TITLE: Are we still healthy in hard times? Revisiting the relationship between employment conditions and smoking

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ABSTRACT

Smoking is the leading preventable cause of mortality in the United States. Previous research on the impact of labor market cycles on smoking suggests that when state employment rates decline, 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. 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. Further analyses suggest that this attenuation may be due to a curvilinear relationship between unemployment rates and emotional distress that triggers increased smoking in hard times.

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. Although cyclical variation often triggers concerns about economic and housing stability, health may be impacted as well. Counter to conventional wisdom, previous research finds that when labor market conditions worsen, overall mortality and many disease conditions actually improve (Laporte, 2004; Neumayer, 2004; Ruhm, 2000; Ruhm, 2003; Ruhm, 2007; Svensson & Kruger, 2010). Such "procyclical" patterns, however, are not found for diseases like cancer, perhaps because diseases and related-deaths from cancer typically occur following years of exposure to risk factors, making it difficult to immediately ascertain impacts from short-term employment shocks.

Rapidly modifiable cancer risk factors, such as smoking, may be better indicators of how economic declines ultimately impact morbidity and mortality. 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). Currently, about 20% of adults smoke in the United States, a prevalence rate that remains above the 12% goal of Healthy People 2020 (U.S. Department of Health and Human Services [HHS], 2012).

Previous work examining the impact of changing labor market conditions specifically on smoking generally finds that as the economy worsens, smoking rates decline, particularly among heavy smokers. In the most extensive national study to date, 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. Additional studies

partially confirm these results among specific population groups, including men who are likely to be employed (Charles & DeCicca, 2008), and construction workers (Okechukwu, Bacic, Cheng, & Catalano, 2012).

This research, however, is limited in several ways. The data employed in recent national studies derive from surveys conducted in the 1990s and early 2000s, and therefore fail to include the periods of particularly high unemployment observed recently. Furthermore, 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 trigger different smoking responses by workers, compared with a similar uptick in the midst of a recession. For example, if concerns about losing work or finding employment are heightened during recessionary periods, procyclical "benefits" of increasing unemployment could be offset if recession-related stresses trigger more smoking. In the one study that considered non-linear relationships, Okechukwu and colleagues (2012) found evidence in support a quadratic association between labor market conditions and smoking among construction workers, especially for smoking intensity in general, and smoking status among the employed. No previous work, however, explicitly tests a non-linear relationship between employment conditions and smoking in a national sample of adults.

Previous studies also provide little insight into why procyclical smoking patterns exist. Most commonly, researchers argue that procyclical effects derive from individual changes in income; during periods of economic decline, consumers have less income to purchase tobacco products. Yet empirical support for income as a mechanism 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.

The ability to purchase cigarettes is a function of product price as well as income. Tobacco control advocates have suggested that economic contractions may drive states to raise tobacco taxes to generate revenue, noting the spikes in the number of states passing hikes following the national recessions of 1981, 1990 and 2001 (Campaign for Tobacco Free Kids, 2012). Because they increase product prices, tobacco taxes have been associated with declines in smoking in the general population (Chaloupka et al., 2000; Chaloupka, Straif, & Leon, 2011; Levy, Chaloupka, & Gitchell, 2004). Although three previous labor market studies include a measure of tobacco prices or taxes in their analyses (Charles & DeCicca, 2008; Okechukwu et al., 2012; Xu & Kaestner, 2010), results related to these measures are unreported or considered unreliable by authors.

Purchasing power derived from income and prices 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. 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; Daniels & Guppy, 1994; Smith, Cohen, Stammerjohn, & Happ, 1981), and high unemployment rates could alleviate some of this work-related stress. 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 suggests this may reflect higher job-related stress during periods of high employment. On the other hand, Barnes and Smith (2009) recently found that increases in an individual's economic insecurity increased the likelihood that men who smoked in 1983 remained smokers in 1998.

More research is needed to fully understand the complex pathways linking macroeconomic conditions and smoking, especially in the aftermath of recent downturns. 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, including whether this relationship is non- linear in nature. I then investigate the potential impact of income, tobacco taxes and emotional distress in mediating those relationships.

METHODS

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 Bureau of Labor Statistics (BLS). The BLS Local Area Unemployment Statistics captures key state indicators of economic conditions, including monthly and annual estimates of unemployment and employment.

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). 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 1.

Outcome variables: 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: To measure macroeconomic conditions, I use the state civilian unemployment rate for individuals age 16 and older, averaged across the three months[1]

[1] 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

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 not working, but actively looking for work, within a specific geographic area. 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 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 (Bureau of Labor Statistics [BLS], 2009).

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

with data from earlier years. In sensitivity tests, I use annual unemployment rates for the 12 months prior to, and including, the survey month.

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 using the Consumer Price Index-Urban, 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. 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. Excises taxes are adjusted for inflation and measured in 2010 cents per pack of 20 cigarettes.

The BRFSS includes questions which capture numbers of "unhealthy days" the respondent experienced in the past month due to poor physical health or poor mental health. Because the theoretical basis for the proposed analyses focuses on changes in emotional state brought about by changing labor market conditions, I measure emotional distress using a continuous measure of the number of days that a respondent indicated their mental health, including stress, depress, and problems with emotions, was not good (HHS, 2000). Although the mental health question that generates these responses has not been individually subjected to a wide range of validation tests, researchers often report trends in mental health using responses to only the mental health question (Moriarty, Zack, & Kobau, 2003; Zahran et al., 2005). As with income, 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). 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 both labor market participation and smoking, I include several measures of individual characteristics in all analyses, including a dichotomous indicator of female gender, as well as variables identifying respondent's age (linear and quadratic), binary variables for education levels (less than a high school degree, high school graduate, some college, college graduate), and binary variables for marital status (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.

Analysis

I model smoking status as a function of state, individual, and time characteristics, according to the following econometric specification:

$$S_{ijmy} = X_{ijm}\beta + E_{mjy}\,\gamma + \alpha_j + \delta_m + \lambda_y + \varepsilon_{ijmy}$$

where S_{ijm} measures smoking status (any or daily) for individual *i* in state *j* during month *m* in year *y*; X is a vector of individual or family sociodemographic characteristics; E captures state employment conditions; α, δ, and λ 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, 2011). Smoking also fluctuates seasonally, with higher rates during the summer months, and lower rates in the winter (Chandra & Chaloupka,

2003). Inclusion of the state, month, and year dummy variables, therefore, control for some potential bias in estimates due to correlation of both employment conditions and smoking with space and time. The majority of the 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 (X^2=5673.48, p=0.000), suggesting that the dummy variables inclusion may be required to prevent some omitted variable bias. All analyses are conducted using probit models on pooled data that include cluster-robust standard errors to account for the possibility that observations collected within a state in a given month are not independent.

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.

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).

RESULTS

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 were below 5.5%, but in the three years during and following the two recessionary periods in 2001 and 2007-2009, rates were higher, including average rates above 9% in both 2009 and 2010 (Figure 1). Across the entire time period, smoking prevalence among adults in the BRFSS sample declined from 23.4% to 17.3% overall (Figure 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.

Association of Unemployment Rates with 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 behavior remains procyclical, but this relationship attenuates 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). 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 from a starting point of 7.6% is associated with declines of only a slight, statistically insignificant, 0.03 percentage point decline in smoking prevalence, and a 0.06 percentage point decline in daily smoking rates (Table 2).

Income, Taxes and Emotional Distress as Mediators

Tables 3 and 4 present the coefficients (Table 3) and AMEs (Table 4) of unemployment derived from models used to test mediation of the unemployment-smoking relationship 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 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), and Columns 3 and 5 present the coefficients from the same probit models of any and daily smoking, with the mediator added. Table 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 provides a graphical depiction of the predicted prevalence of any (Panel A) and daily (Panel B) smoking for both unmediated and mediated models.

Income: The unemployment rate is negatively associated with income (Table 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. Income is also 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 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.[2]

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 and Table 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.

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 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). Any smoking and daily smoking both decline as cigarette taxes rise (Table 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). Average marginal effects decline slightly when mediators are added, though remain well within a standard error of the unmediated AMEs (Table 4).

Emotional distress: The results presented in Model C1 of Table 3 indicate that emotional distress *declines* as unemployment grows at low levels of unemployment. The significant

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

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 suggested by prior research, emotional distress is positively associated with any smoking, as well as daily smoking (Table 3, Models C3 & C5). At lower levels of unemployment, therefore, the negative 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 a 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 4, Models D & I). At higher levels of unemployment, however, the positive association between unemployment and stress results in an enhancement of 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, 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 4, Models E & J), AMEs of unemployment are relatively unchanged under strong employment conditions. Specifically, a one percentage point increase in unemployment from a low level of 3.7% is associated with a 0.12 percentage point increase in any smoking and a 0.11 increase in daily smoking, both when unmediated and when all mediators are included. 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.

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 (results not shown). Other measures of employment conditions produce slightly different marginal effects when substituted for the three month unemployment. 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 (results not shown).

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 a (statistically insignificant) 0.03 percentage point drop in prevalence (or a 0.1% drop from average prevalence rates). 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.[3] 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.

[3] In sensitivity analyses, 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.

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, 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.

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 2000 National Health Interview Survey indicate that more than one third of individuals living in or near poverty were current smokers, compared to only one fifth of those earning more than 300% of the federal poverty level (Barbeau, Krieger, & Soobader, 2004). 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. Other trends in the labor market may need to be considered. 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 occupational movement 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.

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, King, & Dube, 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, it does present another limitation. 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. Trends toward no or counter-cyclical effects under high rates of unemployment suggest the possibility warrants exploration.

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.

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, and these analyses suggest that in healthy economies, declines in employment conditions relieve emotional distress, but in weak 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.

Although full understanding of the mechanisms underlying procyclical smoking remains elusive, the analyses here predict 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, 2012). 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); both may deserve consideration by employers, and support from government.

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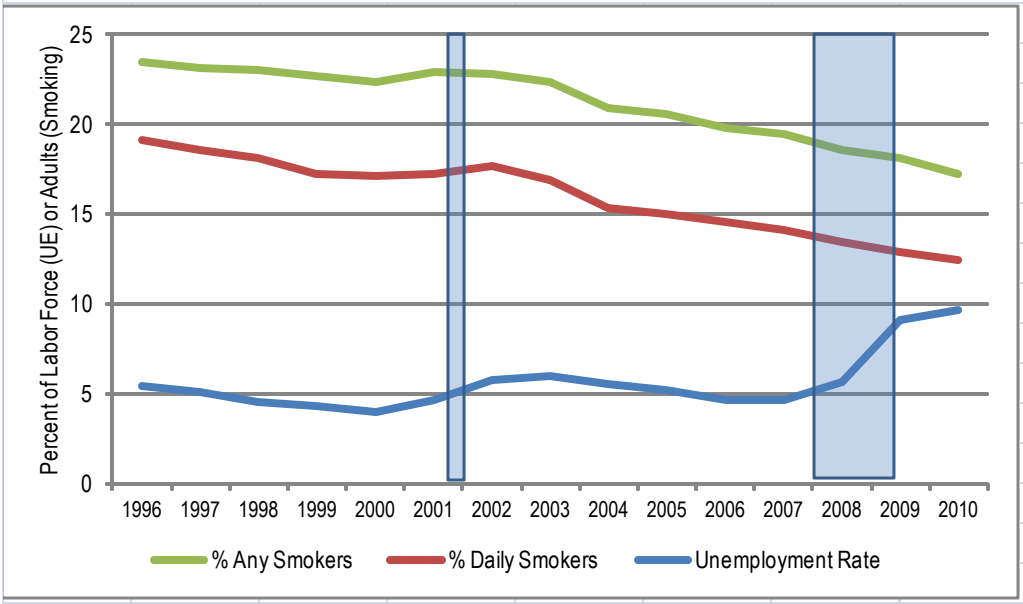
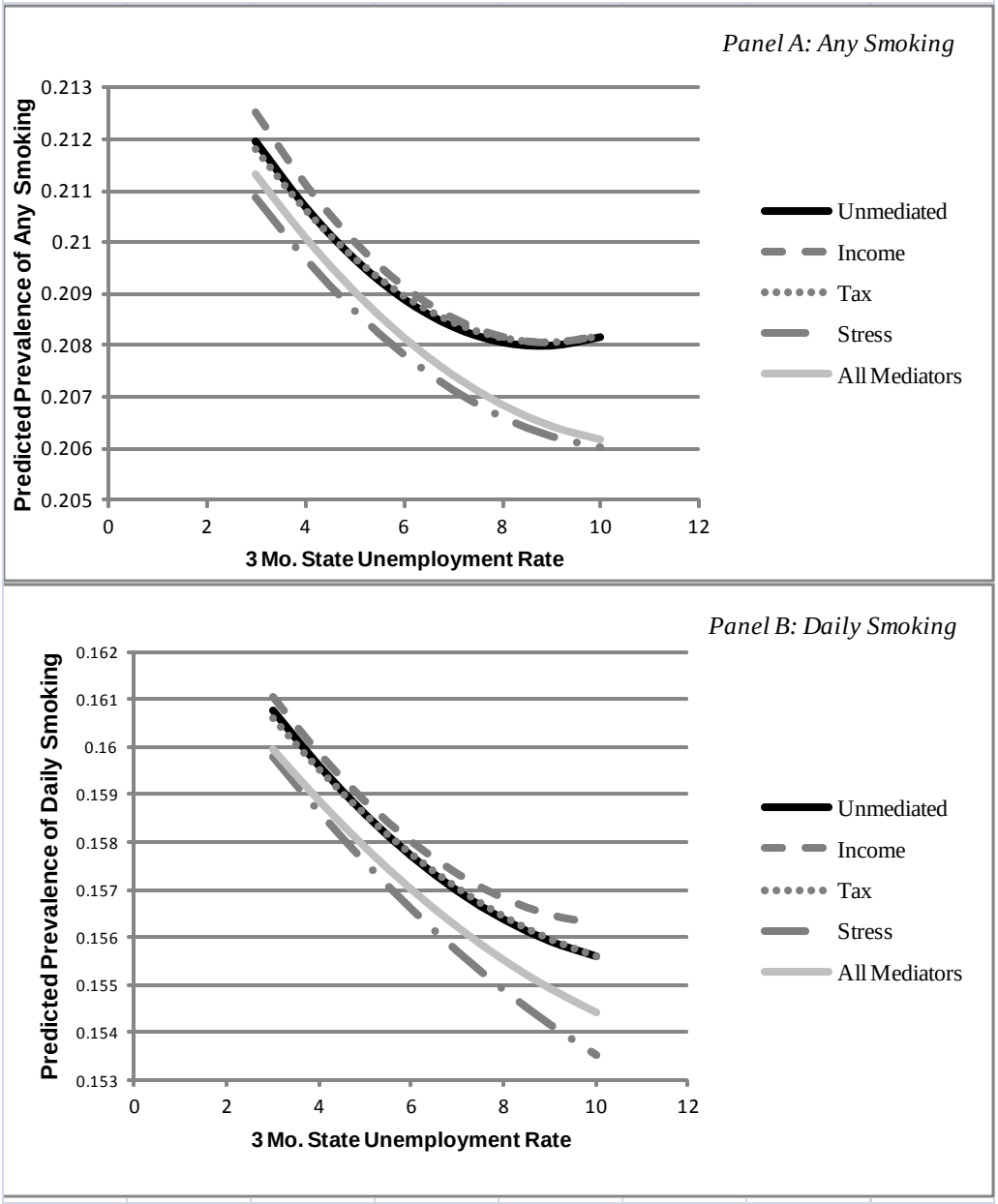
Figure 1: Trends in Unemployment and Smoking in Analytic Sample, 1995-2010, n=4,027,243



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 in surveyed in a given year. Blue bars indicate periods of national recession.

Figure 2: Predicted Prevalence of Any and Daily Smoking by Unemployment Rate



Notes: Predicted smoking prevalence is calculated as the weighted average, across all participants, of the predicted propensity based on the indicated model of smoking, holding the state unemployment rate at a specific level.

Table 1: Characteristics of BRFSS Analytic Sample (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			
Three Month 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: Frequencies are unweighted and means are weighted, se = standard error. Cigarette excise taxes combines the state and federal rates, is adjusted for inflation and measured in 2010 cents. Income describes the average income of individuals of the same race, gender, age group, education and state in the survey year, and is measured in thousands of 2010 dollars. Participant mental health indicates the number of days respondents report being in poor mental health, averaged across individuals of the same race, gender, age group, education and state in the survey year.

Table 2: Association of State Employment Conditions with Smoking Status

					Low Unemployment (3.7%)			Average Unemployment (5.6%)			High Unemployment (7.6%)		
		b	**(se)**		Average Marginal Effect	(se)		Average Marginal Effect	(se)		Average Marginal Effect	(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: 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 average marginal effect 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 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 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. The average marginal effect 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. 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. 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.

* p<.05; ** p<.01