (CDC, 2000; Committee on Reducing Tobacco Use: Strategies, Barriers and Consequences [CRTU], 2007). These policies therefore remain critical for tobacco control. To supplement such broad efforts, however, policymakers may want to consider programs targeted at workers. In particular, health officials should consider working with new and growing industries to institute tobacco prevention measures in workplaces. Evidence suggests that both workplace smoking bans and workplace-based smoking cessation programs can help prevent and reduce smoking among workers (Ham et al., 2011; Hopkins et al., 2010; Leeks, Hopkins, Soler, Aten, & Chattopadhyay, 2010); both may deserve consideration by employers, and support from government. Industries that employ larger proportions of men, Blacks, and Hispanics may be particularly important to target.

This study also suggests that the ultimate impact of the Great Recession on smoking rates and associated health outcomes may depend on the strength and the speed of recovery. In the event of a quick recovery, the health care community may need to prepare for hindered progress toward lower smoking prevalence goals, and the associated medical and social costs that are incurred by smoking-related health problems, if stronger procyclical smoking re-emerges. On the other hand, a languishing economy characterized by high unemployment rate, while likely producing a variety of social concerns, may at least facilitate current smoking prevention efforts, especially if accompanied by efforts to limit smoking-responses to the stressors caused by living in hard times.

C. Conclusion

Consistent with previous research, this study finds evidence that as unemployment rates increase, smoking declines. This pattern appears strongest when changes in employment conditions occur under stronger initial economic conditions, suggesting that the strength of observed relationships depend on the conditions occurring in the analysis period. In the current economy, efforts to address the implications of procyclical smoking may not be necessary until lower unemployment rates are reached, though practitioners may want to use this time to work with employers to ensure effective smoking prevention programs and policies are in place. Because explanations for observed smoking relationships remain elusive, researchers should explore other mechanisms, like occupation, job insecurity, and long-term market exposures, while continuing to track trends in employment conditions and smoking to document whether previously explored patterns are maintained as the nation struggles to recover from the recent Great Recession.

Table 2.1: Characteristics of the BRFSS analytic sample, 1996-2010 (n=4027243)

	n	% /mean	(se)
Participant Smoking Status			
Smoker	791757	21.1%	(0.0004)
Daily Smoker	607974	15.9%	(0.0004)
Non-Smoker	3235486	78.9%	(0.0004)
State Economic and Tax Conditions			
Unemployment Rate	4027243	5.6%	(0.0022)
Cigarette Excise Tax Rate	4027243	132.98	(0.1216)
Participant Gender			
Male	1566630	48.4%	(0.0005)
Female	2460613	51.6%	(0.0005)
Participant Race/Ethnicity			
White	3292763	72.8%	(0.0005)
Black	322528	10.0%	(0.0003)
Hispanic	237563	12.0%	(0.0004)
Other	174389	5.1%	(0.0003)
Participant Age			
Age in Years	4027243	45.7	(0.0179)
Age Groups			
Age 18-24	220541	12.4%	(0.0004)
Age 25-54	2047802	57.4%	(0.0005)
Age 55-64	725782	13.0%	(0.0003)
Age 65+	1033118	17.2%	(0.0003)
Participant Educational Status			
< 12 years	421966	12.2%	(0.0004)
High School Graduate	1249102	30.4%	(0.0005)
Some College	1082030	26.8%	(0.0004)
College Graduate	1274145	30.6%	(0.0005)
Participant Partnership Status			
Married	2228321	59.7%	(0.0005)
Divorced/Separated	651588	11.5%	(0.0003)
Widowed	500656	6.8%	(0.0002)
Single or Unmarried Relationship	646678	22.1%	(0.0005)
Participant Employment Status			
Employed	2268905	61.4%	(0.0005)
Unemployed	173246	5.3%	(0.0003)
Not in the Labor Force	1574199	33.0%	(0.0005)
Missing	10893	0.3%	(0.0001)
Participant Income Category			
Income (in thousands)	4027229	59.3	(0.0232)
Participant Mental Health			
Days in Past Month in Poor Mental Health	3901417	3.4	(0.0017)

Notes: Unweighted frequencies, weighted means, se = standard error. The unemployment rate is averaged across the three months leading up to and including the survey month, in the state of respondent residence. Cigarette excise taxes are measured as the sum residential state and federal rates, adjusted for inflation and measured in 2010 cents. Income is also adjusted and measured in thousands of 2010 dollars. Participant mental health indicates the number of days respondents report being in poor mental health. Both income and mental health days are averaged across individuals of the same race, gender, age group, education and state in the survey year.

Table 2.2: Association of state employment conditions with smoking status (n=4027243)

					Low Unemployment (3.7%)			Average Unemployment (5.6%)			High Unemployment (7.6%)		
		b	(se)		AME	(se)		AME	(se)		AME	(se)	
1. Any Smoking	Unemployment Rate	-0.0079	(0.0026)	**	-0.121	(0.041)	**	-0.075	(0.030)	*	-0.028	(0.025)	
	Unemployment Rate (square)	0.0005	(0.0002)	**	---	---		---	---		---	---	
2. Daily Smoking	Unemployment Rate	-0.0075	(0.0028)	**	-0.114	(0.037)	**	-0.086	(0.027)	**	-0.058	(0.023)	*
	Unemployment Rate (square)	0.0003	(0.0002)	†	---	---		---	---		---	---	

Notes: b=beta ceofficient; se=standard error; AME=average marginal effect. All analyses employ probit models of linear and quadratic measures of the average three month state unemployment rate up to and including to the interview month, controlling for participant characteristics, month, state, and year fixed effects, with standard errors adjusted for clustering within month and state. The low, average and high employment categories were determined based on the weighted distribution of the employment rate variable in the sample, in which average is defined by the weighted mean, and low and high employment are defined as one standard deviation below and above the weighted mean. The AME measures the marginal change in the percentage of individuals who are predicted to be smoking when the unemployment rate increases one percentage point from the starting reference level, based on the weighted average of the predicted effects for each individual in the sample, and taking into account linear and quadratic effects.
† p<0.10, * p<0.05, ** p<0.01

Table 2.3: Impact of proposed mediators on the unemployment rate-smoking relationship

		Proposed Mediator			*Any Smoking*						*Daily Smoking*					
		1			2			3			4			5		
	Regressor	b	(se)		b	(se)		b	(se)		b	(se)		b	(se)	
A. Income	Unemployment Rate	-0.3534	(0.0601)	**	-0.0079	(0.0026)	**	-0.0086	(0.0026)	**	-0.0075	(0.0028)	**	-0.0080	(0.0028)	**
	Unemployment Rate (square)	-0.0235	(0.0038)	**	0.0005	(0.0002)	**	0.0005	(0.0002)	**	0.0003	(0.0002)	†	0.0004	(0.0002)	*
	Income	---	---		---	---		0.0169	(0.0004)	**	---	---		0.0203	(0.0004)	**
	Income (quadratic)	---	---		---	---		-0.0002	(0.0000)	**	---	---		-0.0002	(0.0000)	**
B. Cigarette Taxes	Unemployment Rate	5.3276	(1.1424)	**	-0.0079	(0.0026)	**	-0.0073	(0.0026)	**	-0.0075	0.0028	**	-0.0067	(0.0028)	*
	Unemployment Rate (square)	-0.3425	(0.0799)	**	0.0005	(0.0002)	**	0.0004	(0.0002)	*	0.0003	0.0002	†	0.0027	(0.0002)	
	Cigarette Taxes	---	---		---	---		-0.0001	(0.0000)	**	---	---		-0.0017	(0.0000)	**
C. Emotional Distress	Unemployment Rate	-0.0411	(0.0084)	**	-0.0079	(0.0026)	**	-0.0066	(0.0026)	*	-0.0075	0.0028	**	-0.0065	(0.0029)	*
	Unemployment Rate (square)	0.0032	(0.0009)	**	0.0005	(0.0002)	**	0.0003	(0.0002)	*	0.0003	0.0002	†	0.0002	(0.0002)	
	Emotional Distress	---	---		---	---		0.0168	(0.0025)	**	---	---		0.0153	(0.0026)	**
	Emotional Distress (square)	---	---		---	---		0.0033	(0.0003)	**	---	---		0.0033	(0.0003)	**

Notes: b=beta coefficient; se=standard error. Models in Column 1 use multivariate linear regression to assess the influence of state unemployment rates on the mediating variable (income, taxes or emotional distress). Models in Column 2 uses probit regression to assess the influence of unemployment on the probability of any smoking, Models in Column 3 add the proposed mediating variable to the regression. Models in Columns 4 and 5 are similar to 2 and 3, but assess probability for daily, rather than any, smoking. In Column 1, a linear combination of the coefficients (b_{ump}+2*UMP*b_{ump2}) creates the marginal effect of unemployment on income at a specified unemployment level. Marginal effects can not be generated through a linear process in models in columns 2-5; however, the sign of the coefficient does indicate direction of relationship. All models control for participant characteristics, month, state, and year fixed effects, with standard errors adjusted for clustering within month and state. † p<0.10, * p<0.05, ** p<0.01

Table 2.4: Average marginal effects of a one percentage point increase in state level unemployment rates on smoking prevalence

			Low Unemployment (3.7%)			Average Unemployment (5.6%)			High Unemployment (7.6%)		
		N	AME	(se)		AME	(se)		AME	(se)	
Any Smoking	A. Unmediated Model	4027243	-0.121	(0.041)	**	-0.075	(0.030)	*	-0.028	(0.025)	
	B. With Income Effects	4027229	-0.133	(0.041)	**	-0.085	(0.030)	**	-0.034	(0.025)	
	C. With Cigarette Tax Effects	4027243	-0.112	(0.041)	**	-0.071	(0.029)	*	-0.028	(0.025)	
	D. With Stress Effects	3901417	-0.115	(0.041)	**	-0.084	(0.030)	**	-0.052	(0.025)	*
	E. All Mediators	3901403	-0.118	(0.041)	**	-0.087	(0.030)	**	-0.056	(0.025)	*
Daily Smoking	F. Unmediated Model	4027243	-0.114	(0.037)	**	-0.086	(0.027)	**	-0.058	(0.023)	*
	G. With Income Effects	4027229	-0.116	(0.037)	**	-0.083	(0.027)	**	-0.050	(0.023)	*
	H. With Cigarette Tax Effects	4027243	-0.105	(0.037)	**	0.082	(0.026)	**	-0.058	(0.023)	*
	I. With Stress Effects	3901417	-0.113	(0.038)	**	-0.097	(0.027)	**	-0.080	(0.023)	**
	J. All Mediators	3901403	-0.107	(0.037)	**	-0.088	(0.027)	**	-0.068	(0.022)	**

Notes: AME=average marginal effects, se=standard error. All analyses employ probit models of linear and quadrattic measures of the average three month state unemployment rate up to and including to the interview month, controlling for participant characteristics, month, state, and year fixed effects, with standard errors adjusted for clustering within month and state. The low, average and high employment categories were determined based on the weighted distribution of the employment rate variable in the sample, in which average is defined by the weighted mean, and low and high employment are defined as one standard deviation below and above the weighted mean. The AME measures the marginal change in the percentage of individuals who are predicted to be smoking when the unemployment rate increases one percentage point from the starting reference level, based on the weighted average of the predicted effects for each individual in the sample, and taking into account linear and quadratic effects. * p<.05; ** p<.01

Table 2.5: Predicted effect of a one percentage point increase in the unemployment rate on smoking prevalence by population group

		Model 1: Unmediated							Model 2:Fully Mediated						
	Smoking Prevalence	N	Low UE AME	(se)		High UE AME	(se)		N	Low UE AME	(se)		High UE AME	(se)	
A. All Participants	21.07%	4027243	-0.121	(0.041)	**	-0.028	(0.025)		3827689	-0.118	(0.041)	**	-0.056	(0.025)	*
Gender															
B. Men	23.29%	1566630	-0.167	(0.064)	**	-0.107	(0.039)	**	1516185	-0.148	(0.064)	*	-0.123	(0.039)	**
C. Women	18.99%	2460613	-0.096	(0.048)	*	0.021	(0.029)		2385218	-0.100	(0.048)	*	-0.008	(0.029)	
Race/Ethnicity															
D. White	21.59%	3292763	-0.128	(0.045)	**	-0.054	(0.027)		3187191	-0.122	(0.046)	**	-0.099	(0.027)	***
E. Black	21.83%	322528	-0.412	(0.147)	**	-0.235	(0.083)	**	322528	-0.475	(0.148)	**	-0.276	(0.084)	**
F. Hispanic	17.93%	237563	-0.377	(0.148)	*	-0.022	(0.088)		232857	-0.385	(0.150)	*	0.017	(0.089)	
Age Group															
G. Young Adults (Age 18-24)	26.38%	220541	-0.007	(0.168)		0.036	(0.115)		211072	-0.046	(0.168)		0.009	(0.116)	
H. Middle Age Adults (Age 25-6	22.96%	2773584	-0.081	(0.048)		-0.023	(0.030)		2684478	-0.022	(0.048)		0.037	(0.030)	
I. Older Adults (Age 65+)	9.53%	1033118	-0.058	(0.057)		-0.010	(0.031)		1005853	-0.032	(0.057)		-0.002	(0.032)	
Education															
J. No college education	27.73%	1671068	-0.082	(0.069)		-0.006	(0.042)		1616266	-0.127	(0.069)		-0.052	(0.041)	
K. At least some college educatic	16.12%	2356175	-0.130	(0.046)	**	-0.042	(0.028)		2285137	-0.123	(0.046)	**	-0.070	(0.028)	*
Marital Status															
L. Married	16.99%	2228321	-0.151	(0.048)	**	-0.049	(0.029)		2160377	-0.149	(0.049)	**	-0.066	(0.029)	*
M. Not Married	27.11%	1798922	-0.071	(0.066)		-0.006	(0.041)		1741026	-0.051	(0.066)		-0.028	(0.041)	
Employment Status															
N. Employed	22.32%	2268905	-0.195	(0.053)	**	-0.120	(0.033)	**	2193355	-0.162	(0.053)	**	-0.104	(0.033)	**
O. Not employed	35.47%	173246	-0.114	(0.213)		-0.076	(0.121)		167868	-0.062	(0.214)		-0.026	(0.123)	
P. Not in the Labor Force	16.40%	1574199	-0.028	(0.057)		-0.013	(0.033)		1529464	0.024	(0.057)		0.007	(0.034)	

Notes: Low/High UE AME=average marginal effects based on a 3.7%/7.6% unemployment rate; se=standard error. Smoking prevalence and AMEs are weighted across the sub-sample. Unmediated models analyzed as in Table 2.2, row 1; fully mediated models add measures of income, cigarette taxes and emotional distress.
* p<.05; ** p<.01, ***p<.001

Table 2.6: Sensitivity of models to alternate estimation procedures or employment specifications

		A. Unmediated				B. Fully Mediated		
	Mean	AME	(se)			AME	(se)	
Unemployment rate (3 mo.)								
Model 1: Probit	5.64%	-0.076	(0.030)	*		-0.088	(0.030)	**
Model 2: Linear Probability Model	5.64%	-0.095	(0.028)	**		-0.078	(0.029)	**
Model 3: Logit	5.64%	-0.065	(0.030)	*		-0.083	(0.030)	**
Model 4: Employment Rate (3 mo.)	62.63%	0.054	(0.020)	**		0.071	(0.021)	**
Model 5: Unemployment rate (12 mo.)	5.54%	-0.095	(0.032)	**		-0.108	(0.032)	**

Notes: AME=average marginal effects; se=standard error. Models 1-3 use different estimation techniques on the same basic regression equation. Model 1 is the probit model reported in the paper, model 2 presents results from linear probability models, and model 3 reports results using logit estimation. Models 1, 4 and 5 employ probit regression models substituting different measures of employment conditions. Model 1 is the model presented in the paper, and includes the linear and quadratic measures of the state unemployment rate of the respondent averaged across the three months prior to, and including, the survey month. Model 4 is similar, but uses a three month average of the state employment rate. Model 5 averages the 12 months of state unemployment rates prior to, and including, the survey month. All models include the same standard error corrections and covariates as the primary model; the fully mediated models further add measures of income, cigarette taxes and emotional distress. * p<.05; ** p<.01, ***p<.001

Figure 2.1: Conceptual model of procyclical smoking and proposed mediators

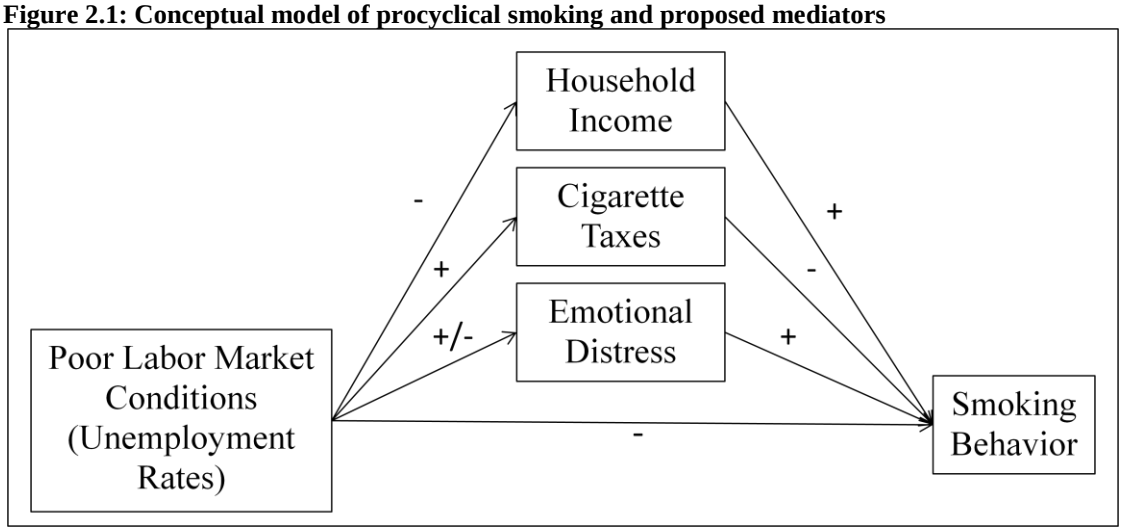
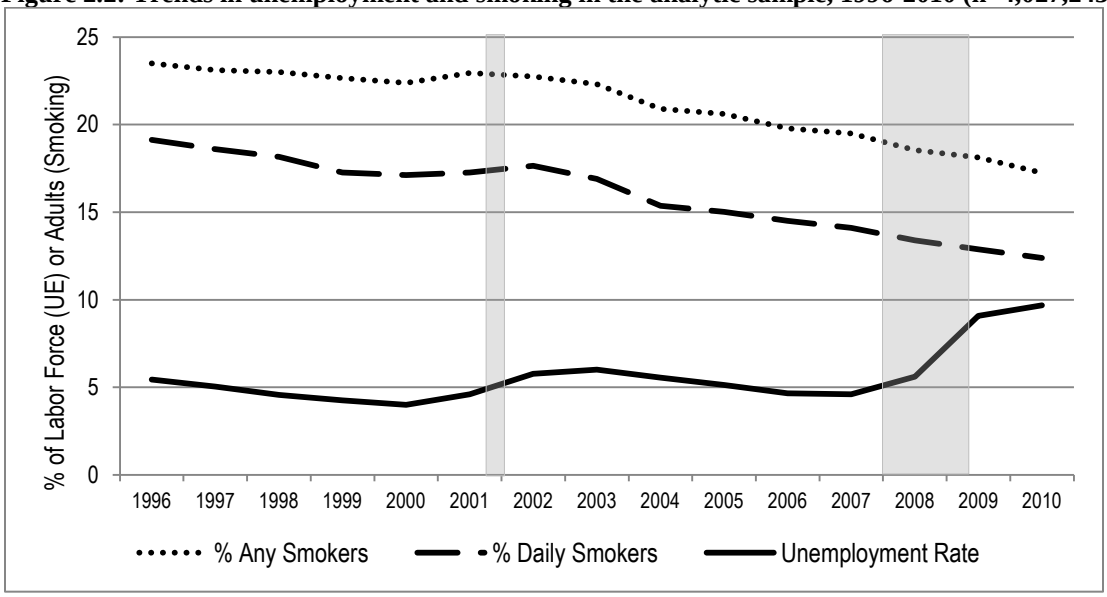
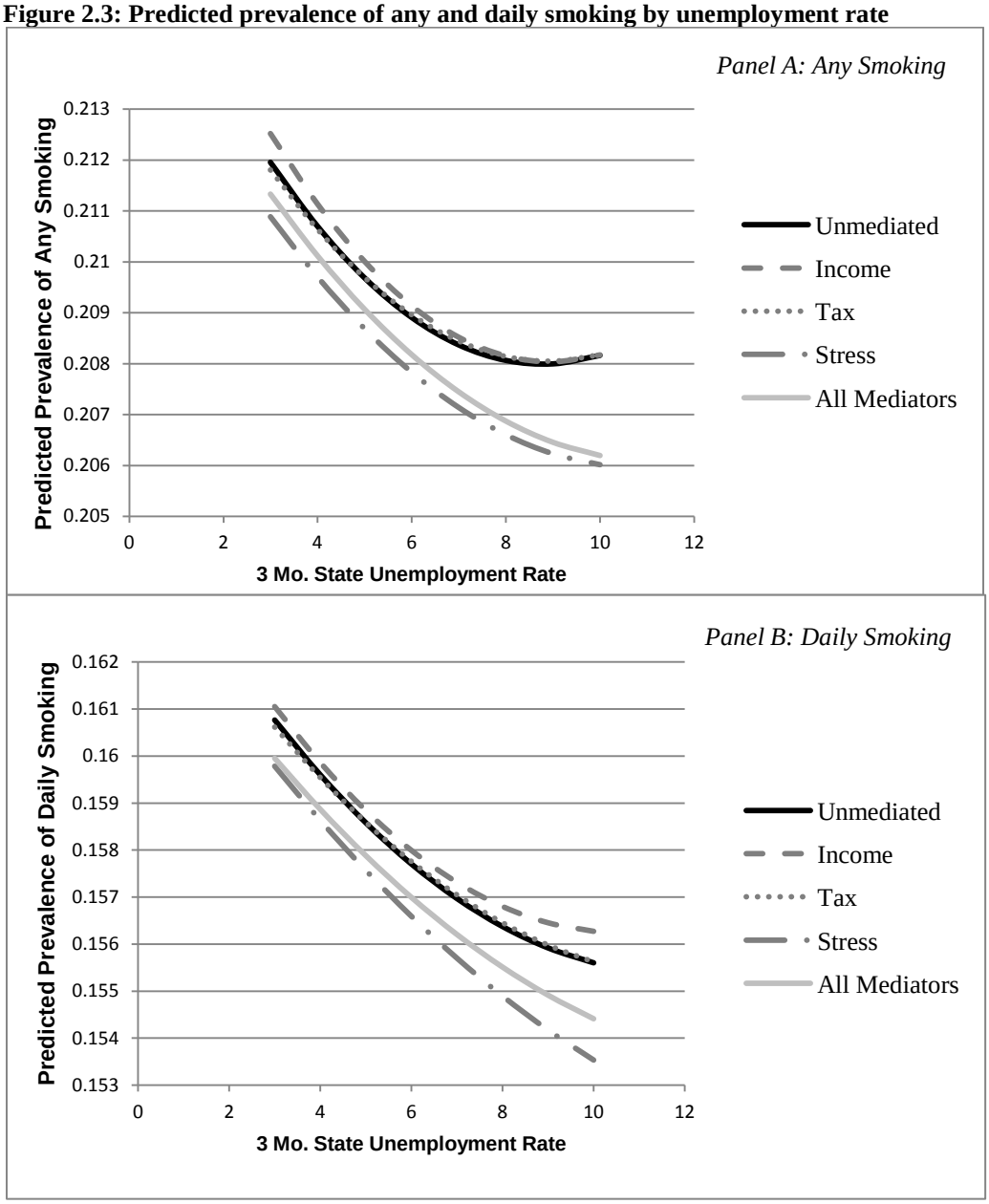


Figure 2.2: Trends in unemployment and smoking in the analytic sample, 1996-2010 (n=4,027,243)



Notes: Smoking prevalence is measured as the percent of BRFSS sample members indicating a given smoking status, calculated with probabilty weights. Individuals are considered smokers if they indicate they have smoked at least 100 cigarettes in their lifetime, and smoke on all or most days at the time of survey. Daily smokers comprise the subsample of all smokers who indicate currently smoking on all days. Annual unemployment rates are calculated as the weighted average of the unemployment rate in the survey month and two months prior to survey for all individuals surveyed in a given year. Grey bars indicate periods of national recession, as defined by the NBER.

Figure 2.3: Predicted prevalence of any and daily smoking by unemployment rate



Notes: Predicted smoking prevalence is calculated as the weighted average of the individual smoking probabilities predicted by analytic models, holding the state unemployment rate at a specific level.

CHAPTER 3: EMPLOYMENT CHANGES AND SMOKING

I. Introduction

In each of the past ten years, more than 20 million people lost work, and this number skyrocketed to more than 27 million people in 2009 (deWolf & Klemmer, 2010). Although unemployment rates remain high, the economy has been improving, with steady, albeit slow, growth in hiring rates. More than 50 million hires occurred in 2011, accounting for 38% of employment (BLS, 2012). As the country continues to recover from the recent Great Recession, a better understanding of the short- and long-term health ramifications of changes to employment status is necessary to effectively prepare for future health needs, and guide prevention programs.

Demonstrating a causal relationship between employment changes and health, however, is difficult for several reasons. First, effective analysis requires accounting for the possibility that less healthy people may be more likely to be unemployed, or to lose work (Böckerman & Ilmakunnas, 2009; Jin, Shah, & Svoboda, 1995). Researchers have tried to isolate causal effects by focusing on exogenously-determined changes in employment, such as job loss from plant closures, or controlling for health status that precedes an employment change, with mixed results. Some research suggests that when health-related selection into employment status is controlled in these ways, observed relationships between employment and health diminish or disappear (Browning, Moller Dano, & Heinesen, 2006; Burgard, Brand, & House, 2007; Böckerman & Ilmakunnas, 2009), while other work finds continued evidence for causal relationships (Gallo,

Bradley, Siegel, & Kasl, 2000; Korpi, 2001; Kuhn, Lalive, & Zweimüller, 2009; Strully, 2009).

Additionally, researchers must account for the fact the most prevalent health problems, such as heart disease, cancer, stroke, and lower respiratory diseases generally arise following a build-up of risk factors and behavior over an extended time period (Ben-Shlomo & Kuh, 2002; Claussen, Davey Smith, & Thelle, 2003; Hart, Smith, & Blane, 1998; G. D. Smith & Hart, 2002). Many events and other life changes can occur in between an employment change and the onset of a health condition, making it difficult to isolate the effect of entering or leaving employment or the labor force.

In this paper, I address these concerns by leveraging six waves of longitudinal data from the nationally representative Panel Study of Income Dynamics (PSID) to study changes in smoking behaviors following changes in employment. Multiple observations of work status and smoking behavior of PSID participants allow me to employ individual fixed effect analytic techniques, which control for many unobserved individual characteristics that might simultaneously influence employment choices and risky health behaviors.

By focusing on smoking, I examine health effects that may be more rapidly susceptible to employment shocks than other health conditions. Because of its association with many prevalent diseases, smoking is associated with nearly one out of every five deaths each year (Adhikari et al., 2008; Mokdad et al., 2004). As such, it may serve as an early indicator of the longer term health consequences of the high levels of hiring and separation that have characterized the current economy. In addition, smoking is considered the leading preventable cause of mortality in the United States; research about

the ways in which employment changes trigger smoking responses are necessary to guide workplace health promotion programs, as well as public policies providing resources to individuals who lose work or leave the labor market.

II. Background

A. Previous studies of employment status and smoking

Although limited by sample restrictions and analytic design, previous research about the relationship between employment changes and smoking suggests that being out of work, or losing work, may increase smoking behaviors. In a cross-sectional study of young men, Montgomery and colleagues (1998) found that the odds of smoking at age 33 more than doubled for men who had experienced at least 3 years of unemployment, compared to men who had never lost work, and nearly tripled for men who had experienced unemployment in the past year, compared to those who had not. Schunck and Rogge (2010) analyzed German microdata and found that the odds of smoking were more than 50% higher among individuals looking for work, compared to those who were employed. Recent cross-sectional analyses of employment status and smoking in California found that the odds of smoking were 23% higher among the unemployed, when compared to the employed (Prochaska et al., 2013).

Cross-sectional analyses, however, may be inadequate because they usually measure employment status and smoking behavior at the same point in time, and therefore cannot establish whether employment changes preceded smoking changes, or if smoking behavior may have triggered job leaving or loss. Longitudinal data can sometimes improve on cross-sectional estimates by leveraging temporally ordered observations of smoking and employment. Prior analyses of longitudinal data partially

confirm higher rates of smoking among the unemployed, and provide some evidence for a causal relationship between job loss and smoking. Using two waves of a national sample of older adults in the United States, Falba and colleagues (2005) found that former smokers who lost work had more than twice the odds of relapsing, compared to their peers who remained working, and that individuals who smoked at baseline were consuming an average of about five more cigarettes per day after a job loss, if not re-employed. Similarly, Weden, Astone and Bishai (2006) explored 11 years of data from the National Longitudinal Survey of Youth (NLSY) and found evidence for decreased likelihood of smoking cessation among the non-employed. This effect, however, was only statistically significant for European American women. Finally, a recent study of Korean men found no statistically significant relationship between unemployment status and smoking status, smoking intensity or quitting, but did find that the odds of re-initiating smoking was 66% higher among the unemployed compared to standard workers (Jung, Ph, Huh, & Kawachi, 2013).

Several gaps exist in current research on employment status and smoking. Nearly all of the prior studies compare employment with unemployment, failing to include or distinguish individuals who have left the labor force, and are neither working for pay, nor actively searching for work. Individuals can leave the labor market in order to retire, pursue education, or be a caretaker. In addition, people may leave the labor force because they have become discouraged during their job searches. The BLS (2009b) estimates that between 5-7% of people who are categorized as not in the labor force are actually interested in finding work.

Transitions in and out of the workforce are becoming increasingly common. Even

retirement is not a permanent condition, with research indicating that at least 26% of people eventually "unretire" (Maestas, 2010). With the exception of retirement, however, little research examines the health or behavioral ramifications of these transitions. Research on the effects of retirement are contradictory, with some studies documenting beneficial health outcomes and others documenting negative ones (Moon, Glymour, Subramanian, Avendano, & Kawachi, 2012). The two studies that did compare all individuals out of the labor force with workers found that labor market departure increased the risks of smoking, but results were limited to specific sub-populations (Weden et al., 2006) or geographic areas (Prochaska et al., 2013).

Research on employment status and work also tends to focus on the repercussions of a job loss experience, or a comparison of static employment states, without considering experiences with re-employment or other components of recent work history. Many scholars argue that the modern labor market is increasingly characterized by job insecurity and precarious work, resulting in a decline in employment stability and high rates of job churning, or movement in and out of work (Cappelli, 1995; Cappelli, 1999; Grimshaw, Ward, Rubery, & Beynon, 2001; Hollister, 2011; Kalleberg, 2009; Osterman, 2000). Analyses of recent labor market conditions suggest that recent high rates of unemployment result more from decreases in work opportunities and new hires than from increases in involuntary job losses (deWolf & Klemmer, 2010; Falba et al., 2005). In addition, rates of long-term unemployment peaked recently (Allegretto & Lynch, 2010), and the amount of time people spend looking for work before finding it or leaving the labor market more than doubled between 2007 and 2010 (Ilg & Theodossiou, 2012). No current work examines the influence of unemployment duration or re-employment on

smoking, but one recent study documented an increased likelihood of developing poor health conditions following a job loss, even when people were re-hired (Strully, 2009). This same study, however, found no differences in self-rated health when comparing the longer-term workers to those who had recently begun work after experiencing a job loss.

B. Theoretical Bases for Relationships between Work and Smoking

Work is a key social institution that conveys income and other material benefits, structures time use, facilitates social contacts, assigns social status and personal identification, and provides an opportunity to meaningfully engage in society (Andersen, 2009; Jahoda, 1982). Individual movement in and out of the labor force, as well as in and out of employment within the labor force, may therefore have both financial and psychosocial ramifications that could influence smoking behaviors. While theories focused on resource loss suggest that expensive behaviors like smoking generally decline when individuals move out of employment, theories focused on changes in psychosocial conditions often predict the opposite, arguing that loss of work, unemployment, and even departure from the labor market may generate high levels of stress which can trigger unhealthy coping behaviors. An additional body of work, however, identifies potential negative health ramifications of working, and suggests that leaving employment could alleviate work-related stressors, and thereby reduce smoking behaviors.

Income: Job loss is associated with a decline in income, with effects persisting several years into the future (Jacobson et al., 1993; Ruhm, 1991), especially if multiple job losses are experienced (Stevens, 1997). As individuals lose income or anticipate income loss from an upcoming change in employment, economic theory suggests they decrease their purchase of all normal goods, including cigarettes. Cigarette consumption,

however, may be relatively income inelastic, or relatively insensitive to changes in income. A wide variety of income elasticities for cigarettes have been reported in the literature; a meta-analysis summarizing nearly 400 estimates suggests that a one percent loss of income is associated with only a 0.28 percent decrease in cigarette demand in the short run, and a 0.39 percent decrease in cigarette demand in the long run (Gallet & List, 2003).

Employment-related psychosocial factors: In addition to consequences for income levels, employment changes likely have psychosocial impacts. Job loss or perceived job insecurity may cause financial anxiety, disturb one's self image and sense of life control, or inhibit one's ability to engage socially (Andersen, 2009; Brand & Burgard, 2008; Jahoda, 1982; Price, Choi, & Vinokur, 2002), each of which might generate high stress levels. Significant research demonstrates declining mental health following job loss (Paul & Moser, 2009). Furthermore, research indicates that workers who are re-employed following displacement have lower levels of occupational status, job authority, and employer-sponsored benefits, and are more likely to work part-time (Brand, 2006; Kletzer, 1998), so the psychosocial impact of job loss may be long lasting as well. While chronic stress can directly impact physical health by inhibiting the body's immune and endocrine response systems, it may also spur coping mechanisms, including unhealthy behaviors such as smoking (Bosma et al., 1998; Kubzansky et al., 1997; McEwen, 1998; McKee et al., 2003; Thoits, 1995).

Other researchers, however, argue that work is a source of stress, particularly if working environments require long hours and allow little autonomy (Clougherty et al., 2010; Daniels & Guppy, 1994; M. J. Smith et al., 1981). Recent empirical work has

documented positive associations between working conditions or longer work hours and poor mental health (Clumeck et al., 2009; Virtanen et al., 2011). Stressful employment conditions and work hours have also been associated with several risky health behaviors (Escoto et al., 2010), though research specific to smoking has been limited and inconclusive (Ota et al., 2010; Perdikaris, Kletsiou, Gumnopoulou, & Matziou, 2010).

C. Impact on Sub-Populations

If financial resources and employment-related psychosocial stressors are the primary mechanisms linking employment changes and smoking, those groups with more labor force attachment or with limited financial reserves may be most susceptible to effects. In particular, as women's participation in the labor market has changed over time, it is important to consider whether gender might moderate relationships between employment and smoking. In addition, higher levels of income or wealth could buffer the financial and stress-related impacts of job loss or employment changes, perhaps attenuating effects.

Gender: Many labor market studies have limited analyses to men, under the assumption that women are less attached to the labor force, due to lower rates of employment and higher rates of part-time work when they are employed. Women continue to make up a smaller portion of the labor force; in 2020, the BLS estimates that 57.1% of all women over age 16 will participate in the labor force, compared to 68.2% of similarly aged men (Toossi, 2012). It is possible, therefore, that income and stress changes from employment changes might be less relevant for women, diminishing impact on smoking. Yet in the last 50 years, women's labor force participation has increased, peaking in 1999 at 60%, while men's participation rates have declined. Women make up

a larger portion of the population, so even with lower labor market participation rates, they are projected to make up 47% of the labor force between 2010 and 2020 (Toossi, 2012). As women's labor force participation grows, their susceptibility to health ramifications of employment changes may increase as well.

Income and wealth: Although economic theory generally suggests that individuals consume less following income losses, other work predicts that individuals aim to maintain stable consumption levels following income shocks, a concept known as consumption smoothing (Friedman, 1957). To accomplish this, consumers will accumulate assets in anticipation of a potential economic shock, or borrow resources when such a shock occurs. Following job loss, individuals have relied on wealth, or in its absence, unemployment benefits, to smooth consumption (Bloemen & Stancanelli, 2005; Browning & Crossley, 2001; Gruber, 1997; Gruber, 2001). Much of this work focuses on food or other necessity consumption patterns; whether individuals similarly smooth smoking consumption, however, is unknown. If they do, individuals with access to more resources through incomes from family members or accumulated savings and wealth may be less prone to change smoking behavior following an employment change. In addition, reserves of income or wealth might offset financial stresses related to moving into unemployment or out of the labor force, and some previous work documents positive associations between financial strain and smoking behavior (Kendzor et al., 2010).

D. Contribution

In this paper, I assess the influence of changing employment on the probability of smoking on all workers, as well as the intensity of smoking behavior among periodic or continuous smokers. By using longitudinal data from recent waves of the PSID and fixed

effect models, I examine smoking changes during different employment transitions, comparing working with both unemployment and labor force departure. In additional analyses, I consider whether experiencing a recent job loss influences the relationship between employment and smoking, and whether duration of unemployment predicts smoking behavior among the unemployed. Finally, I investigate whether either female gender or increased household resources attenuates observed relationships.

III. Methods

A. Data and Sample

Individual- and family-level information about smoking behaviors, employment status, recent job losses, income, wealth and demographic characteristics are derived from the six waves of the PSID that were administered biennually between 1999 and 2009. The PSID is a nationally representative, longitudinal study of individuals and their families which began in 1968.[7] In addition to the original household adults enrolled, the study follows children of the original respondents as they age and begin families of their own, and added new families in 1990 and 1997 to better represent the country given immigration trends. As a result, the survey has grown from about 4,800 families in 1968 to more than 9,000 families in 2009. The primary purpose of the PSID is to track economic and demographic behavior, and the survey instrument includes detailed questions about employment status and transitions. In 1999, a series of questions about health behaviors and conditions were added to the core survey, supplementing previous questions focused on self-rated health and health expenditures.

The PSID is designed to collect information about a family from a single

[7] The Panel Study of Income Dynamics is primarily sponsored by the National Science Foundation, the National Institute of Aging, and the National Institute of Child Health and Human Development and is conducted by the University of Michigan.

representative of that family. Individuals identified as heads of households are interviewed if available, though sometimes interviews are instead conducted with a cohabitating partner or spouse of a household head. Employment and smoking information is gathered about the interviewee, and the interviewee also reports employment and smoking information for a cohabitating partner or spouse if relevant. In the six waves of data used for this analysis, data for 17,492 unique household heads and partners are available. Because analyses focus on transitions out of employment, individuals must be working at some point during data collection. I further restricted the analytic sample to individuals who had worked within five years of each survey observation, to remove individuals who worked very infrequently, and thus demonstrated little attachment to the labor force during the analysis period. Since analyses rely on the longitudinal nature of the data, eligible individuals also had to participate in at least two waves of the data. Of the total number of heads and partners, 2,040 (11.7%) were not working in any wave and 1,274 (7.3%) had spent more than five years out of the labor force. An additional 1,571 (9.0%) only appeared in a single wave. Ten of the remaining eligible individuals (<0.1%) failed to provide key covariate information, and were dropped, resulting in a final analytic sample of 12,597 individuals. Descriptive statistics about the analytic sample, including demographic and employment information, are provided in Table 3.1.

In each wave of the PSID, new household heads and partners establish or join PSID families. Additionally, individuals who previously participated may be lost to follow-up if they do not participate or are no longer a member of a PSID family. The available analytic sample in each of the six waves of the PSID employed in this analysis,

therefore, ranges from a low of 8,095 (64% of the full analytic sample) in 1999 to a high of 10,786 (86% of the full analytic sample) in 2007, before dropping to 10,179 (81% of the full analytic sample) in 2009. Nearly half of the analytic sample members (49%, n=6,210) appear in all six waves of PSID data. In total, 58,053 person-wave observations of eligible individuals are available for analysis. Information about wave-specific samples is available in Table 3.2.

B. Measures

Outcome variables: Current smoking is measured in two ways in the PSID. First, each respondents is asked whether he or she currently smokes cigarettes, and whether his or her partner currently smokes cigarettes (if cohabitating or married). Previous research suggests that family member proxy reports of smoking status are reliable (Gilpin et al., 1994; Hyland, Cummings, Lynn, Corle, & Giffen, 1997). I use responses to these questions to create a dichotomous smoking *status* variable for each interviewee and partner. Second, each respondent is asked the number of cigarettes he or she smokes each day, on average. I use responses to this question as continuous measures of smoking intensity. Previous research suggests that self report of smoking behavior corresponds relatively well to biochemical indicators of smoking, especially when a survey is administered by an interviewer, rather than completed independently by a respondent, and when a survey is not connected to specific smoking cessation intervention programs (Patrick et al., 1994).

Explanatory Variables: Through repeated questioning, the PSID measures the current employment status of respondents and their partners, using eight response categories. I collapse these to create three mutually exclusive indicators of current

employment status: working, unemployed, or not in the labor force. Individuals are considered to be working if they report working at the time of survey, being only temporarily laid off, or being on sick or maternity leave, whereas those who indicate they are looking for work and not currently working are considered unemployed, consistent with BLS definitions. All others, including those who are retired, permanently disabled, "keeping house," students, or in prison, are categorized as not in the labor force.

Along with current employment status, the PSID collects detailed information about jobs that earned income for individuals in the two years prior to the survey (e.g., in 2001 and 2002 for the 2003 survey), including start and stop dates, and the reasons that previous jobs ended. To capture recent work histories, I used employment dates, in conjunction with the interview date, to create a variable measuring the number of months since an individual last worked, for individuals not currently working. In addition, I used responses to the question about why jobs ended to create indicators of recent job loss experience. Specifically, an individual is categorized as having recently experienced *any job loss* if a job ended in the last two years due to plant or company closure, other involuntary job loss (layoff, fired, strike), or voluntary job loss (quit, retired, wanted a change, job ended, other). Recent *involuntary job loss* is indicated by restricting the job loss experience to plant or company closure, layoff, firing or strike. Strictly categorizing job loss as involuntary or voluntary can be difficult, especially if individuals who take early retirement packages as alternatives to layoffs or who resign to avoid being fired are categorized as voluntary job leavers, when in reality external pressure caused the job loss. All analyses that incorporate job loss as a key variable are therefore run twice, alternatively employing indicators of any job loss and involuntary job loss only.

Moderating variables: In my analyses, I consider variation in the impact of employment status on smoking by three participant characteristics: gender, household income and household wealth. Gender is measured with a time-invariant dichotomous female indicator, based on whether a participant is a male (=0) or female (=1). To capture total family income and total family wealth, I employ composite measures calculated by the PSID staff based on a series of questions. The total family income variable measures the total taxable, transferable and social security income of household heads, married or cohabitating partners, and other family unit members. This variable includes income from assets, earnings, business profits, social security, and government transfers. The total family wealth variable is the sum of the value of eight key asset categories (business/farm, checking/savings, home equity, other real estate, vehicles, stocks, annuities, other assets), net household debt. Income data in the PSID is considered to be measured more reliably than in other studies (Kim & Stafford, 2000), and the wealth data in the PSID is considered comparable to the data in other surveys that utilize significantly more detailed wealth question (Wolff & Gittelman, 2011). To account for inflation, income and wealth data are adjusted to reflect real prices in 1999 (in tens of thousands of dollars) using the Consumer Price Index-Urban, available from the BLS. The PSID measures of income and wealth are both continuous, and can be negative. In my analyses, I employ logged values of the income and wealth variables to decrease skewness in their distributions.

Control variables: As is described in detail below, most analyses reported here employ participant fixed effects, which control for time-invariant characteristics of sample members. All analyses further incorporate measures of a participant's age at the

time of survey (linear and quadratic), and their partnership status (co-habitating with a spouse or partner vs. not cohabitating). To account for labor market influences on both employment status and smoking behavior, I also matched geographic information about the survey household with data from the BLS, allowing me to include a measure of the unemployment rate during the three months leading up to the survey month in the participant's state of residence in all analyses. The unemployment rate measures the percentage of people in the labor force who are unemployed within a specific geographic area (BLS, 2009a). In sensitivity tests in which fixed effects are not used, PSID indicators of an individual's gender, race, educational level, and state of residence are also used to account for characteristics of individuals that might predict both employment status and smoking behavior.

C. Analytic Approach

The theory underpinning this research suggests that employment changes produce changes in smoking behavior. Two alternative explanations, however, are possible. First, individuals who smoke may be more likely to lose or leave work. And second, other unobserved factors, such as a proclivity for risk-taking behavior, could influence both employment likelihood and smoking behaviors. Previous research has usually addressed these concerns by either controlling for baseline and childhood health indicators, or limiting the job loss exposure variable to losses due to plant or company closures.

Each of these approaches, however, has certain limitations. While inclusion of health status indicators prior to the employment change experience should improve the causal estimate of the relationship if poor health predicts loss or leaving of work, its inclusion cannot account for endogeneity problems from other unmeasured variables like

risk-taking proclivity. Limiting employment changes to those that occur due to exogenous reasons unrelated to characteristics of individual job losers can address broader endogeneity concerns, but will also produce an estimate of the effect of unemployment on smoking only for those people who lose work for a specific reason, like plant closure. Plant closure job loss is only a small portion of the total job loss experience; within the defined analytic PSID sample, this kind of job loss represents only 7% of all voluntary and involuntary job losses, and only 27% of all involuntary job losses. Furthermore, because plant closure job loss is often shared with coworkers, it may have different psychosocial ramifications for people who experience it, and may result in a flooded labor market, producing unique conditions determining future employment likelihood. Finally, because plant closure job loss is relatively uncommon,[8] demonstrating statistically significant effects, even when such effects exist, can be difficult. These analyses instead leverage the repeated observations of individuals available in the PSID to employ individual participant fixed effects in analyses.[9] Fixed effect models control for time-invariant unobserved individual characteristics by using only variation within individuals to develop regression coefficient estimates.

Fixed effects models require sufficient within-individual variation in explanatory and outcome variables over time to be able to identify effects. As described in Table 3.1, almost 18% of analytic sample members changed their smoking status at some point during their participation. By design, nearly all sample members reported working during

[8] Plant closure job loss is only indicated in 1,027 (<2%) of the 58,053 observations utilized in this analysis.

[9] Before choosing the fixed effects model, I compared the fixed effect models to random effects models, which account for the participant-specific component of the error term, but assume that term is uncorrelated with model covariates. Formal Hausman tests comparing the fixed and random effects models were statistically significant, suggesting it is inappropriate to conclude that the beta coefficients do not differ between the models. Results of the fixed and random effects comparisons is provided in Table 3.3.

at least one observation; almost 18% of sample members were unemployed, and nearly 25% were out of the labor force in at least one other observation. Table 3.4 provides describes changes in smoking and employment status between participant observations. In each wave, between 3-4% of respondents indicated they had quit smoking since their last observation, and 2-3% indicated they had initiated or returned to smoking since last surveyed. Between 11-20% of participants changed employment status between observations. Sizeable portions of respondents experienced job loss (range: 22-29%), including involuntary job loss (range: 5-10%), in the two years prior to survey.

Even with this variation, however, the power of the fixed effect model to control for unobserved individual characteristics can also be a weakness, as it may unnecessarily control for characteristics unrelated to the independent and dependent variables, limiting the amount of variation used in the model to levels that may be too extreme to allow detection of actual effects. To respond to this potential, I discuss all results that have a probability of differing from zero in 90%, rather than the more traditional 95% of cases, though distinguish these more marginally significant effects in the tables and text.[10]

While fixed effects linear regression models work well for continuous outcomes, like numbers of cigarettes smoked, inclusion of fixed effects in logistic regression, as appropriate for modeling dichotomous outcomes like smoking status, poses challenges. In fixed effect logistic regression models, individuals with no observed smoking status

[10] I also considered the use of wave-specific propensity scores that would capture the conditional probability of experiencing an employment change between two waves, given a set of observed covariates. In theory this score could be used to create a matched sample of "treated" and "untreated" individuals with similar propensity scores, or to weight observations to allow individuals with more common propensities to contribute more to the estimate than those with outlying propensity scores. To use this technique, however, I would have had to limit the sample to consecutive observations, eliminating 23% of my observations. In addition, my paper investigates transitions both to unemployment and to labor force departure. The variables to predict such changes likely vary, and I was unable to identify regression models that accounted for more than 5% of the variation in employment status changes.

variation drop out, creating smaller and possibly problematically selected samples. As an alternative, and to facilitate comparison across models, I use fixed effect linear probability models, which use linear regression approaches to model smoking probability as a continuous variable.[11]

The econometric specification for both smoking status and intensity models is:

$$S_{it} = \alpha_0 + Emp_{it}\beta_1 + X_{it}\beta_2 + Y_t\beta_3 + \mu_i\alpha_1 + \varepsilon_{it}$$

where S_{it} is the probability of being a smoker or the continuous measure of smoking intensity, for individual *i* at time *t*; Emp_{it} is a categorical indicator of current employment status, for individual *i* at time *t*; X_{it} is a vector of individual or household characteristics including age, partnership status, and state unemployment rate; Y_t is a vector of observation year indicators; μ_i is a vector of time-invariant, unobserved personal characteristics; and ε_{it} is an error term. Because the PSID samples the same households and individuals over time, observations may be correlated within individuals over time; all models employ cluster-robust standard errors to help limit bias in standard errors.

By modeling employment status using an individual fixed effects approach, estimates are identified based on changes in employment status within individuals, and thus capture the influence of participant changes in employment on smoking. Beta coefficients from regression models compare the probability or intensity of smoking when an individual is in the relevant employment category (i.e., unemployed or not in the labor force) to when an individual is in the omitted category (working), averaged across

[11] Two potential problems with linear probability models are heteroskedastic errors and predicted values that are smaller than zero or greater than one, and therefore outside the possible range for a probability score. Cluster-robust standard errors help adjust for heteroskedasticity. In my models, out-of-range predictions occur in 14% of cases in the basic model of employment status and smoking status. While this is non-neglible, the range of predictions (-0.2 -- 1.009) is not large, suggesting that even those predictions that are outside the expected range are not extremely outside.

participants. Following the main models, I conduct Wald tests to additionally compare the difference in smoking behaviors during unemployment vs. non-labor force participation.

Additional analyses: In order to capture the influence of recent job history on smoking behavior changes, I incorporate measures of unemployment duration and job loss experience in additional models. In separate models, I interact indicators of 1) any job loss and 2) involuntary job loss with different employment conditions to determine whether the relationship between employment change and smoking is affected by a recent job loss experience. Additionally, I test the potential impact of unemployment duration on the smoking behaviors of the unemployed, using an analytic sample restricted to those who are unemployed at the time of survey. Table 3.1 provides descriptive statistics of this sub-sample.

To ascertain whether gender, household income, or household wealth conditions associations between employment and smoking, I examine several other models that use interaction terms. Specifically, the employment variables are interacted with variables measuring gender, household income, or household wealth in separate models. Results tables present the beta coefficients from these models; in the text, I also report the marginal effects of unemployment and labor force departure for distinct groups. Marginal effects are calculated through a linear combination of coefficients on the employment status and interaction terms, for an identified gender group, or level of household income or wealth.

All analyses are conducted using panel regression techniques and the lincom post-estimation command in STATA 11 (Statacorp, College Station, Tex).

IV. Results

A. Differences in Participants by Employment Status

In addition to information about the full analytic sample, Table 3.1 provides descriptive statistics for those individuals who were either unemployed or out of the labor force in at least one wave. Bivariate comparisons of the sub-samples through t-tests indicate that employment conditions are significantly associated with smoking; compared to all others, people who experienced either unemployment or time outside the labor force had higher smoking rates. These same groups were also less likely to be White, and had lower levels of education, income and wealth, and were more likely to have experienced job losses, compared to other sample members. In addition, people who had been unemployed were less likely to cohabitate with a partner, and people who spent time outside the labor force were more likely to be female.

B. Employment Status, Job Loss and Smoking

Analyses of fixed effect linear probability and regression models also indicate that employment conditions are significantly associated with some measures of smoking, though not always in the same manner as predicted by the bivariate associations (Table 3.5, Model 1). In particular, individuals are less likely to smoke, and smoke fewer cigarettes when they do smoke, when they are *not* members of the labor force, compared to when they are working. Specifically, the probability of smoking decreases by 1.7 percentage points and daily smoking declines by 0.79 cigarettes, on average, when individuals leave work and the labor market altogether. On the other hand, the probability of smoking increases by 1.2 percentage points when an individual is unemployed, compared to when he or she is working, though this effect is only marginally significant

(p=0.05). No significant impact on smoking intensity is observed when comparing unemployed and employed statuses (b=0.29, p=0.21). Wald tests comparing the coefficients on the unemployed and not in the labor force terms suggest that individuals are more likely to smoke, and smoke more, when they are unemployed compared to when they are not in the labor force (F=16.57, p=0.00 for status; F=12.84, p=0.00 for intensity).

Two additional models assess whether a recent job loss experience influences the relationships among employment status categories and smoking (Table 3.5, Models 2 & 3). For individuals who are unemployed or not in the labor force, job loss interaction terms are insignificant, regardless of whether any job loss (Model 2) or involuntary job loss (Model 3) is considered.[12] On the other hand, for individuals who are currently working, having experienced a recent job loss does appear to influence some smoking behavior. Specifically, for current workers, the probability of smoking is 0.8 percentage points higher when work was recently lost, compared to when it was not, although this difference is not statistically significant when narrowing the job loss experience to involuntary losses (b=0.008, p=0.23). Recent job loss experience also increased smoking intensity among the employed. For working individuals, experiencing a recent job loss of any kind is associated with smoking 0.27 more cigarettes per day (p=0.09), and experiencing a recent involuntary job loss is associated with smoking 0.51 more cigarettes per day (p=0.04), compared to working with recent employment histories that did not include such losses.

[12] In more than 80% of observations, people who are unemployed experienced some form of job loss in the previous two years. The main unemployment term in this model measures the effect of unemployment for individuals who did not lose work recently. The lack of statistical significance likely reflects the small sample of people who fit in this category. The linear combination of the unemployment terms and any job loss interaction (in Model 2) is statistically significant, which seems to confirm the marginally significant findings from Model 1.

Sub-analyses of employment history among the unemployed indicated that the length of unemployment did not significantly impact smoking behaviors. In results not shown, the number of months an unemployed person had spent out of work was not associated with changes in smoking probability (b=0.00, p=0.86) or intensity (b=0.00, p=0.88).[13]

C. Gender Differences

Table 3.6 presents the results of analyses of smoking status and intensity models that add a term interacting employment status with gender. While interaction terms are insignificant, the signs on the interaction terms indicate that predicted marginal effects for women are higher than those predicted for men, and predicted effects for women achieve statistical significance, whereas those for men do not. Specifically, women's probability for smoking increases by a marginally significant 1.3 percentage points (p=0.10) during unemployment and decreases by a statistically significant 2.0 percentage points (p=0.00) when she leaves the labor force, as measured by t-tests on the linear combination of employment categories and associated interaction terms.

D. Differences Based on Household Income or Wealth

Results of models that incorporate measures of household income and wealth are presented in Table 3.7. No interaction terms are statistically significant in these models, with one exception. Higher levels of wealth appear to offset the protective effect that leaving the labor force exerts on smoking status and intensity. Whereas an individual with a relatively low level of accumulated wealth ($5,000) would decrease his or her

[13] Only 550 individuals were unemployed in multiple observations, suggesting that a fixed effects model might not have sufficient power to detect actual effects. Futhermore, variation in length of unemployment between unemployed individuals was greater than variation between (standard error (between)= 8.2; standard error (within) = 5.1).However, neither OLS nor random effects models indicated any significant associations between length of unemployment and smoking behavior among the unemployed.

smoking probability by 2.4% by leaving the labor market, the smoking probability of an individual with more wealth ($200,000) would decrease by 1.3% from the same employment change. Lower wealth smokers making this same shift smoke 0.6 fewer cigarettes per day, on average whereas higher wealth smokers would not significantly decrease their smoking.[14] On the other hand, smoking responses from transitions between work and unemployment do not change as income and wealth incrementally increase, and income does not appear to impact smoking when people leave the labor force.

V. Discussion

The results presented here indicate that when individuals stop working, their smoking behaviors change. In these analyses, however, whether smoking increases or decreases following an employment transition depends on whether former workers leave the labor market altogether. People appear more likely to smoke when they are unemployed and actively searching for work than when they are working, although intensity of smoking among smokers does not change with this transition. When people retire, go to school, or otherwise exit the labor market, they are less likely to smoke altogether, and smoke fewer cigarettes even when they continue to smoke.

Although employment may alleviate some smoking-related pressures, work may also pose some smoking risks. In this sample, working participants had significantly higher income levels than all others; strong differences in smoking behavior between workers and those outside the labor market could reflect increased purchasing power among the employed. Additionally, if poor working conditions, long hours and little job

[14] The two wealth figures used for comparison represent the 25% and 75% levels of the wealth distribution. The marginal effect is a linear combination of the $b_{nilf} + b_{nilf*wealth}*\ln(W)$. For high wealth smokers the marginal effect on smoking intensity is 0.13, p=0.70.

autonomy trigger smoking coping responses, as some research predicts (Clumeck et al., 2009; Virtanen et al., 2011) departure from employment may alleviate these pressures. For those who need to find more work, however, the anxiety surrounding the job search process may overwhelm these effects, causing upticks, rather than declines, in smoking likelihood.

While other previous studies suggest being unemployed is a risk factor for smoking (Falba et al., 2005; Montgomery et al., 1998), two previous explorations of labor market departure found that such movement also enhanced smoking, rather than decreased it, as was found here. Differing results could be due to alternative methods and samples. Weden and colleagues (2006) used hazard models to assess quitting behavior among smokers from the NLSY. Although hazard model estimates may be resistant to endogeneity bias, aspects of the sample could influence results. Because an age-based cohort was used, individuals in the sample grew up and joined the workforce at similar times, and therefore may have shared experiences with smoking norms at home and at work. In the PSID sample, participants are not limited by birth year; in each wave, most participants were between 20 and 69 years old. As a collective, they were exposed to a much wider variety of norms and trends related to smoking than the NLSY participants, and may better represent the current working population. In addition, because the sample used by Weden and colleagues was restricted to smokers, that analysis fails to consider smoking initiation or relapse.

The other study that found increased smoking following labor market departure is based on cross-sectional data from California in 2007 and 2009 (Prochaska et al., 2013). Because this period spans the recent recession, discouraged workers, whose stress and

income-related risk factors might most resemble the unemployed, may have made up a larger proportion of those outside of the labor force than in other years. California's population also differs from much of the rest of the country in terms of race, ethnicity and nativity status (U.S. Census Bureau, 2013), so it may be difficult to extrapolate results found there elsewhere. More research specifically focused on transitions out of the labor force are needed to both confirm influences on poor health, and identify the pathways that underpin these relationships.

My results also suggest that for people who have become unemployed or who have left the labor market, the circumstances that surround that transition, including whether a job loss was recent or involuntary, are less important than the transition itself. For these groups, current relationship to the labor force may be a better predictor of smoking behavior than recent work history. These results, however, likely need to be interpreted with caution, as they may reflect limited variability in the sample, rather than true null effects. In each wave, only 3-9% of the sample reported being unemployed, and of those, about 80% had experienced some form of job loss in the past two years, and between one third and one half had experienced an involuntary job loss. While slightly higher percentages of people reported being outside the labor force during any wave (range=7-13%), only half had experienced any form of recent job loss, and fewer than 10% had experienced a recent involuntary job loss in each wave. It's possible that the cell sizes for unique unemployment status-job loss history groups were too small to capture effects. Similarly, analyses examining length of unemployment among the unemployed may reflect limited variation within individuals in a fixed effects model, rather than null effects.

On the other hand, there is some evidence that a recent job loss does enhance some smoking behaviors among those who subsequently resume working. This suggests that spells of unemployment could have lingering impacts on the health of workers, even after they have returned to work. This is partially consistent with another study of PSID respondents which found that re-employed workers who had experienced job loss reported more problematic health conditions (e.g. stroke, diabetes, heart disease), although this result is limited to individuals who experienced "no fault" job loss through a plant closure or similar event (Strully, 2009). Re-employed workers who had been laid off, fired, or voluntarily separated did not face more health risks than their continuously employed peers. The smoking models presented here suggest that any job loss experience may increase smoking likelihood following re-employment, though effects are only marginally significant when restricted to involuntary losses. Effects on smoking may be more observable than effects on health conditions, both because smoking is more rapidly modifiable, and because it is a coping behavior that could serve as an immediate response to the stresses of movement in and out of work.

Despite the fact that women were less likely to participate in the labor force than men, the smoking effects of employment transitions did not differ by gender in this sample. Although not statistically significant, coefficient signs on female interaction terms matched those of main effects, implying that if any gender-based differences exist, smoking responses may be stronger, not weaker, among women compared to men. One previous study has similarly documented stronger smoking responses to employment changes for women (Weden et al., 2006). Traditionally women's lower rates of labor force participation have caused them to be considered less "attached" to the labor force,

and therefore less susceptible to labor market forces. In an examination in trends of women's labor force participation over the last century, however, Goldin (2006) argues that recent decades mark a "revolution" in women's labor force participation, as women have begun viewing work as a long-term endeavor on which their sense of self depends. She suggests that exits from employment or the labor force now impact women financially and psychosocially in the same way that such transitions impact men. The results presented here lend support to the proposition that women's health behaviors are just as sensitive to employment changes as those of men, and underscore the need to include women in health-related labor market studies.

Whereas higher levels of income do not appear to influence the smoking benefits of leaving the labor market, higher wealth levels do. Specifically, higher levels of wealth offset the reduction in smoking behavior experienced on average. Although for any individual the size of the differences was relatively small (1 percentage point difference in smoking probability, 0.6 cigarettes difference in number smoked), the significance of the effect may shed insight on the mechanisms underpinning observed relationships. Research indicates that smoking is inversely associated with wealth, such that smokers have less accumulated wealth than non-smokers (Zagorsky, 2004). Among wealthy smokers, however, accumulated assets could neutralize financial pressures to reduce smoking due to income losses from labor market departure.

Neither household wealth nor income altered smoking responses to unemployment. It is possible that psychosocial stressors associated with job searching generate a smoking response, even when financial resources may minimize financial strain from being unemployed. However, caution is likely required when drawing any

conclusions from these null findings, especially in light of the analytic approach used here. In general, wealth and income vary extensively within, as well as between, individuals in the analytic sample. Among those who report being unemployed, however, these variables vary much more between participants than within participants across waves,[15] so the variation used to generate the effects on the interaction terms is limited.

A. Strength and Limitations

Different from most previous examinations of the relationship between employment conditions and smoking, this study employed nationally representative data, unrestricted by age, gender or geographic area. Data on smoking and employment status were gathered from participants in at least two, and up to six, different time periods. As a result, I was able to examine changes in behavior and work within individuals in regression analyses, thereby controlling for unobserved characteristics, like risk-taking proclivity, that might jointly predict labor market participation and smoking. While this approach decreased the variation used to generate effect estimates, resulting in relatively large standard errors, and at times, only marginally significant effects, it should have decreased the bias in coefficients that would be produced from ordinary least squares (OLS) analysis that characterizes some previous research on this topic. Moreover, different from other approaches that only examine exogenously determined job loss through plant closures, this analysis is generalizable to other, more common forms of employment transition, including layoff and voluntary departure.

In addition, this analysis explicitly distinguished between transitioning to unemployment or leaving the labor force altogether. My results suggest a different

[15] Specifically, for the full sample, standard errors for between and within variation, respectively, are 8.8 and 7.1 for income 85.8 and 83.3 for wealth. Among the unemployed, between and within standard errors are 6.3 and 1.1 for income and 34.7 and 15.3 for wealth.

pattern than has been observed in other research, specifically identifying a protective influence of labor market departure on smoking behaviors. The two studies that instead document increased smoking following labor market departure employ different methods and are based on different analytical specifications and assumptions. The contradictory results demonstrated here suggest that previous conclusions about the risks associated with being out of the labor market are subject to debate, especially in the current context.

One limitation of the PSID data is that smoking is only measured every two years. While detailed information about different jobs in the period between interviews can be used to construct more comprehensive work histories, the data provide no information about the number or timing of smoking behavior modifications between waves. Research suggests that up to one third of current or former smokers have made more than three quit attempts during their smoking tenure (John, Meyer, Hapke, Rumpf, & Schumann, 2004; Larabie, 2005); it seems possible that individual smoking status and intensity could shift more than once between observations. When smoking status does differ across waves, I am unable to determine when initiation, relapse or quitting occurred, so I cannot determine with precision whether the employment shift preceded the smoking shift. Longitudinal data that better tracks changes in smoking and employment may be needed to further test the relationships explored here.

In addition, the PSID data prevent me from investigating other important information about employment history. Although I attempted to explore some influence of events that preceded an employment shift, I was not able to specifically consider whether participant responsibility for movement out of work influenced relationships. The PSID involuntary job loss categories fail to distinguish between job losses from

layoffs, and job loss due to firing, when employee behavior, including smoking, might be partially responsible for the employment shift. Although the PSID isolates "no fault" job losses from plant closures, few people in the analytic sample experienced this type of job loss, limiting the power of fixed effects models to uncover relationships. If individuals respond differently to an involuntary employment status change based on their perception of their own responsibility for that shock, those results will likely be masked here.

The PSID also includes no information about job insecurity. Anxiety is common among workers who feel insecure about their current employment (Burgard, Kalousova, & Seefeldt, 2012; László et al., 2010). If people can accurately assess their job risks, they may correctly anticipate a shift to unemployment before it happens, and initiate behavior changes in advance of the actual transition. Because insecure workers are grouped with other employed participants in these analyses, any smoking responses they make in advance of changing employment status could serve to decrease observed effects. Other data may be required to determine whether insecurity about employment triggers smoking behaviors in advance of employment changes.

B. Policy Implications

According to these analyses, labor market participation increases smoking risks, both for those who are working, and those who are looking for work. Smoking prevention efforts, therefore, may need to target both the employed and the unemployed. For the employed, workplace smoking prevention programs, including smoke-free policies, incentives, and supportive programs have been shown to effectively decrease smoking and enhance quit attempts (Ham et al., 2011; Hopkins et al., 2010; Leeks et al., 2010). Such programs may be most successful in limiting uptake or increases in smoking

intensity if they target new employees, especially those joining or re-joining the labor force.

Health promotion initiatives outside of the workforce should attend to the specific smoking-related needs of the unemployed. The effectiveness of community or healthcare-based smoking cessation efforts among displaced workers is under-studied; one Danish study found that generalized programs did not serve unemployed smokers as well as it did others (Neumann, Rasmussen, Ghith, Heitmann, & Tonnesen, 2012). Integration of employment support and assistance into smoking prevention programs, or the tailoring of prevention efforts specifically to individuals who are looking for work could improve outcomes for this at-risk group.

Policymakers may want to incorporate the findings of this study into current discussion of strategies to support people out of work. During and after the Great Recession, many states extended unemployment benefits from 26 weeks to as many as 99 weeks, invoking discussion about the ramifications of such extensions for the labor market and individual recipients (Howell & Azizoglu, 2011). One study found decreased rates of risky health behaviors among re-employed workers who had received unemployment benefits during their unemployment (Bolton & Rodriguez, 2009). The debate about benefits extension could be improved by considering health outcomes during the cost and benefit analyses of these policies. Furthermore, if unemployment assistance programs could be paired with tobacco cessation programs or materials, public policies designed to support individuals financially during unemployment spells could help protect the health of the unemployed as well.

C. Conclusion

Although actively seeking work when not employed is associated with a greater likelihood of smoking, employment itself is not without smoking risks. Individuals are more likely to smoke, and smoke with greater intensity, when they participate in the labor force than when they leave it. These results hold for both men and women, and regardless of household income levels, though high levels of household wealth do attenuate some of these effects. By understanding and acting on these results, employers, policymakers and public health professionals can all contribute to national efforts to curtail smoking rates.

Table 3.1: Demographic characteristics of sample participants

	Full Sample (n=12,597)		Unemployed at least once (n=2241)			Not in the labor force at least once (n=3106)		
	n	**% /Mean**	**n**	**% /Mean**		**n**	**% /Mean**	
Smoking Experience (1999-2009)								
Continuous non-smoker	8575	68.1%	1185	47.1%	**	2007	64.6%	**
Continuous smoker	1822	14.5%	514	28.7%	**	477	15.4%	**
Periodic smoker	2200	17.5%	542	24.2%	**	622	20.0%	**
# cigarettes smoked per day[a]	4022	9.6	1056	9.6	*	1099	9.6	*
Gender								
Male	6235	49.5%	1106	49.4%		989	31.8%	**
Female	6362	50.5%	1135	50.6%		2117	68.2%	**
Age	12597	40.8	2241	38.1		3106	42.8	**
Race								
White	7422	58.9%	928	41.6%	**	1754	56.5%	**
Black	3765	29.9%	1039	46.6%	**	956	30.8%	
Hispanic	1064	8.4%	223	10.0%	**	318	10.2%	**
Other	296	2.3%	42	1.9%		71	2.3%	*
Missing	50	0.4%	9	0.4%		7	0.2%	
Completed education								
Less than HS	1234	9.8%	407	18.7%	**	420	13.5%	**
HS graduate	4606	36.6%	984	45.2%	**	1188	38.2%	*
Some college	3316	26.3%	512	23.5%	**	808	26.0%	
College graduate	3047	24.2%	272	12.5%	**	588	18.9%	**
Missing	394	3.1%	66	2.9%		102	3.3%	
Partnership Status								
Cohabitating at least once	10408	82.6%	1632	72.8%	**	2594	83.5%	
No cohabitation	2189	17.4%	609	27.2%	**	512	16.5%	
Household Resources								
Total family income[b]	12597	8.59	2241	5.48	**	3106	7.47	**
Total family wealth[b]	12597	26.14	2241	10.09	**	3106	30.12	**
Job Loss Experience (1999-2009)								
No reported losses	4657	37.0%	116	5.2%	**	225	7.2%	**
At least one job loss	7941	63.0%	2125	94.8%	**	2881	92.8%	**
At leave one invol. job loss	2972	23.6%	1375	61.4%	**	853	27.5%	**

Notes: Income and wealth are adjusted for inflation and measured in tens of thousands of 1999 dollars. Asterisks indicate statistical significance mean differences (weighted across samples for time-varying variables) between sample members who were and were not in an employment category. In wave-specific t-tests: a) smokers who experienced unemployment smoked fewer cigarettes in 1999, and more cigarettes in 2009, compared to never unemployed smokers; smokers who left the labor market smoked less in 2009 than smokers who had not; b) people who were unemployed in at least one wave had consistently lower levels of income and wealth than those who were never unemployed; people who were ever outside of the labor force had lower income levels, compared to those in the labor force, in all waves, but had higher wealth in 2001, 2003, 2007 & 2009. * $p<0.05$, ** $p<0.01$

Table 3.2: Wave-specific individual analytic samples

	Eligible participant in previous wave	New eligible participants this wave	Total eligible this wave	Loss to Follow-Up	(% of Total Eligible)	Missing Smoking or Employment Data this wave	(% of Total Eligible)	Wave Analytic Sample	(% of Total Analytic Sample)
1999	---	8161	8161	0	(0.0%)	66	(0.8%)	8095	(64.3%)
2001	8161	1202	9363	187	(2.0%)	147	(1.6%)	9029	(71.7%)
2003	9363	1008	10371	540	(5.2%)	130	(1.3%)	9701	(77.0%)
2005	10371	1125	11496	1115	(9.7%)	118	(1.0%)	10263	(81.5%)
2007	11496	1106	12602	1696	(13.5%)	120	(1.0%)	10786	(85.6%)
2009	12602	0	12602	2139	(17.0%)	284	(2.3%)	10179	(80.8%)
Tot. Obs.								58053	---
Tot. Indiv.	---	---	---	---	---	---	---	12597	(100.0%)

Note: To be eligible, participants must have been employed at least once between 1999-2009, must have worked within five years of each observation, and must have been observed at least twice.

Table 3.3: Comparison of fixed and random effects models of employment status and smoking

	A. Fixed Effects					B. Random Effects			
	b		CI			b		CI	
1. Smoking Status									
Working	---		---	---		---		---	---
Unemployed	0.0116	†	(0.000	, 0.023)		0.0221	**	(0.011	, 0.034)
Not in the labor force	-0.0179	**	-(0.027	-, 0.009)		-0.0116	*	-(0.021	-, 0.003)
2. Smoking Intensity									
Working	---		---	---		---		---	---
Unemployed	0.2850		-(0.165	, 0.735)		0.5195	*	(0.087	, 0.952)
Not in the labor force	-0.7868	**	-(1.257	-, 0.316)		-0.7044	**	-(1.149	-, 0.260)

Notes: b=beta coefficient; CI=confidence interval; asterisks denote significance of t-tests on beta coefficients. All models control for respondent age (linear and quadratic), and partnership status, as well as the three month unemployment rate in the state in which the participant resided and year fixed effects. Fixed effects models further control for time-invariant participant characteristics; random effects models control for participant race, gender, educational level and state of residence at survey time. Both fixed and random effects models adjust standard errors to account for repeated observations of participants. The Hausman tests comparing the fixed and random effects models of smoking status (X2=471.70) and intensity (X2=29.04) were statistically significant at the 0.01 level. Because Hausman tests are not permitted on models with robust standard errors, they were conducted on the above models without the error correction (all beta coefficients are the same). * $p<0.05$, ** $p<0.01$

Table 3.4: Changes in smoking and key risk factors over time

	1999 (n=8,095)		*2001 (n=9,029)*		*2003 (n=9,701)*		*2005 (n=10,263)*		*2007 (n=10,786)*		*2009 (n=10,179)*	
	n	%/Mean	n	%/Mean	n	%/Mean	n	%/Mean	n	%/Mean	n	%/Mean
Smoking status & history												
Non-smoker	6254	77.3%	6960	77.1%	7460	76.9%	7954	77.5%	8471	78.5%	8132	79.9%
Quit since last observation	---	---	288	3.2%	311	3.2%	360	3.5%	440	4.1%	427	4.2%
Smoker	1841	22.7%	2069	22.9%	2241	23.1%	2309	22.5%	2316	21.5%	2048	20.1%
Initiated/relapsed since last observation	---	---	233	2.6%	293	3.0%	262	2.6%	301	2.8%	321	3.2%
Avg # cigs per day	---	11.9	---	11.2	---	10.6	---	9.6	---	8.9	---	7.1
Employment status & history												
Employed	7193	88.9%	7922	87.7%	8508	87.7%	9045	88.1%	9255	85.8%	8064	79.2%
Unemployed in last observation	---	---	155	1.7%	238	2.5%	360	3.5%	259	2.4%	275	2.7%
Not in the labor force in last observation	---	---	304	3.4%	366	3.8%	374	3.6%	363	3.4%	300	2.9%
Experienced any job loss in last two years	1135	14.0%	1292	14.3%	1543	15.9%	1686	16.4%	2173	20.1%	1458	14.3%
Experienced invol. job loss in last two years	200	2.5%	234	2.6%	361	3.7%	350	3.4%	451	4.2%	405	4.0%
Unemployed	276	3.4%	384	4.3%	527	5.4%	426	4.2%	519	4.8%	838	8.2%
Working in last observation	---	---	186	2.1%	295	3.0%	238	2.3%	297	2.8%	637	6.3%
Not in the labor force in last observation	---	---	38	0.4%	57	0.6%	36	0.4%	53	0.5%	78	0.8%
Experienced any job loss in last two years	218	2.7%	297	3.3%	438	4.5%	343	3.3%	429	4.0%	666	6.5%
Experienced invol. job loss in last two years	105	1.3%	159	1.8%	239	2.5%	160	1.6%	210	1.9%	442	4.3%
Not in the labor force	626	7.7%	723	8.0%	666	6.9%	792	7.7%	1013	9.4%	1278	12.6%
Working in last observation	---	---	297	3.3%	313	3.2%	427	4.2%	583	5.4%	643	6.3%
Unemployed in last observation	---	---	36	0.4%	42	0.4%	59	0.6%	59	0.5%	67	0.7%
Experienced any job loss in last two years	310	3.8%	358	4.0%	345	3.6%	440	4.3%	475	4.4%	495	4.9%
Experienced invol. job loss in last two years	65	0.8%	59	0.7%	65	0.7%	65	0.6%	72	0.7%	122	1.2%
Employment changes and job loss												
Any change in employ. status since last obs.	---	---	1016	11.3%	1311	13.5%	1494	14.6%	1614	15.0%	2000	19.6%
Any job loss since last observation	---	---	1947	21.6%	2326	24.0%	2469	24.1%	3077	28.5%	2619	25.7%
Any involuntary job loss since last observation	---	---	452	5.0%	665	6.9%	575	5.6%	733	6.8%	969	9.5%

Table 3.5: Associations of employment status and job loss experience with smoking status and intensity

	A. Smoking Status			B. Smoking Intensity		
	b		CI	b		CI
Model 1: Employment Status						
Employment Status						
Working (ref)	---		--- ---	---		--- ---
Unemployed	0.0116	†	(0.000 , 0.023)	0.2850		-(0.165 , 0.735)
Not in the labor force	-0.0179	**	-(0.027 -, 0.009)	-0.7868	**	-(1.257 -, 0.316)
Model 2: Impact of *Any* Recent Job Loss						
Employment Status & Job Loss Interaction						
Working (ref)	---		--- ---	---		--- ---
Interaction (working & any job loss)	0.0078	*	(0.002 , 0.014)	0.2686	†	-(0.045 , 0.582)
Unemployed	0.0133		-(0.013 , 0.040)	0.4146		-(0.625 , 1.454)
Interaction (unemployed & any job loss)	0.0008		-(0.028 , 0.029)	-0.0504		-(1.129 , 1.028)
Not in the labor force	-0.0112	†	-(0.023 , 0.001)	-0.6814	*	-(1.341 -, 0.022)
Interaction (not in labor force & any job loss)	-0.0099		-(0.025 , 0.005)	-0.0691		-(0.822 , 0.684)
Model 3: Impact of Recent *Involuntary* Job Loss						
Employment Status & Job Loss Interaction						
Working (ref)	---		--- ---	---		--- ---
Interaction (working & invol. job loss)	0.0075		-(0.005 , 0.020)	0.5064	*	(0.013 , 1.000)
Unemployed	0.0136	†	-(0.002 , 0.029)	0.4832		-(0.105 , 1.072)
Interaction (unemployed & invol. job loss)	-0.0030		-(0.024 , 0.018)	-0.3177		-(1.096 , 0.460)
Not in the labor force	-0.0179	**	-(0.027 -, 0.008)	-0.7584	**	-(1.256 -, 0.261)
Interaction (not in labor force & invol. job loss)	0.0030		-(0.024 , 0.030)	0.1053		-(1.095 , 1.305)

Notes: b=beta coefficient; CI=confidence interval. Analyses employ linear probability models of smoking status and linear regression models of smoking intensity, with standard errors adjusted to account for repeated observations on participants. All models control for respondent age (linear and quadratic), and partnership status, as well as the three month unemployment rate in the state in which the participant resided, year and participant fixed effects. Smoking status models are based on 58,053 observations from 12,597 people. Smoking intensity models use the number of cigarettes smoked as the outcome variable, are limited to those participants who report smoking at some point in the analysis period, and are based on 17557 observations from 4017 people. † p<0.10, * p<0.05, ** p<0.01

Table 3.6: Gender differences in associations of employment status with smoking

	A. Smoking Status			B. Smoking Intensity		
	b	CI		b		CI
Employment Status						
Working	---	---	---	---		--- ---
Unemployed	0.0104	-(0.008	, 0.029)	0.2819		-(0.384 , 0.948)
Interaction (unemployed & female)	0.0023	-(0.021	, 0.026)	0.0067		-(0.871 , 0.884)
Not in the labor force	-0.0134	-(0.030	, 0.003)	-0.7442	†	-(1.598 , 0.109)
Interaction (not in the labor force & female)	-0.0065	-(0.026	, 0.013)	-0.0669		-(1.073 , 0.939)

Notes: b=beta coefficient; CI=confidence interval. Analyses employ linear probability models of smoking status and linear regression models of smoking intensity, controlling for respondent age (linear and quadratic), and partnership status, as well as the three month unemployment rate in the state in which the participant resided, year and participant fixed effects, with standard errors adjusted to account for repeated observations on participants. Smoking status models are based on 58,053 observations from 12,597 people. Smoking intensity models are based on 17557 observations from 4017 people who smoked during at least one observation. The beta coefficient on the uninteracted employment status terms reflect the marginal effect for moving from work to a particular category for men; a similar effect for women is measured as the linear combination of the uninteracted and interacted employment terms. Although interaction terms are insignificant, the marginal effect of leaving the labor force is statistically significant for women's smoking status at the p=0.01 level, and marginally significant for smoking status at the p=0.10 level. † p<0.10, * p<0.05, **p<0.01

Table 3.7: Associations of employment status with smoking behavior by income and wealth

	A. Smoking Status					B. Smoking Intensity			
	b		CI			b		CI	
Model 1: Income interaction									
Employment Status									
Working	---		---	---		---		---	---
Interaction (working & income)	-0.0018		-(0.007	, 0.003)		0.0103		-(0.173	, 0.194)
Unemployed	0.0107		-(0.004	, 0.026)		0.3215		-(0.162	, 0.805)
Interaction (unemployed & income)	-0.0012		-(0.008	, 0.005)		-0.0092		-(0.178	, 0.160)
Not in the labor force	-0.0183	*	-(0.033	-, 0.003)		-0.6347	*	-(1.213	-, 0.057)
Interaction (not in the labor force & income)	-0.0018		-(0.007	, 0.004)		-0.1249		-(0.385	, 0.135)
Model 2: Wealth interaction									
Employment Status									
Working	---		---	---					
Interaction (working & wealth)	-0.0005		-(0.002	, 0.001)		-0.0361		-(0.106	, 0.033)
Unemployed	0.0061		-(0.007	, 0.020)		0.4028		-(0.190	, 0.996)
Interaction (unemployed & wealth)	-0.0004		-(0.004	, 0.003)		0.0576		-(0.051	, 0.167)
Not in the labor force	-0.0219	**	-(0.033	-, 0.011)		-0.5439	*	-(1.085	-, 0.003)
Interaction (not in the labor force & wealth)	0.0030	*	(0.000	, 0.006)		0.1380	*	(0.026	, 0.250)

Notes: b=beta coefficient; CI=confidence interval. Income and wealth are both initially measured in tens of thousands, adjusted for inflation to 1999 dollars, and logged to reduce skewness. Analyses employ linear probability models of smoking status and linear regression models of smoking intensity, controlling for respondent age (linear and quadratic), and partnership status, as well as the three month unemployment rate in the state in which the participant resided, year and participant fixed effects, with standard errors adjusted to account for repeated observations on participants. All models use the same analytic samples as those in Table 3.4, except that Model 2A is based in 50,772 observations from 12,120 people and model 2B is based on 14,784 observations from 3,849 people due to missing wealth data. † p<0.10, * p<0.05, ** p<0.01

CHAPTER 4: THE INFLUENCE OF ECONOMIC, POLITICAL AND EXTERNAL FACTORS ON STATE CIGARETTE TAXES

I. Introduction

Smoking prevalence has declined significantly in the last few decades, but in recent years, progress has stalled (CDC, 2011b; HHS, 2012). In 1997, nearly one in four adults, and more than one in three high school students, smoked at least one cigarette in the previous month. Although by 2007 rates for both groups dropped to about 20%, no declines have been observed for either adults or youth since (CDC, 2011b; CDC, 2012b). Without further progress, Healthy People 2020 goals for adult (12%) and youth (16%) smoking will not be met (HHS, Healthy People 2020, 2012).

Cigarette excise taxes are considered one of the most effective strategies for reducing cigarette use because they are associated with decreased consumption and their revenues are sometimes used to fund tobacco control programs (CDC, 2000; CRTU, 2007; National Cancer Institute, 2011). Although all states levy cigarette excise taxes, rates vary from a few cents to several dollars per pack (Orzechowski & Walker, 2011). In 2007, the Institute of Medicine recommended that states with excise taxes below those in the top quintile raise their rates to be consistent with the high tax states (CRTU, 2007).

Unfortunately, little is known about what motivates changes in state excise tax levels, especially in recent years, making it difficult for public health advocates to efficiently target their efforts. Tobacco control professionals have suggested that economic contractions may drive states to raise cigarette taxes to generate revenue, noting spikes in the number of states passing hikes following the national recessions of

1981, 1990, and 2001 (CTFK, 2012b) Political scientists, however, argue that economic characteristics are only one of several factors that drive tobacco policy innovation (Studlar, 1999) Political factors, like legislative control, election cycles, and public opinions about potential or related policies, as well as pressures from neighboring states, may also be important policy predictors (F. S. Berry & Berry, 1992; Lowery, Gray, & Hager, 1989). Some previous research suggests that public support of tobacco control efforts, as well as actions of local and neighboring governments, influence the uptake of indoor air and tobacco sales restriction policies (Pacheco, 2012; Shipan & Volden, 2006). Whether economic circumstances, state politics, constituency beliefs, or regional pressures influence state cigarette excise tax rates, however, remains unclear.

Moreover, the key determinants of cigarette taxes could be changing over time, as tobacco control funding and public opinion evolves. In particular, the 1998 Master Settlement Agreement (MSA) between tobacco manufacturers and 46 state attorneys general resulted in new allocations of tobacco control revenue, some of which was used to fund social marketing campaigns to change beliefs about smoking and the tobacco industry. In the more than ten years since the MSA, the public has increasingly identified smoking as hazardous to smokers and others, and the majority now support some form of tobacco control legislation (Pacheco, 2011). If these public sentiments extend to beliefs about cigarette excise taxes, political resistance to tax reform may diminish, especially if economic downturns produce state budget deficits. On the other hand, current anti-tax rhetoric could be applied to excise taxes, enhancing, rather than diminishing the importance of political circumstances in predicting excise tax rates.

Cigarette excise taxes may be an invaluable resource for ensuring that smoking

reductions continue in the future, if they are levied at recommended levels. Yet many factors likely contribute to state decisions about appropriate tax rates. Better understanding of these factors is critical for the planning of future tobacco control programs and advocacy. Using annual data from all 50 states between 1980-2010, I explore the magnitude and strength of the associations between key economic, political, and regional characteristics and state cigarette excise tax levels. In addition, I examine whether the important predictors of cigarette tax rates have changed since the passage of the MSA.

II. Background

A. Cigarette Taxes as a Mechanism to Decrease Consumption

Cigarette excise taxes are considered one of the most successful mechanisms for decreasing smoking prevalence (CRTU, 2007; HHS, 2012). In a perfectly competitive tobacco market, the full price of any levied tax would be passed on to the consumer through price increases. If, however, tobacco companies collude in setting prices, they could share some of the costs of the tax with the consumer, particularly if tobacco consumption is relatively sensitive to price adjustments. Although estimates of the exact impact differ, recent research generally finds that cigarette tax hikes result in disproportionately higher cigarette prices. In other words, prices actually rise by more than the tax increase amount (Chaloupka, Hu, Warner, van der Merwe, & Yurekli, 2000). In one study, for example, a one cent increase in state cigarette taxes was associated with a 1.11 cent increase in price (Keeler, Hu, Barnett, Manning, & Sung, 1996).

In economics, the law of demand states that as the price for a particular product increases, consumer quantity demanded for that product will decrease. The addictive

nature of tobacco use could limit cigarette price elasticity, or consumer sensitivity to price changes. Theoretical work, however, suggests that people are likely to smoke less in the face of higher prices and higher taxes because they account for future benefits of reduced consumption in their decision-making (Becker, Grossman, & Murpy, 1991; Chaloupka, 1991). Recent analyses of cigarette price elasticity find that a one percent increase in the price of cigarettes is associated with a 0.4 percent decrease in cigarette demand (Gallet & List, 2003), with some evidence that the influence of price may be even stronger among individuals of low socioeconomic status (Townsend et al., 1994). Although relatively inelastic in conventional economics terms, these analyses suggest that consumers do respond, at least moderately, to changing cigarette prices.

A growing body of literature examines the logical extension of these findings, documenting decreased tobacco consumption following cigarette excise tax increases. Cigarette tax increases have been associated with declines in smoking, both among youth (Chaloupka & Wechsler, 1997; Chaloupka et al., 2011; Levy et al., 2004) and the general population (Chaloupka, Hu, Warner, van der Merwe et al., 2000; Chaloupka et al., 2011; Hu, Sung, & Keeler, 1995; Levy et al., 2004). In light of these studies and others, a recent panel of experts from 12 countries, assembled by the International Agency for Cancer Research, found sufficient evidence to conclude that increased tobacco prices and taxes are effective in reducing overall tobacco consumption by preventing initiation, increasing cessation and reducing consumption among current smokers (Chaloupka et al., 2011).

Most state and federal cigarette excise taxes are fixed rates that do not automatically adjust with inflation or changes in product price. Without regular increases

in cigarette tax rates, therefore, the real value of the excise tax will decrease over time relative to increased prices of other goods, potentially undercutting their role in smoking prevention. All states and the District of Columbia currently levy cigarette excise taxes, but tax levels vary by state. In 2011, New York's $4.35 tax rate was more than 25 times higher than the $0.17 rate levied by Missouri (CDC, 2012) Research, however, has not sufficiently analyzed these differences and the potential factors contributing to geographic variation in excise tax rates.

B. Factors Associated with Tobacco Policy Adoption and Diffusion

Political scientists argue that state public policy adoption is driven by the economic or political circumstances within a state, pressures generated by the policy actions of other legislative bodies, or a combination of the two (F. S. Berry & Berry, 1990; Lowery et al., 1989). Several key articles provide insight into the factors that are potentially important for cigarette excise tax policy. Berry & Berry (1992) developed a theoretical model of state tax policy adoption, using data on income taxes and gasoline taxes, in which they suggested five key factors that prompt state tax policy adoption. Two of these factors describe internal state economic conditions, two describe internal political conditions, and one describes regional political factors (F. S. Berry & Berry, 1992). In addition, recent research finds that coercive political forces, citizen attitudes toward smoking, and economic competition from neighboring states are important contributors to the diffusion of non-tax tobacco control policies (Pacheco, 2012; Shipan & Volden, 2008), and therefore warrant consideration as determinants of cigarette excise taxes.

Economic Factors: Berry & Berry (1992) argue that legislators consider both the

fiscal capacity and the revenue demands faced by a state when deciding whether to balance state budgets by limiting expenditures or raising taxes. States that are experiencing periods of economic development may have a large private resource base that can be leveraged through taxes, increasing the tax hike likelihood. On the other hand, economic crises might *also* stimulate tax policy, if short-term demand for state services increases at the same time that tax revenues stagnate or decline (F. S. Berry & Berry, 1992).

The extent to which politicians currently view cigarette excise taxes as a good source of long-term revenue, however, is unclear. Economic models suggest that increased cigarette taxes should increase revenues in the short-term, even as consumption falls. Even presuming cigarette prices are more elastic than data suggests, the percent increase in revenues from higher taxes will likely be greater than the percent decrease in consumption, resulting in an immediate jump[16] and then slow decline in revenues, taking many years to reach pre-tax levels (Chaloupka, Yurekli, & Fong, 2012). Some critics, however, have argued this process will occur much more quickly, resulting in stagnant or even lower tax revenues (K. E. Smith, Savell, & Gilmore, 2012); if politicians subscribe to these beliefs, neither economic development nor fiscal crisis may spur cigarette excise tax hikes. Moreover, in states where tobacco is produced, any fall in consumption, even if associated with higher tax revenues, could be perceived as hurting the local economy. Although some advocates have suggested that economic recessions may trigger state cigarette excise tax hikes based on descriptive data (CTFK, 2012b), no previous research has sufficiently explored relationships among state economic conditions and state excise

[16] Chaloupka et al. (2012) indicate that if cigarette price elasticity is -0.8, and tax accounts for 50% of product price, a doubling of the tax will result in a 40% decline in smoking, but a 20% increase in revenues.

rates throughout the country.

Political Factors: In addition to economic factors, Berry & Berry (1992) also consider two key political factors in their model of tax policy adoption. First, since tax increases are often considered politically unpopular, they may be least likely to be passed during a gubernatorial election year. Second, the political party composition of elected officials may determine likelihood of tax policy passage, though the exact relationship between party politics and policy outcomes is debated. Unified governments, in which either party controls both the legislative and executive government branches, may be more likely to pass new taxes because oppositional forces can erect fewer roadblocks in the process. However, the ideology or platform of the party in power could be important; more liberal parties that embrace extensions of government services may be particularly interested in raising taxes to cover the costs of such expenditures (F. S. Berry & Berry, 1992). In a recent assessment of voting behavior on federal tobacco legislation, Luke & Krauss (2004) found on the federal level, Republicans were more than three times as likely to vote in favor of policies supported by the tobacco industry (Luke & Krauss, 2004). Similar assessments of the role of party ideology or control on state cigarette taxes have not been conducted.

Other models of policy adoption note the importance of organized political interests (Gray & Lowery, 1996) and public support (Erikson, Wright, & McIver, 1993; Page & Shapiro, 1983). In an analysis of non-tax anti-smoking policies, Shipan & Volden (2006) found that higher proportions of lobbyists employed by health organizations were associated with greater likelihood of state tobacco control policy implementation. The presence and activities of interest groups mobilized around tobacco control, health, and

the tobacco industry may be important to consider for excise taxes as well (Campbell & Balbach, 2008; Givel & Glantz, 2001), though one recent study argues that effects demonstrated in previous studies are confounded (Bergan, 2010). Additionally, public opinion could predict tobacco control policy if politicians aim to respond to citizen concerns, or avoid electoral repercussions from the passage of unpopular legislation. Pacheco (2012) recently demonstrated that public opinions about smoking bans in public places were positively correlated with adoption of smoking ban policies. General support for either tobacco control or modifications to tax policies could facilitate increases in cigarette excise tax rates, yet no studies have explored these relationships analytically.

External Factors: The final factor in the Berry & Berry (1992) model of tax policy adoption and diffusion is the tax behavior of neighboring states. Other states likely serve as testing grounds for new policies; politicians who observe successful implementation of policies in similar states may be more amenable to instituting those policies at home (F. S. Berry & Berry, 1992). Pacheco posits that neighboring state policies impact not only politicians, but also citizens themselves, finding that public opinions in favor of public smoking bans increase when such bans are instituted in nearby states. On the other hand, some researchers argue that geographic proximity may be less important to these social learning processes in the current context of global markets and enhanced communication, or may mask impacts due to regional similarities, rather than learning (Shipan & Volden, 2012). It is plausible that important regional factors, like smoking prevalence and history of tobacco production might produce similar tendencies toward particular tax levels in a group of neighboring states. Yet neighbor state tax policies may still yield independent effects through economic competition for consumer

dollars. According to previous research, consumers will cross state borders in pursuit of lower cigarette tax rates (Beatty, Larsen, & Somervoll, 2009; Decicca, Kenkel, Mathios, Shin, & Lim, 2008). Politicians seeking to keep citizen expenditures in state will likely pay attention to surrounding state excise tax rates when making policy decisions, yet this hypothesis has not been explored empirically. In addition, cigarettes are taxed at the federal as well as state level, so politicians may consider changes in the federal tax burden when setting state rates as well.

Taken together, current theoretical and empirical work focused on the adoption of either tax policies or non-tax tobacco control initiatives suggest three categories of key factors that may influence cigarette excise tax policies. Economic conditions within a state may identify both need and capacity for generating revenues through taxation. Internal political dynamics, as well as opinions about smoking or tax-related topics, may determine the acceptability of increasing current tax levels for both politicians and the citizenry. Finally, characteristics external to a state, including neighboring state or federal tax policies and shared regional history, may produce state or regional tendencies toward or away from higher tax rates.

C. The Role of the Master Settlement Agreement

In 1998, tobacco manufacturers and 46 state attorneys general entered into a Master Settlement Agreement (MSA), bringing to close a set of lawsuits brought by the states against four major tobacco companies to recover Medicaid costs for treating tobacco-related illness. As part of the settlement, the tobacco companies agreed to pay the states a total of $206 billion over a 25 year period, with additional payments disbursed consistent with tobacco sales (Schroeder, 2004). Certain provisions in the MSA

were also designed to limit youth access to tobacco products and restrict tobacco-related advertising (Daynard, Parmet, Kelder, & Davidson, 2001). Despite evidence suggesting that states rarely dedicated allocated funds to smoking prevention efforts (Gross, Soffer, Bach, Rajkumar, & Forman, 2002), the MSA is arguably a key turning point in the history of tobacco control. One study credits the settlement with between a 5-13% decline in smoking rates, depending on the age group, by 2002 (Sloan & Trogdon, 2004). The MSA may also have led, indirectly, to increased support for tobacco control policies, since funds from the settlement were used to create the American Legacy Foundation, which launched a national social marketing effort to raise awareness about the harms of smoking. Between 1992 and 2007, the percent of Americans who believed that smoking should be banned in restaurants increased from 42% to 64%, and the percent who believed that smoking should be banned in workplaces increased from 55% to 75% (Pacheco, 2011). Finally, evidence suggests that tobacco industry responded to the MSA by changing its approach to both advertising and advocacy in the wake of the agreement (King & Siegel, 2001; LaVack & Toth, 2006; LaVack, 2006; Ruel et al., 2004; King & Siegel, 2001), keeping profits from tobacco products high (Sloan & Trogdon, 2004; Sloan, Mathews, & Trogdon, 2004).

If the MSA triggered a new era of both tobacco control and industry response, it may have altered the context in which cigarette excise taxes are enacted. The relative influence of political factors, in particular, may have changed, though this may depend on whether cigarette taxes are viewed primarily as health or fiscal policies. Cigarette taxes may now be considered more politically feasible if viewed as a mechanism for tobacco control, which has gained popularity. Different from indoor air laws or advertising

restrictions, however, cigarette excise taxes alter the price of the product, and may instead be viewed primarily as tax policy. Public opinion about taxes in general has remained relatively unchanged in recent years. As they did nearly a decade ago, the majority of Americans continue to oppose federal tax increases, even for the explicit purpose of reducing the federal deficit (Shaw & Gaffey, 2012). Political factors may therefore influence excise tax rates similarly both before and after the MSA, despite other changes in the tobacco control policy landscape.

III. Methods

A. Data and Sample

I compiled data describing cigarette excise tax rates for all 50 states and the District of Columbia from 1981 to 2011, creating a data set of 1,581 state-year observations. Because tax rates are recorded in the year they are implemented, I matched each state-year tax rate with a series of select economic, political, attitudinal and demographic characteristics from the prior year, when tax policy decisions were likely made. State non-tax data, therefore, are annual measures from the years 1980-2010.

All variables were derived from public databases maintained by government agencies or research teams, or publications that chart changes in state political characteristics, including cigarette excise taxes. For additional analyses, sub-samples of specific time ranges were created, based on research question or data availability.

B. Measures

State cigarette taxes: Information about state cigarette excise taxes were drawn from the 2011 edition of an annual publication entitled *The Tax Burden on Tobacco* (Orzechowski & Walker, 2011). This edition is produced by the economic consulting

firm Orzechowski and Walker, with financial support from leading cigarette manufacturers, and cooperation of the tobacco tax administrators in all 50 states and the District of Columbia. Excises taxes are measured in cents per pack of 20 cigarettes. In regression analyses, rates are adjusted over time for inflation to reflect real prices in 2010 using the Consumer Price Index-Urban, available from the BLS. Tax values are logged to decrease skewness in the distribution.

State economic conditions: I employed two annual measures of state economic conditions: the state civilian unemployment rate and the state per capita income. The state unemployment rate is calculated by the BLS, and measures the percentage of people in the labor force who are unemployed within a specific state. State per capita income data derive from the U.S. Bureau of Economic Analysis (BEA), and are calculated by dividing the total personal income of all residents of a state by the mid-year population of that state. In sensitivity analyses, I considered several alternatives to unemployment measures, including the national unemployment rate, available from the BLS, and indicators of national recession, as defined by the National Bureau of Economic Research (NBER).[17]

Finally, I include a dichotomous, time-invariant indicator of whether a state is an agricultural producer of tobacco. States are considered tobacco growers if the Economic Research Services (ERS) section of the U.S. Department of Agricultural reported that farmers in the state grew a non-zero number of tobacco acres in the analysis period. To investigate whether amount of tobacco grown, in addition to tobacco grower status,

[17] The NBER defines a recession as a period between an economic peak and trough in which a significant decline in economic activity spreads across the economy. The NBER's business cycle dating committee uses a variety of metrics, including GDP, employment and income, to assign start and end dates to recessionary periods.

influences cigarette tax rates, ERS data describing the annual number of farmed tobacco acres (in thousands), downloaded from the Centers for Disease Control and Prevention's State Tobacco Activities Tracking and Evaluation (STATE) System were added in sensitivity analyses.[18]

State political conditions and attitudes: These analyses include two measures of the annual political climate in a state: gubernatorial election, and party control of government. The gubernatorial election binary variable indicates whether the election occurred in a specific year (=1) or did not (=0). Party control is a categorical variable with three possible values. State party control was coded as Democrat if, in a given year, the state governor was Democrat and if Democrats held majorities in both the state house and senate bodies. Likewise, state party control is coded as Republican if, in a given year, Republicans controlled the governorship and held majorities in both legislative bodies. In all other cases, state party control is considered shared. Political information was compiled from the annual publication, *The Book of the States*, produced by the Council of State Governments.[19]

[18] This measure is included in sensitivity, rather than primary analysis, due to inconsistency of the reported data. None of the 18 identified tobacco growing states reported zero tobacco growth at any point in the analysis period, but data on acreage numbers is missing for 60 of the 522 state-year combinations.

[19] Some research about policy innovation incorporates measures of liberalism, in addition to party control. Citizen ideology and government ideology scores were developed by Berry and colleagues to capture the mean ideological position of the state's citizenry or elected officials in a given year, on a liberal-conservative continuum (W. D. Berry, Ringquist, Fording, & Hanson, 1998; W. D. Berry, Fording, Ringquist, Hanson, & Klarner, 2010) Citizen ideology scores are based on interest group ratings of Congressional representatives, with adjustments to account for citizen support for alternative candidates. Government ideology scores derive from analyses of roll call votes for elected Congressional representatives, applied to state governing bodies, weighted for each party's relative representation. Higher scores on each ideology index reflect higher levels of liberalism. These scores have been widely applied in policy research, including research on tobacco control legislation (Shipan & Volden, 2006). However, these measures were highly correlated with indicators of party control, and were not available for the full analyses period, so I incorporated them in sensitivity tests.

To capture citizen or resident opinions of taxes in general, I use a measure of attitudes specific to taxation based on data from 19 waves of the General Social Survey (GSS), an ongoing survey of societal trends (T. W. Smith, Mardsen, Hout, & Kim, 2011) administered between 1980-2009. Respondents were asked whether they believed federal income taxes were "too high," "about right," or "too low." Sample sizes preclude stable aggregation of these responses at the state level; responses are instead aggregated by regional division as the best approximation of state-level opinions about taxes. There are nine regional divisions in the United States defined by the U.S. Census Bureau, each containing between three and nine states. Very few respondents (<5%) specified a belief that taxes were too low, I therefore included only a continuous variable measuring the percent of respondents concerned that taxes were too high. Because the GSS is administered every other year, I interpolated values in alternate years by averaging percentages from the prior and subsequent years.

Two variables describing public attitudes toward tobacco control are derived from seven iterations of the Current Population Survey (CPS) Tobacco Use Supplement (TUS) that were administered between 1992 and 2007 (U.S. Census Bureau, 2008). Support for restaurant smoking bans is measured as the percentage of respondents, within a state in a survey period, who agreed that smoking in restaurants should be not allowed at all, as opposed to allowed in some or all areas. Voluntary home smoking bans are measured as the percentage of respondents who indicated smoking was not permitted in their home.

External conditions: In addition to incorporating annual state cigarette taxes as the dependent variable in analyses, I used cigarette tax data to create measures of annual cigarette tax levels in contiguous states. In most analyses I incorporate a measure of the

average cigarette tax levels in contiguous states; in sensitivity analyses I also consider the minimum and maximum tax level among the contiguous states. I add the average cigarette tax in contiguous states to regression analyses to assess regional political pressures specific to tobacco taxation. In addition, to capture federal activity around tobacco taxation I include a dichotomous variable to indicate the six years in which federal excise taxes on cigarettes were raised. To isolate the impact of tobacco production from general area effects, I also include categorical variables indicating the geographic region of the state, as defined by the U.S. Census Bureau (Northeast, Midwest, South, West).

State demographic controls: Measures describing the sociodemographic characteristics of a state in a specific year were drawn from data from the U.S. Census Bureau using annual Census measures and intercensal estimates of the March Supplement of the Current Population Survey, administed by the BLS, and employed as control variables. Population growth is measured as the annual percent increase in population size from the previous year, with negative numbers reflecting population loss. Variation in racial and ethnic composition is measured by the percent of the state population identifying as both Black and non-Hispanic, Non-Black (mostly White) and Non-Hispanic, or Hispanic of all races. Changes in age and educational level of residents are measured as the percentages of the population that are under the age of 18, over the age of 64, and over the age 25 with a college degree.

C. Analytic Approach

To assess the relationships between economic, political and external conditions and state cigarette excise taxes, I implement linear regression models, incorporating

techniques to account for potential bias or clustering from a variety of sources. In order to produce unbiased estimates of model coefficients, regression models require that all unmeasured factors captured in error terms be uncorrelated with other regressors. Furthermore, to produce accurate standard errors, observations must be independent of one another.

Each of these conditions could be violated in an OLS regression model of factors associated with state tobacco excise taxes, for several reasons. First, states have varied histories related to tobacco production and consumption that may produce state-specific leanings toward or away from taxation that are difficult to measure. Second, national time trends or periodic "shocks" to tobacco consumption, production or policy could have uniform impact on excise tax rates in all states. Third, theoretical arguments suggest that state policymakers are influenced by their neighbor state policies; observations are therefore likely to be clustered spatially. Finally, because politicians likely identify new cigarette tax levels in reference to their state's current levels, rather than choosing them at random, tax observations might be clustered from one year to the next within each state.

To arrive at a final analytic model, I examined the data in light of each of these, and considered different alternatives for addressing them. Details of these procedures and associated analytic tests are described in the Appendix. Based on my explorations, I model relationships between state cigarette excise rates and economic, political and social characteristics using multivariate linear regression employing state random effects, linear time trends and a spatial lag, controlling for first order autocorrelation. The econometric specification is:

$$t_{jy} = X_{jy-1}\beta + S_j\gamma + WB_{jy-1}\rho + f_{y-1}\alpha + C\Delta_y + \lambda_j + \eta_{jy-1} + \varepsilon_{jy}$$

where t_{jy} measures the real cigarette excise tax rate for state *j* in year *y*; X_{jy-1} is a vector of time-varying economic, political, and demographic characteristics in the year prior to observation; S_j is a vector of measured time-invariant state characteristics, including region and tobacco producer status; WB_{jy-1} measures the average cigarette excise tax rate in the states that border state *j*;[20] f_{y-1} denotes years in which federal cigarette excise tax hikes were implemented; C is a vector of two linear time periods (before and after the MSA); and λ_j *and* η_{jy-1} represent unobserved characteristics of states and first order state error terms, respectively. To better inform results and discussion, I also ran several unadjusted models, in which key covariates were entered as isolated regressors, controlling only for time trends.

In addition to a full model based on data from all years and all states, I conducted further analysis to consider variation in models over time and the potential role of tobacco control attitudes in tobacco taxation. To determine whether correlations between predictor variables and tax rates changed following the MSA, I conducted stratified analyses in the two time periods. To assess the potential impact of tobacco control attitudes on tax rates, I estimated an additional model, incorporating measures of such attitudes. These data are unavailable for the full analysis period, so this model assessed correlations between attitudes held between 1991-2007 and taxes implemented between 1992-2008.

To ensure the results I present are not sensitive to slight variations in construct measurement, I conducted alternative analyses in which 1) additional variables describing

[20] Formally, B is a vector of the excise tax rates in each state j, in the year prior to analysis and W is a matrix of state weights that captures the relative influence of each contiguous state's tax on a referent state's tax. Each w_{jn} captures the weight of influence that state n is hypothesized to have on referent state j. In these models, $w_{jn}=0$ for all states n that are not contiguous to state j, and when n=j. Otherwise $w_{jn}=1/k$ where k=the total number of states that share a border with state j.

political ideology and acres of farmed tobacco, available for a subset of years and/or states, were added to the model, 2) alternative economic indicators were substituted for state level unemployment, or 3) alternative indicators of the spatial tax lag were used.

All analyses were conducted using panel data or spatial model estimation packages in STATA 11 (Statacorp, College Station, Tex).

IV. Results

A. Growth of State Cigarette Excise Rates

Between 1981 and 2011, average nominal rates of cigarette excise taxes increased from $0.13 to $1.38, an increase nearly six times the rate of inflation. The increase is not uniform over the time period; throughout the country, rates grow more quickly following the MSA time period (Figure 4.1). Although little regional variation is evident in 1981, by 2011, the average excise tax rate in the Northeast ($2.70 per pack) was three times higher than the average rate in the South ($0.91) (Panel A), and taxes in non-tobacco growing states ($1.58) were 1.5 times higher than those in tobacco growing states ($1.08) (Panel B). Differences in average tax rates by region and tobacco-growing status were statistically significant in t-test comparisons, both before and after the MSA (Table 4.1).

B. Variation in Cigarette Excise Rates

In bivariate t-tests comparing average values, state cigarette excise taxes varied significantly under select state conditions, as a result of differences in both the number and magnitude of cigarette tax hikes (Table 4.1). Although average taxes do not vary across states with high versus low unemployment rates across the full time-period, stratified analyses indicate that tax rates were *lower* in high unemployment states before the MSA, but *higher* in high unemployment states following it. This shift appears to

reflect higher tax hikes when they occurred, rather than a greater prevalence of hikes. In all time periods, higher income and non-tobacco growing states were more likely to pass tax hikes, and incorporated hikes that were larger in magnitude, compared to lower income and non-tobacco growing states, resulting in significantly higher average rates.

Significant differences in average tax rates by party control exist only following the MSA, when average Democrat-controlled state rates were 1.7 times higher than those in Republican-controlled states (Table 4.1). This difference appears to be due to more, rather than larger, tax hikes. Finally, cigarette tax rates are lower in states where a larger percentage of people believe that federal income taxes are too high, and in states that border relatively low tax areas.

C. Correlates of State Cigarette Excise Rates

Comparing mean tax rates with bivariate tests can reveal patterns, but does not account for potential confounding from correlations between predictors of tax rates. The results of the multivariate regression models, which capture independent effects of various state characteristics on cigarette tax rates, are presented in Table 4.2.

The only economic factor significantly related to tax rates during the complete time period is tobacco-growing status (Table 4.2, Model 1). Non-tobacco growing states had 41% higher excise tax rates, compared to growing states, holding other factors constant from 1981-2011.

Across all years, Republican party control was significantly associated with 6% lower rates, compared with mixed party control, whereas Democrat control and gubernatorial election year are unrelated to cigarette tax rates (Model 1). Regional beliefs about federal income taxes demonstrated a slight positive association with cigarette taxes,

such that a one percentage point increase in the percent of people believing income taxes are too high is associated with a 0.3% increase in excise tax rates. Gubernatorial election years are uncorrelated with tobacco excise taxes.

Federal and regional cigarette tax rates are correlated with state rates in Model 1. Over the 31 year period, when average taxes in neighboring states double, taxes in the referent state increased by an average of 21%. Additionally, in the year following a federal tax hike, state taxes increased an average of 2.6%, holding other factors constant.

Finally, significant differences in regional tax rates and changes over time remain in multivariate models. Model 1 shows that under similar economic, political and social conditions, states in the Northeast and Midwest would have tax rates 67% and 34% higher than those in the South, respectively. Model 1 also indicates that the rate of growth in cigarette taxes increases after the adoptions of the MSA. Prior to the MSA, cigarette rates grew an average of 1% per year, though this was only marginally significant ($p=0.05$); after the MSA, the annual growth rate increased to 7%, holding all other factors constant.

D. Differences in Excise Tax Correlates over Time

In order to document changes in the correlates of excise tax rates before and after the MSA, the second and third models depicted in Table 4.2 stratify the results of the first model by time period. Consistent with Figure 4.1, variation in taxes by tobacco growing state, as well as region, is strongest after the MSA. In addition, per capita income is significantly and positively associated with taxes in the early time period ($b=0.03$), but shows no impact in the later time period.

Stratified results also demonstrate that prior to the MSA, control by the Democrat

party was associated with a 4% increase in excise tax rates, whereas Republican control had no impact. After the MSA, however, Democrat control becomes an insignificant factor, and tax rates under Republican control are 17% lower than those under mixed party control. Whereas neighboring states' tax rates appear to consistently impact referent state rates in both time periods, federal tax hikes appear to be stronger correlates following the MSA (b=.06).

E. Tobacco Control Attitude Models

In unadjusted models, positive attitudes toward bans on smoking at home and in restaurants and higher excise taxes are correlated, but only the influence of home smoking bans remains significant once models are adjusted for economic, political and social factors (Table 4.3). The one exception relates to home smoking bans. A one percentage point increase in non-smokers living in homes with smoking bans is associated with a 1.4% increase in excise taxes. In this model, the effects of other covariates (not shown) remain similar to what is reported in Table 4.1, Model 1, with one exception. The measure of attitudes toward income taxes becomes insignificant.

F. Sensitivity Tests

Including alternative measures of political sentiment or levels of tobacco production did not change the magnitude or significance of most effects (Table 4.4, Models 2-3). Increased tobacco production was associated with a small (<1%) decrease in excise tax rates, whereas measures of government and citizen ideology, when added to the original model, showed no effect. Models that employed alternative indicators of economic circumstances did not substantially differ from original models; neither rates of national unemployment nor indicators of recession were significant factors (Table 4.4,

Models 4-5).

Models that alternatively included a measure of either the maximum or minimum border tax, in the place of the average border tax, did not substantively impact regression results (Table 4.4, Models 6-7). While each measure of border taxes is significantly and positively associated with the referent state tax, the magnitude of impact is strongest when the single lagged measure of the average tax is used. Within, between and overall R^2 estimates for each of these models, which capture the extent to which the variation in taxes are explained by the model, are slightly lower in Models 6 and 7 than those in the final model reported in the data.

V. Discussion

Consistent with the growth of tobacco control initiatives in general (CRTU, 2007; HHS, 2012), state cigarette excise tax rates have, on average, increased over time, with stronger growth following the 1998 Master Settlement Agreement. Moreover, variation in excise tax rates has also increased over time. States where tobacco is farmed lag behind the rest of the country. Adjusted models that control for economic, political and other factors suggest that non-producing states levy tax rates that are more than 40% higher than those in tobacco producing states. Furthermore, even when tobacco production is taken into account, states in the Northeast, and more recently the Midwest and West, are establishing higher rates than states in the South. The results presented here suggest this may be due to both greater likelihood of tax hikes in certain areas and higher rate increases when hikes are adopted.

While some advocates and media pundits have argued that economic downturns may trigger tax hikes designed to fill budget shortfalls (CTFK, 2012b), the results

presented here suggest otherwise. Taxes do appear to be higher when state unemployment is high, particularly in recent years, but this relationship appears confounded by other factors. Once politics, attitudes and regional variation are considered, any relationship between state unemployment rates and cigarette taxes disappears. Similar patterns emerge when employing other measures of economic conditions or recession.

Instead, these results imply that changing distributions of political power may be more important than macroeconomic changes for understanding cigarette excise tax rates. Passage of any policy, including cigarette taxes, may be easier when the same party controls legislative and executive bodies; the significant effects associated with political control in some of the models, therefore, may be unsurprising. More notable are the change in those impacts over time. Prior to the MSA, Democrat control resulted in higher excise taxes, all else equal, and Republican control had little impact. Since 2000, however, Democrat control is no longer associated with high rates, whereas Republican control is now associated with 17% lower cigarette tax levels, compared with mixed control states. The descriptive data suggest this is largely due to fewer tax increases under Republican control, rather than smaller tax hike magnitudes. The 2012 election resulted in the largest number of unified governments since 1952, with 23 under Republican control (up from 18 following the 2010 election) (Kurtz, 2012). In these states, it seems likely that Republican leadership will continue to hinder efforts to raise cigarette tax rates.

Consistent with both theories of policy diffusion and research on other tobacco-related policies (Pacheco, 2012; Shipan & Volden, 2006), cigarette taxes in neighboring

and federal jurisdictions may play a role in the determination of a state's excise tax rates. These analyses indicate that as federal and surrounding excise tax rates rise, rates in referent states follow. In addition, cigarette taxes may be influenced by attitudes toward tobacco restrictions, though the magnitude and significance of these relationships were limited, once other factors were considered. Beliefs about smoking in restaurants and home smoking bans were somewhat to highly correlated with state demographic and regional characteristics (results not shown). Changes to the composition of state populations, and general time trends, may therefore drive changes in both attitudes and policies. Alternatively, more years of data may be needed to better assess the impact of tobacco-related attitudes on taxation.

A. Strengths and Limitations

While prior work has evaluated the drivers of both tax policy in general (F. S. Berry & Berry, 1992), and non-tax tobacco control legislation (Pacheco, 2012; Shipan & Volden, 2008), this research provides the first nationwide evaluation of state-level characteristics associated with cigarette excise tax rates. The analysis employs data from all 50 states and the District of Columbia over a 30 year period ending in 2011. As such it provides an opportunity to both comprehensively examine excise tax policies in recent history, and consider such policies both before and after the landmark Master Settlement Agreement. Furthermore, the size of the dataset allows for statistical techniques that incorporate assumptions about unmeasured state and regional characteristics relevant to tobacco control and potential serial correlation over time.

One key limitation of this research, however, is the absence of measures of organized advocacy. I was unable to find data describing the state level political activities

by either the tobacco industry or tobacco control advocates, yet other research suggests such influence could be important. Analyses of tobacco lobbying campaigns in the 1990s document comprehensive strategies designed to defeat a wide variety of tobacco control policies (Givel & Glantz, 2001). For example, in 2012, the tobacco industry spent more than $45 million dollars to fight a ballot initiative to raise excise taxes by a dollar in California. Tobacco control advocates credit these expenditures with the defeat of that initiative (CTFK, 2012a) Some research, however, suggests the California experience could be the exception rather than the norm (Bergan, 2010). Based on an assessment of tobacco lobbying efforts in the 1990s and the 2000's, Lum and colleagues (2009) argue that tobacco lobbying is becoming more sophisticated over time, targeting a smaller number of initiatives, but successfully defeating a larger portion of the ones that were targeted. If lobbyist power only applies to a handful of tax initiatives, inclusion of such data in models that equally weight all tax changes over several decades may produce little impact on effect sizes. The results presented here, therefore, could prove relevant for most moderate tax policy adjustments, when lobbying is less likely. For more radical and publicized tax proposals, however, advocacy dollars could trump party dynamics or other policy drivers. Without uniform data on spending by both advocates supporting and advocates fighting tax increases, however, the average role of interests groups in excise tax policies is unknown.

This study considers the impact of a variety of factors on enacted state excise tax rates, and therefore considers defeats of potential tax hikes and non-consideration of new tax policies equally. It is possible that economic, political and external factors impact the introduction of tax legislation differently from its ultimate passage. Advocates for excise

tax policies may benefit from information about the drivers of tax policy proposals, but this is outside the scope of this investigation. Final excise tax levels are most salient to consumers of tobacco, as they directly impact product prices, and therefore are most likely to significantly impact smoking and associated health outcomes. From a broad public health perspective, therefore, the results presented here may be most relevant.

B. Policy Implications

Cigarette taxes are considered one of the most promising tools in the tobacco control toolkit. The analyses presented here illuminate two potential opportunities for tobacco control advocates. First, states that border others where excise taxes have recently risen are ideal targets for rate adjustment. Consumers likely cross state borders in pursuit of lower tobacco tax rates (Beatty et al., 2009; Decicca et al., 2008). Consequently, politicians may be most amenable to raising cigarette taxes when the potential for losing revenue due to a tax hike is minimized.

Second, tobacco control advocates might benefit from distinguishing cigarette taxes from other taxes. In these analyses, higher cigarette taxes were positively correlated with both concerns about high federal taxes and support for other tobacco restrictions, especially home smoking bans. Thus, despite opposition to higher income tax rates generally, the American public may favor higher tax rates on harmful products, such as cigarettes, more specifically. As public opinion in favor of tobacco control continues to grow (Pacheco, 2011), public health officials have a window of opportunity to work with politicians to raise cigarette taxes and promote reductions in tobacco consumption.

C. Conclusion

State cigarette excise taxes remain one of the most promising strategies for

reducing cigarette use and preventing smoking-related illness and death, yet implementing them requires action by state legislators or voters. Although cigarette taxes have generally increased over time, there is significant disparity in tax rates across states, with tobacco growing and Southern states lagging behind the rest of the country. Despite suggestions by advocates that recessionary periods could spark higher cigarette taxes, the speed of excise tax growth in the future may depend more on the political make-up of state legislatures than the economic circumstances facing lawmakers.

Table 4.1: Prevalence of cigarette tax hikes and rates by state characteristics, 1981-2011

	All Years (1981-2011)					Pre-MSA (1981-1999)					Post-MSA (2000-2011)				
	N	% Obs with Hike	Avg. Hike Amt.	Avg. Tax Rate		N	% Obs with Hike	Avg. Hike Amt.	Avg. Tax Rate		N	% Obs with Hike	Avg. Hike Amt.	Avg. Tax Rate	
All State/Year Periods	1581	(16.4%)	21.3	59.8		969	(16.0%)	6.0	37.6		612	(17.2%)	43.8	95.0	
Economic Characteristics															
Unemployment Rate															
High State UE (>6%)	681	(15.9%)	18.8	57.7		505	(15.6%)	5.8	35.4	**	176	(16.5%)	54.3	121.7	**
Low State UE (<6%) (ref)	900	(17.0%)	23.9	61.8		464	(16.4%)	6.2	40.0		436	(17.7%)	41.4	84.9	
Per Capita Income (in thous.)															
High Income (>33)	736	(19.0%)	33.3	87.6	**	261	(19.9%)	10.1	49.8	**	475	(18.5%)	47.0	108.4	**
Low Income (<33) (ref)	845	(14.3%)	8.5	36.0		708	(14.5%)	3.9	33.1		137	(13.1%)	34.5	50.6	
Tobacco Growing Status															
Non-Tob. Growing State	1023	(19.0%)	21.3	68.5	**	627	(19.5%)	6.4	41.8	**	396	(18.2%)	46.5	110.7	**
Tob. Growing State (ref)	558	(12.0%)	23.3	44.5		342	(9.6%)	4.6	30.0		216	(15.7%)	41.4	67.6	
Poitical Characteristics															
Government Party Control															
Democrat	455	(17.1%)	21.1	61.1		314	(16.2%)	4.9	36.1		141	(19.1%)	51.5	116.7	**
Republican	260	(13.8%)	27.7	54.3		121	(15.7%)	6.9	39.9		139	(12.2%)	51.0	66.7	**
Mixed	866	(17.0%)	20.7	61.2		534	(15.9%)	6.4	38.0		332	(18.7%)	40.4	98.5	
Gubenatorial Election Status															
Gov. Election Year	421	(18.8%)	21.4	63.6		262	(18.3%)	8.5	39.2		159	(19.5%)	41.3	103.7	
Non-Gov. Election Year (ref)	1160	(15.7%)	21.4	58.6		707	(15.1%)	4.8	37.0		453	(16.6%)	46.3	92.2	
Attitudes tow. Fed. Inc. Taxes															
>62% Believe Tax High	824	(17.1%)	18.3	56.6	*	561	(16.6%)	7.0	39.1	**	263	(18.3%)	40.4	94.0	
<62% Believe Tax High (ref)	757	(15.9%)	25.9	63.7		408	(15.2%)	4.5	35.5		349	(16.6%)	48.6	96.6	
External Characteristics															
Federal/Border Taxes															
Above Avg Border Tax	690	(17.8%)	26.8	79.5	**	431	(16.2%)	8.2	44.9	**	259	(20.5%)	51.4	137.2	**
Below Avg Border Tax (ref)	891	(15.5%)	17.3	44.9		538	(15.8%)	4.2	31.8		353	(15.0%)	38.4	64.9	
Federal Excise Hike	306	(22.2%)	25.0	63.1		153	(20.9%)	3.8	36.2		153	(23.5%)	43.9	89.9	
No Federal Excise Hike (ref)	1275	(15.1%)	20.6	59.3		816	(15.1%)	6.5	37.9		459	(15.3%)	45.4	97.3	
Census Region (Indicator)															
Northeast	279	(27.2%)	26.6	96.1	**	171	(23.4%)	6.1	49.5	**	108	(33.3%)	49.3	170.1	**
Midwest	372	(15.1%)	19.2	58.6		228	(16.7%)	5.1	41.6		144	(12.5%)	48.8	85.5	**
South	527	(10.1%)	23.2	38.1	**	323	(7.4%)	5.2	27.7	**	204	(14.2%)	38.2	54.5	**
West	403	(18.9%)	17.9	65.0	*	247	(21.5%)	6.9	38.7	**	156	(14.7%)	43.5	106.6	*

Notes: All categories measured in the year prior to the tax rate variable to account for tax implementation lag (1980-2010). Tax hikes refer to changes in state-set excise tax rates not due to inflation. Average tax hikes based only on observations in which a hike is implemented; the average tax rate is based on all observations in the time period. Tax levels are adjusted for inflation and measured in 2010 cents. Categorical groups based on continuous variables are created by dichotomizing at the mean value for the entire sample, except for border tax rates, which are dichotomized at the mean for the time period. Asterisks denote significant differences in the average tax rate of a category group, compared to its referent group (for two group categories) or all others (for political control and region), using two-way t-tests. * p<.05; ** p<.01

Table 4.2: State economic, political and attitudinal factors associated with state cigarette excise tax rates (Logged) (n=1,581)

		Model 1: All Years				Model 2: Pre-MSA				Model 3: Post-MSA			
		(n=1,581)				1981-1999 (n=969)				2000-2011 (n=612)			
	Mean	b		CI		b		CI		b		CI	
State Economic Characteristics													
Unemployment Rate	5.98	0.002		(-0.01	, 0.02)	0.010		(0.00	, 0.02)	-0.010		(-0.04	, 0.02)
Per Capita Income (in thousands)	33.00	0.011		(0.00	, 0.03)	0.025	**	(0.01	, 0.04)	0.006		(-0.02	, 0.03)
Non-Tobacco Growing State	0.65	0.411	**	(0.14	, 0.68)	0.347	*	(0.08	, 0.62)	0.526	**	(0.21	, 0.84)
State Political Characteristics													
Government Party Control													
Democrat	0.29	0.034		(-0.01	, 0.08)	0.041	*	(0.00	, 0.08)	0.039		(-0.06	, 0.14)
Republican	0.16	-0.064	*	(-0.12	, -0.01)	0.021		(-0.04	, 0.08)	-0.170	**	(-0.29	, -0.05)
Mixed Control	0.55	--		--	--	--		--	--	--		--	--
Governor Election Year	0.27	0.002		(-0.02	, 0.02)	0.009		(-0.01	, 0.03)	-0.028		(-0.07	, 0.01)
Attitudes toward Federal Income Taxes													
% Believe Taxes Too High	61.49	0.003	*	(0.00	, 0.01)	0.002		(0.00	, 0.00)	0.005		(0.00	, 0.01)
% Believe Taxes Right/Too Low	38.51	--		--	--	--		--	--	--		--	--
External Factors													
Average Border State Tax (log)	2.87	0.207	**	(0.12	, 0.30)	0.180	**	(0.07	, 0.29)	0.185	*	(0.03	, 0.34)
Federal Excise Hike	0.19	0.026	*	(0.00	, 0.05)	0.008		(-0.02	, 0.03)	0.059	*	(0.01	, 0.11)
Census Regions													
Northeast	0.18	0.669	**	(0.31	, 1.03)	0.503	**	(0.15	, 0.86)	0.964	**	(0.49	, 1.44)
Midwest	0.24	0.340	*	(0.02	, 0.66)	0.260		(-0.06	, 0.58)	0.479	*	(0.08	, 0.88)
South	0.33	--		--	--	--		--	--	--		--	--
West	0.25	0.281		(-0.09	, 0.65)	0.104		(-0.26	, 0.47)	0.550	*	(0.07	, 1.03)
Time Trends													
Linear trend 1980-1999	--	0.011		(0.00	, 0.02)	0.008		(0.00	, 0.02)	--		--	--
Linear trend 2000-2010	--	0.067	**	(0.05	, 0.08)	--		--	--	0.078	**	(0.05	, 0.10)

Notes: b=beta coefficient; CI=confidence interval. All regressors lagged one year. Tax rates and per capita income are both adjusted for inflation. Excise taxes are measured in logged 2010 cents, income in thousands of 2010 dollars. All analyses based on linear regression models with random state effects, controlling for state demographic conditions, and adjusted for first order autocorrelation. * p<.05, ** p<.01

Table 4.3: Association of tobacco taxes with tobacco control attitudes, 1993-2008 (selected)

		Unadjusted				Adjusted for variables included in Table 4.2 Models			
	Mean	b		CI		b		CI	
Model 1: Percent of homes with smoking bans (n=561)	60.62	0.021	**	(0.02	, 0.02)	0.014	*	(0.00	, 0.03)
Model 2: Percent supporting full restaurant smoking ban (n=510)	52.44	0.025	**	(0.02	, 0.03)	-0.156		(-1.01	, 0.70)

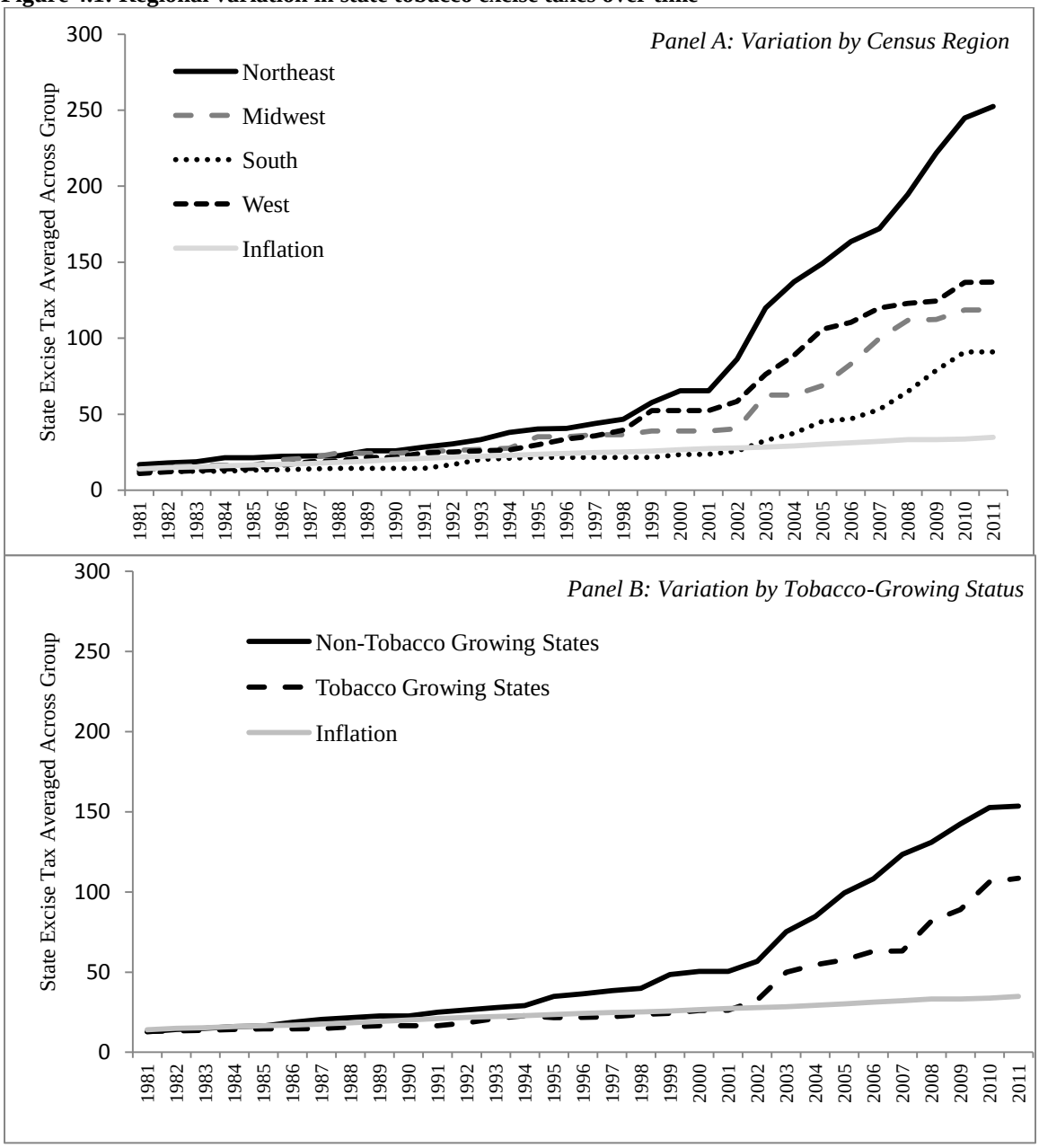
Notes: b=beta coefficient; CI=confidence interval. All regressors are lagged one year. All analyses based on linear regression models with random state effects, controlling for all covariates used in Table 4.2 models, and adjusted for first order autocorrelation. Data for Model 1 drawn from all states in the years 1992-3, 1995-6, 1998-9, 2001-2, 2003, 2006-7. Due to data availability, Model 2 excludes the year 2003. * $p<0.05$, ** $p<0.01$

Table 4.4: Sensitivity of models to alternative variable specifications

	Model 1			Model 2			Model 3			Model 4			Model 5			Model 6			Model 7		
	Original			Ideology			Tob. Prod.			Recession Ind.			Nat. UE			Min. Bord Tax			Max. Bord Tax		
	b	(se)		b	(se)		b	(se)		b	(se)		b	(se)		b	(se)		b	(se)	
State Economic Factors																					
State Unemployment Rate	0.00	(0.01)		0.01	(0.01)		0.01	(0.01)		---	---		---	---		0.00	(0.01)		0.00	(0.01)	
National Recession Indicator	---	---		---	---		---	---		-0.02	(0.01)		---	---		---	---		---	---	
National Unemployment Rate	---	---		---	---		---	---		---	---		0.00	(0.01)		---	---		---	---	
Per Capita Income (in thousands)	0.01	(0.01)	†	0.01	(0.01)		0.02	(0.01)	*	0.01	(0.01)	†	0.01	(0.01)	†	0.01	(0.01)	†	0.01	(0.01)	†
Non-Tobacco Growing State	0.41	(0.14)	**	0.37	(0.14)	**	0.35	(0.12)	**	0.42	(0.14)	**	0.42	(0.14)	**	0.39	(0.14)	**	0.42	(0.14)	**
Farmed Tob Acres (in thousands)	---	---		---	---		-0.00	(0.00)	**	---	---		---	---							
State Political Factors																					
Government Party Control																					
Democrat	0.03	(0.02)		---	---		0.04	(0.02)	†	0.03	(0.02)		0.30	(0.02)		0.04	(0.02)		0.03	(0.02)	
Republican	-0.06	(0.03)	*	---	---		-0.06	(0.03)	*	-0.06	(0.03)	*	-0.06	(0.03)	*	-0.06	(0.03)	*	-0.06	(0.03)	*
Mixed	---	---		---	---		---	---		---	---		---	---		---	---		---	---	
Liberal Ideology																					
Government	---	---		0.00	(0.00)	*	---	---		---	---		---	---		---	---		---	---	
Citizen	---	---		0.00	(0.00)		---	---		---	---		---	---		---	---		---	---	
Governor Election Year	0.00	(0.01)		0.01	(0.01)		0.02	(0.01)		0.00	(0.01)		0.00	(0.01)		0.00	(0.01)		0.00	(0.01)	
% Believe Fed. Taxes too High	0.00	(0.00)	*	0.00	(0.00)		0.00	(0.00)	†	0.00	(0.00)	*	0.00	(0.00)	*	0.00	(0.00)	*	0.00	(0.00)	*
External Factors																					
Avg Border St Tax (log)	0.21	(0.05)	**	0.21	(0.05)	**	0.21	(0.05)	**	0.20	(0.05)	**	0.21	(0.05)	**	---	---		---	---	
Min. Border State Tax (log)	---	---		---	---		---	---		---	---		---	---		0.07	(0.02)	**			
Max. Border State Tax (log)	---	---		---	---		---	---		---	---		---	---					0.07	(0.04)	*
Federal Excise Hike Year	0.03	(0.01)	*	0.02	(0.01)	†	0.02	(0.01)	†	0.02	(0.01)	*	0.03	(0.01)	*	0.02	(0.01)	†	0.02	(0.01)	*
Census Regions																					
Northeast	0.67	(0.18)	**	0.78	(0.20)	**	0.58	(0.16)	**	0.68	(0.18)	**	0.67	(0.18)	**	0.74	(0.18)	**	0.76	(0.18)	**
Midwest	0.34	(0.16)	*	0.46	(0.18)	**	0.30	(0.14)	*	0.34	(0.17)	*	0.34	(0.17)	*	0.39	(0.16)	*	0.37	(0.16)	*
South	---	---		---	---		---	---		---	---		---	---							
West	0.28	(0.19)		0.47	(0.22)	*	0.32	(0.17)	†	0.28	(0.19)		0.28	(0.19)		0.31	(0.19)		0.32	(0.19)	†
Time Trends																					
Linear trend 1980-1999	0.01	(0.01)	†	0.01	(0.01)	†	0.01	(0.01)		0.01	(0.01)	†	0.01	(0.01)	†	0.01	(0.01)	*	0.01	(0.01)	†
Linear trend 2000-2010	0.07	(0.01)	**	0.09	(0.01)	**	0.08	(0.01)	**	0.07	(0.01)	**	0.07	(0.01)	**	0.08	(0.01)	**	0.08	(0.01)	**

Note. b=beta coefficient; se=standard error. All regressors are lagged one year. All analyses based on linear regression models with random state effects, controlling for all covariates used in Table 4.2 models, and adjusted for first order autocorrelation. All models based on 1581 observations, except models 2 (n=1400) and 3 (n=1357), which estimated through 2008 due to data availability. † p<0.10, * p<0.05, ** p<0.01

Figure 4.1: Regional variation in state tobacco excise taxes over time



APPENDIX: TESTS OF BIAS AND CLUSTERING IN CIGARETTE TAX MODELS

I examined the potential of clustering of observations within states, during certain time periods, within spatial areas, and from year-to-year within states through a variety of models and tests, described here.

State-based clustering

One mechanism for addressing state-based clustering is the random effects model, which derives estimates that are weighted in conjunction with the proportion of the error presumed to be state-specific (Wooldridge, 2006). However, if unmeasured state characteristics are not only clustered within states, but also correlated with the independent variables of interest, both OLS and random effects models will also result in biased effect estimates by failing to control for omitted variables. In this case, state fixed effects models can be used to control for unmeasured time-invariant characteristics of states (Allison, 2009). However, fixed effects models correct for bias at significant cost to model efficiency, as they rely only on variation within states to develop estimates. In addition, they preclude estimating the effects of measured time-invariant state characteristics, due to the collinearity of these characteristics with the state effect.

In choosing between fixed and random effects models, therefore, researchers may need to weigh the extent of potential bias produced in a random effects model, with the loss of efficiency and inability to assess certain covariates in the fixed effects model. To determine the best approach for this analysis, I compared OLS, state random effects and state fixed effects models, using a series of statistical tests to explore assumptions about correlation of error terms within states and with covariates of interest.

Estimates from OLS regression did suffer from clustering of data within states,

(Breusch-Pagan test χ^2=7174.7, p<.01), indicating that random or fixed effects models are necessary. Table A.1 presents the results of the state fixed effects and random effects models. A Hausman test comparing the regression estimates from each model was statistically significant (χ^2=74.5, p=0.00), which suggests the fixed effects model may be more appropriate.[21] However, the direction and magnitude of the effects for the key explanatory variables of interest differed very little in the two models; where differences did exist, they were primarily in size or direction of estimates of effects for variables that were statistically insignificant in both models. Moreover, the random effects model allowed for an estimation of the effect of state history of tobacco production, as well as regional effects, each of which may have more substantive meaning in interpretation than a state fixed effect. For these reasons, I opted to employ state random effects.

Time-based clustering

The passage of time could influence regression coefficient estimates for two reasons: a shock could occur in a specific year that would alter cigarette excise rates in all states, or trends in cigarette attitudes or consumption could consistently enhance (or diminish) pressure on excise tax rates over time. One shock likely to impact state tax decisions is a modification to federal cigarette tax policies; because this is a measurable variable, I included it in my models. To capture increasing pressures on cigarette taxes across all years and regions, I included a linear time trend; to account for a possible intensification of this trend following the MSA, I experimented with a spline in 2000 to allow the time trend to differ before and after the MSA was passed in late 1998, with a year for policy changes to be implemented. A test of significant differences between the

[21] The random effects and fixed effects estimates used in the Hausman test employed the linear time trends, measure of contiguous state taxes, and further corrected for first order autocorrelation, as described below.

coefficients on the two time trend indicators was significantly significant (χ^2=32.1, p=0.00).

An alternative to the time trend and indicator of federal excise taxes is a year fixed effects model, which adjusts for any unmeasured national shock likely to impact all state cigarette excise taxes in a given year. Table A.1 presents the results of the year fixed effects model, in comparison to the time trend model. The Hausman test comparing these was statistically significant (χ^2=33.4, p=0.02). As with the state fixed effects model, however, the direction and magnitude of the effects for the key explanatory variables of interest differed very little in the two models. Furthermore, the coefficient on the federal excise tax hike was significant in the first model, indicating that at least some time-based variation is due to federal activity in cigarette taxes. Due to the small differences in the model outcomes, and the substantive meaning of the federal cigarette tax hike variable, I chose to incorporate time trends and the tax hike indicator, rather than year fixed effects.

Regional spatial dependence and autocorrelation

For a variety of reasons, including shared histories, economic dependence on tobacco production, and dominant political paradigms, it is possible that cigarette excise tax rates in different geographic areas of the country, or among contiguous states, would more closely resemble each other than random chance would predict. If the tobacco policies of nearby states actually exert an influence on the policy choices in a reference state, state cigarette excise tax rates may be spatially dependent; failure to control for such dependence could lead to biased estimates in regression models (Anselin & Bera, 1998). Even if spatial dependence is non-existent or otherwise addressed, additional spatial autocorrelation could arise if tax levels are clustered simply due to geographic

proximity, producing artificially low standard errors on regression estimates.

I explored issues of spatial dependence and autocorrelation in my data using spatial regression techniques employed in several cross-sectional samples. For each of 1980, 1990, 2000 and 2010, I compared the level of spatial correlation in the residuals of state cigarette tax regression models that did and did not include regional indicators and weighted measures of contiguous state tax rates. Table A.2 lists the Moran's I score calculated on the residuals of each model. The Moran's I is a global indicator of spatial correlation throughout the observations. A score of 0 equals no correlation; positive values indicate positive correlation and negative values indicate negative correlation. In all comparisons, the score decreases or becomes negative, indicating a decrease in positive spatial correlation; in 2010, the significant level of spatial correlation in the unadjusted model disappears in the spatially-adjusted model. For each year, I then estimated formal spatial lag models, which control for spatial dependence, and spatial error models, which adjust standard errors for spatial autocorrelation. Table A.2 provides the results of the Lagrange multiplier tests of the significance of the spatial lag or error. The significant results indicate that the spatial lag model adjusted for significant spatial dependence in 1990, 2000 and 2010 and the spatial error model adjusted for significant spatial clustering in 1990.

Taken together, the results of these models suggest that spatial dependence may present more of a problem than spatial clustering, so I opted to include a type of spatial lag in my final regression models. Because I ultimately adjusted for autoregressive time correlation within states (as described below), I was not able to use the formal spatial panel data models in Stata, but instead included a measure of the average of the cigarette

tax levels in states that are contiguous to the referent state in the panel regression models, which is similar to using a first order rook's weight matrix in spatial regression.

Serial correlation within states

Finally, random effects models can still produce biased standard errors if serial correlation in the non-state specific component of the error term remains (Baltagi, Jung, & Song, 2010). The Baltagi-Li joint test of serial correlation in the observation-specific error term of the random effects model was significant (χ^2=1197.9, p<.01). For my primary analysis, therefore, I modeled relationships between state cigarette excise rates and economic, political and social characteristics using multivariate linear regression employing state random effects, linear time trends and an approximation of a spatial lag, controlling for first order autocorrelation.

Table A.1: Sensitivity of models to alternative econometric specifications

	Model 1			Model 2			Model 3		
	Original			State FE			Year FE		
	b	(se)		b	(se)		b	(se)	
State Economic Factors									
State Unemployment Rate	0.00	(0.01)		0.00	(0.01)		0.01	(0.01)	
Per Capita Income (in thousands)	0.01	(0.01)	†	0.00	(0.01)		0.02	(0.01)	*
Non-Tobacco Growing State	0.41	(0.14)	**	---	---		0.42	(0.14)	**
State Political Factors									
Government Party Control									
Democrat	0.03	(0.02)		0.02	(0.02)		0.04	(0.02)	†
Republican	-0.06	(0.03)	*	-0.06	(0.03)	*	-0.06	(0.03)	*
Mixed	---	---		---	---		---	---	
Governor Election Year	0.00	(0.01)		0.00	(0.01)		-0.02	(0.01)	†
Beliefs about Federal Inc. Taxes									
% Believe Taxes too High	0.00	(0.00)	*	0.00	(0.00)	†	0.00	(0.00)	*
% Believe Taxes Right/Too Low									
External Factors									
Average Border State Tax (log)	0.21	(0.05)	**	0.16	(0.05)	**	0.15	(0.05)	**
Federal Excise Hike Year	0.03	(0.01)	*	0.02	(0.01)	*	---	---	
Census Regions									
Northeast	0.67	(0.18)	**	---	---		0.68	(0.18)	**
Midwest	0.34	(0.16)	*	---	---		0.33	(0.16)	*
South	---	---		---	---		---	---	
West	0.28	(0.19)		---	---		0.30	(0.19)	
Time Trends									
Linear trend 1980-1999	0.01	(0.01)	†	0.02	(0.01)	*	---	---	
Linear trend 2000-2010	0.07	(0.01)	**	0.08	(0.01)	**	---	---	
Constant	0.11	(0.71)		0.11	(0.71)		0.11	(0.71)	
N	1581			1581			1581		

Notes: b=beta coefficient; se=standard error. All regressors lagged one year. Excise tax rates and per capita income are both adjusted for inflation to 2010 values. Excise taxes are measured in logged 2010 cents. All models include variables controlling for changes in state demographic conditions. Model 1 is estimated with state random effects and a linear time trend. Model 2 is estimated with state fixed effects and linear time trends. Model 3 is estimated with state random effects and year fixed effects. Error terms in all models are adjusted for clustering at the state level and for first order autocorrelation. † $p<0.10$, * $p<0.05$, ** $p<0.01$

Table A.2: Models examining spatial autocorrelation

	Model 1			Model 2			Model 3			Model 4		
	Unadj. for Spatial Factors			Adj. for Spatial Factors			Spatial Lag			Spatial Error		
	I	(sd)		I	(sd)		ρ	(se)		λ	(se)	
Year												
1980	0.03	(0.087)		-0.06	(0.087)		-0.0088	(0.012)		0.0042	(0.011)	
1990	-0.11	(0.089)		-0.17	(0.090)	*	-0.026	(0.012)	*	0.0123	(0.008)	†
2000	0.07	(0.090)		0.00	(0.090)		-0.031	(0.014)	†	0.0099	(0.005)	
2010	0.10	(0.088)	†	0.037	(0.089)		-0.035	(0.013)	*	0.076	(0.095)	

Notes: I = Moran's I calcuated on model residuals, sd=standard deviation of I. ρ=coefficient on the spatial lag; λ=spatial error, se=standard error. All models regress state tobacco excise taxes on state economic and political conditions in the indicated year. Model 2 adds indicators of geographic region and an average of the tax rates in the states contiguous to the referent state. Models 3 and 4 employ spatial regression commands in Stata to incorporate a formal spatial lag (Model 3) or adjust for spatial errors (Model 4). The weights matrix employed in Models 3 and 4 is a first order rook contiguity matrix. In models 1 & 2, significance of I is tested using one-tailed t-tests; in models 3 & 4, significance of the ρ and λ are tested using the Lagrange Multiplier test.
† p<.10* p<.05, ** p<.01

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