Association of Cigarette Smoking with Changes in Macroeconomic Conditions*

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Abstract

This study uses data from the 1987–2021 Behavioral Risk Factor Surveillance System and state-level employment rates data from the US Bureau of Labor Statistics to estimate the association between macroeconomic conditions and cigarette smoking. We find that a one percentage point increase in employment rate is associated with a 0.4% increase in current cigarette smoking. This association is stronger among young adults aged 18-34 years (1.1%) than persons aged 35-64 years (0.4%); Black persons (1.4%) than white individuals (0.3%) or persons of other races/ethnicities (0.8%); and persons with a college education or better (0.8%) than those with some college education (0.4%). While we do not find any differences in the associations between males (0.3%) and females (0.4%), there was no association among elderly persons aged $\geq$ 65, Hispanics, and individuals with a high school diploma or lower educational attainment. However, we find evidence of attenuation in the associations over time, with no association in more recent survey data from 2011 to 2021. Based on the 2011–2021 data, we only find positive associations among persons aged 18-34 years (1.7%), Black individuals (1.2%), and persons with a college education or better (1.1%), and a negative association among persons with high school diplomas or lower education levels (-0.4%). We conclude that the economic condition and cigarette smoking relationship may have changed in recent years, especially after the Family Smoking Prevention and Tobacco Control Act in 2009 and the availability of electronic cigarettes in the US marketplace in 2007.

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1. Introduction

Tobacco use remains the leading cause of preventable deaths. Each year, it costs approximately 7 million lives worldwide. In the United States, cigarette smoking alone is responsible for 480,000 deaths annually (Centers for Disease Control and Prevention, 2023). Presently, more than 16 million Americans are living with smoking-related diseases. Additionally, the annual economic burden of cigarette smoking in the US exceeds $436.7 billion (Nargis et al., 2022). Although adults (ages ≥18 years) cigarette smoking rate in the US has declined from 42.4% to 11.5% between 1965 and 2021, an estimated 28 million American adults still smoke cigarettes in 2021 (Centers for Disease Control and Prevention, 2022).

Changes in macroeconomic environment can affect tobacco use. Lifestyle changes during negative shocks in the macroeconomy might occur because affected individuals suffer from unexpected consequences, including involuntary job loss, longer unemployment spells, stress, and poor mental and physical health (Golden and Perreira, 2015; Catalano et al., 2011). A number of individuals affected by such shocks may resort to unhealthy habits like smoking and excessive alcohol consumption as coping mechanisms for stress (Charles and DeCicca, 2008; Catalano and Dooley, 1983; Catalano, 1991). For example, during the Great Recession and the COVID-19 pandemic, evidence show noticeable increases in tobacco sales and use in the US.[1] According to Gallus et al. (2015), the number of current smokers in the US increased by approximately 0.6 million during the Great Recession. Additionally, Asare et al. (2021) demonstrate an increase in cigarette sales in the US during the COVID-19 pandemic.

On the other hand, individuals with low socioeconomic status, mostly affected by unfavorable macroeconomic conditions, may have relaxed budget constraints during good macroeconomic times. Therefore, the direction of change in substance use associated with changes in the macroeconomic environment is theoretically ambiguous since it depends on the lifestyle that dominates.

Studying the effects of macroeconomic conditions on cigarette smoking started in the early 2000s, yet, the evidence is inconclusive. Based on data from the US, some studies find that smoking prevalence falls as the economy contracts (Ruhm, 2005; Xu, 2013; Peng et al., 2022). On the other hand, while Goel (2008) finds that income and unemployment do not sig-

[1] During the Great Recession, the unemployment rate remained at higher levels for several months before returning to its usual long-run trend. By 2012, the unemployment rate was still as high as 8 percent. Economic recovery from the Great Recession was the slowest in history since output and unemployment rates in the US returned to their normal levels after several months (Boen and Yang, 2016; Currie et al., 2015; Cunningham, 2018). One in ten people on the labor market could not find a job, and involuntary unemployment formed a more significant proportion of the unemployment rate during the Great Recessionary period (Golden and Perreira, 2015; Theodossiou and Hipple, 2011). Likewise, the COVID-19 pandemic severely impacted the US macroeconomy, leading to a rise in the unemployment rate to around 15%, the highest level seen since 1932.

nificantly affect cigarette smoking, other studies find contrasting evidence of cigarette smoking increasing during economic downturns (Kalousova and Burgard, 2014; Dehejia and Lleras-Muney, 2004). Beside these pieces of evidence, there are also findings of heterogeneity in the economic conditions and cigarette smoking relationship. Currie et al. (2015) finds that high-educated women are more likely to smoke during economic downturns. Charles and DeCicca (2008) demonstrate that cigarette smoking increases among minorities and less-educated individuals with less employment opportunities and decreases among people with higher chances of being employed. While Falba et al. (2005) find that high-smoking levels persist even after re-employment, Golden and Perreira (2015) show that the effect becomes highest after re-employment and reverses when out of the labor market.

The findings from studies based on data from other countries also suggest ambiguity in the macroeconomic conditions and tobacco use relationship. A study that uses data from Italy shows higher unemployment rate is associated with higher risks of cigarette smoking and stress (De Vogli and Santinello, 2005). Montgomery et al. (1998) demonstrate that young British men who are unemployed are more likely to engage in life-long patterns of risky behaviors. Jung et al. (2013) demonstrate that job loss in Korea during the Great Recession was associated with a higher probability of becoming heavy smokers and job losers were more likely to smoke than their counterparts who remained employed. In China, Wang et al. (2016) find that an increase in the unemployment rate increases cigarette smoking. Kaiser et al. (2017) use German data to find that the propensity of becoming a smoker increases during downturns. On the other hand, Novo et al. (2000) followed young men and women from Sweden during a changing macroeconomic conditions. The study finds that unemployment is associated with lower daily smoking levels. McClure et al. (2012) show that the risk of cigarette smoking reduced among males whose income fell in Iceland shortly after the Great Recession.

The evidence summarized above suggests that the relationship between macroeconomic conditions and cigarette smoking is inconclusive. This study estimates the association between macroeconomic conditions and cigarette smoking using the 1987–2021 Behavioral Risk Factor Surveillance System (BRFSS) and employment data from the Bureau of Labor Statistics. As a baseline finding for comparison, we first replicate the estimates for cigarette outcomes in Ruhm (2005), which uses the 1987–2000 BRFSS sample. We then extend the analysis to include data from 1987 to 2021. Based on 1987–2000 survey data, Ruhm finds that a one percentage point increase in employment rates is associated with a 0.6% increase in current cigarette smoking.

Our replication exercise yields an estimate of 0.7%. However, we find evidence of attenuation such that we find an estimate of 0.4% from the overall sample from 1987 to 2021 and no statistically significant estimate from the 2011 to 2021 subsample.

We also find that the association differs by age, race, and education but not by gender in the overall sample. By age, the association is most pronounced among individuals aged 18-34 years (1.1%) followed by those aged 25-64 years (0.4%); however, no association was found not among persons aged $\geq$ 65 years. Likewise, the association by race/ethnicity is strongest among Black individuals (1.4%), followed by persons of other races/ethnicities (0.8%) and white individuals (0.3%), while no association was found among Hispanic persons. For the analysis by education, individuals with college or higher level of education have the strongest association (0.8%), followed by those with some college education (0.4%), but there is no association among those with high school diploma or lower levels of education. Using only the 2011–2021 sample, we find that the positive association exists only among persons aged 18-34 years (1.7%), Black individuals (1.2%), and people with college degrees or better levels of education (1%). On the other hand, there is a negative association among persons with a high school diploma or lower levels of education; however, no associations exist among the remaining demographic subgroups in this sample.

This study makes two contributions to the literature. The most recent study used BRFSS data from 2004 to 2017 (Peng et al., 2022). In contrast, this study uses the most up-to-date data covering three and half decades of data, allowing us to cover several heavy macroeconomic shocks, including the September 11, 2001, terrorist attack, the 2009 Great Recession, and the 2020 coronavirus pandemic. Including data from these dates when shocks heavily impacted the US provides additional exogenous variations in business cycles to leverage for identification. Additionally, our long-run data allows us to identify changes in the relationship between economic conditions and cigarette smoking over time.

Second, we provide estimates from an analysis that used more recent survey data when the US Food and Drug Administration (FDA) and states implemented several tobacco control policies and electronic cigarettes were available in the US marketplace. There have been several federal and state tobacco control policies in recent years, especially after Family Smoking Prevention and Tobacco Control Act was signed into law in June 2009, giving the FDA the authority to regulate the manufacture, distribution, and marketing of tobacco products (US Food and Administration, 2020). Additionally, electronic cigarettes were introduced in the

US marketplace in 2007 and became the preferred tobacco product among youth in 2014 (US Department of Health and Human Services, 2016). Consequently, there may be paradigm shifts in the relationship between economic conditions and cigarette smoking in recent data, which studies have not explored.

We organize the remaining sections as follows. In Section 2, we describe the methods. We present the results from a replication exercise of the findings in Ruhm (2015) and the new set of results in Section 3. Discussion and conclusion then follow in Section 4.

2. Methods

2.1. Data

Data on cigarette smoking come from the 1987–2021 Behavioral Risk Factor Surveillance System (BRFSS), an annual telephone survey of the adult population administered by the Center for Disease Control and Prevention. The BRFSS collects information on health-related risk behaviors, chronic health conditions, and the use of preventive services from all 50 states and the District of Columbia in the United States. It consists of repeated cross-sections of randomly selected individuals.

The survey collects the smoking behavior of individuals, allowing us to define binary outcomes for daily and current smoking. Before 1996, the BRFSS questionnaire included only one question asking for the number of cigarettes smoked per day. The questionnaires were expanded from 1996 to 2000 and asked for information on the number of cigarettes smoked per day among current smokers. Additionally, respondents were asked if they smoked cigarettes everyday, some days, or not all. We defined daily smokers as individuals who smoked every day and current smokers as those who smoke daily or some days.

The BRFSS data also provide information on individual characteristics. We adjust for age, sex, race/ethnicity, education, and marital status in the regressions. Additionally, the data has information on the state of residence of each respondent, allowing us to account for state-time invariant characteristics that affect cigarette smoking and correlate with changes in macroeconomic conditions.

The second source of data comes from the US Bureau of Labor Statistics (BLS) Local Area Unemployment Statistics.[2] Every month, the BLS publishes data on the number of adults

[2]The website, http://stats.bls.gov/lau/home.htm, which provides information on state-level employment and unemployment rates.

(ages 16+) employed, unemployed, and in the labor force for the 50 states and the District of Columbia. We calculate the percentage of adults in the labor force employed each month for each state to use a proxy for economic conditions.

2.2. Econometric Model

Individuals who smoke a positive number of cigarettes have their unobserved latent utility above some thresholds; otherwise, they become non-smokers. Because we observe smoking status of each individual (0/1) but not the latent utility, we model the observed binary cigarette smoking outcome as follow:

$$Y_{ijmt} = \mathbf{1}(\beta + \lambda Emp_{mjt} + \boldsymbol{\Pi X_{ijmt}} + \boldsymbol{\gamma_j} + \boldsymbol{\tau_m} + \boldsymbol{\delta_t} + \boldsymbol{\kappa_{st}} + \xi_{ijmt} > 0). \tag{1}$$

In equation (1), $\mathbf{1}(\bullet)$ is the indicator function taking the value 1 if its argument is true and 0 otherwise. The variable Y_{ijmt} represents cigarette smoking outcomes (current smoking, daily smoking $\geq$ 20 sticks, or daily smoking $\geq$ 40 sticks) for individual i, living in state j, and interviewed in calendar month m of survey year t, with a corresponding vector of individual-level characteristics X_{ijmt}. Because the outcome (Y_{ijmt}) is a binary variable, we use a probit estimator and report the marginal effect of the variable of interest for interpretation. The variable ξ_{imjt} also represents the disturbance term, indicating the effects of all unobserved and random factors that affect the outcome.

Our measure of the economic condition is the employment rate denoted by Emp_{mjt}. We use the average percent of the civilian non-institutionalized state population (ages 16+) employed during the month (employment rate) as a measure of economic condition. Therefore, the coefficient of interest in equation (1) is λ, and its estimate (i.e., $\hat{\lambda}$) measures the association between state-level employment rate and cigarette smoking. Identification of the parameter λ comes from the fact that local macroeconomic conditions measured through employment rates correlate with cigarette smoking behaviors.

In equation (1), the vector $\boldsymbol{\gamma_j}$ removes time-invariant state-level characteristics correlated with both changes in economic conditions and cigarette smoking. We also include a vector of calendar-month fixed effects ($\boldsymbol{\tau_m}$) to adjust for seasonality in cigarette smoking (Chandra and Chaloupka, 2003). Even after including the calendar-month fixed effects, other fiscal year characteristics might be similar across states. For example, previous evidence show that

cigarette smoking increased in the US during the Great Recession and COVID-19 pandemic (Gallus et al., 2015; Asare et al., 2021). Therefore, we include a linear year time trend ($\boldsymbol{\delta_t}$) to account for this concern. Some specifications for robustness checks include a vector of survey-year fixed effects. We also include $\boldsymbol{\kappa_{st}}$ to account for differential trends in cigarette smoking across states that can correlate with state-level economic conditions. Because our measure of economic conditions (i.e., Emp_{mjt}) is collinear with state, calendar month, and the linear time trend (or survey year fixed effects) altogether, we cannot include year-month fixed effects.

2.3. Changes in the smoking-employment relationship over time

Since we use data over three decades, there could be changes in the relationship between current cigarette smoking and economic conditions over time. We investigate the overtime differential relationship between economic conditions and cigarette smoking by interacting employment rate with a complete set of year dummies as specified below:

$$Y_{ijmt} = \mathbf{1}(\beta + \sum_{t=1987}^{2021} \lambda_t YEAR_t \times Emp_{mjt} + \boldsymbol{\Phi X_{ijmt}} + \boldsymbol{\gamma_j} + \boldsymbol{\tau_m} + \boldsymbol{\delta_t} + \xi_{ijmt} > 0), \qquad (2)$$

where $YEAR_t$ represents a dummy variable for the year t with a corresponding coefficient λ_t. The rest of the variables are described in equation (1). The parameters of interest are λ_t, for $t = 1987, 1988, ..., 2021$. The model is identified from changes in employment rate within states in the same year. Since we use state-level monthly employment rates, there are still state-level variations in the employment rate each year. We summarize the 35 coefficients of interest with their 95% confidence intervals using the "margins plot" command in Stata.

3. Results

3.1. Replication exercise

The replication exercise focuses on only the cigarette use outcomes in Ruhm (2005). Ruhm's study used the same data sources from 1987 to 2000, model specification, and considered tobacco outcomes, body weight, and physical activity. In this exercise, we only replicate the results for cigarette smoking since it's the focus of this study. Table 1 shows the means of the outcomes and covariates. We report the weighted and unweighted means, as reported in the original study. The first two columns show the means reported in Ruhm (2005). We report our

replicated sample means in the next two columns. While Ruhm's data comprised of 1,490,249 individuals, our replicated sample size was 1,490,293.

Generally, our replicated weighted and unweighted sample means do not differ from those reported in Ruhm's study for the three smoking outcomes. We find only one significant difference between our unweighted sample means of the explanatory variables compared to those we replicate. While 49.3% of the individuals used in Ruhm's sample are females, 58.5% of our replicated sample are females. We validate this statistic based on the yearly surveys, which consistently indicate that the proportion of female participants for each year is within the range of 57-59%. It implies that the average percentage of females in the overall sample must be within this range.

Table 2 replicates the regression estimates for the cigarette outcomes in Ruhm (2005). Panel A shows the results of the original study, while Panel B shows our replicated estimates. For each outcome, the second column displays its weighted mean. The third column of Table 2 shows the predicted effect of a one-point increase in employment rate on the percentage point change in the probability of smoking evaluated at the sample means of the explanatory variables reported in Table 1. Each row corresponds to one regression estimate with two standard errors in parenthesis and square brackets. A robust-standard error calculated assuming that observations are independent across months and states but not within states each month are reported in parentheses. Its corresponding robust-standard errors assuming independence across states are shown in brackets. The last two columns of Table 2 show the estimates expressed as a percentage change at the outcome means. Those in the fourth column are calculated by dividing the marginal effects in the third column by the sample averages in the second column. On the other hand, the estimates in the last column are the averages of the marginal effects for all the individuals in the sample divided by the means in the second column.

The results in Panel B of Table 2 show that our replicated sample generates estimates that are quantitatively and qualitatively similar to those reported in Ruhm's study. While Ruhm (2005) found that a one-point increase in state-level employment rate increases current cigarette smoking by 0.132 percentage points, we find 0.168 percentage points. These estimates correspond to an increase in cigarette smoking by 0.6% and 0.7%, respectively. For the daily smoking ≥ 20 and ≥ 40 sticks of cigarettes, Ruhmn found 0.104 and 0.016 percentage points, respectively, while we find 0.108 and 0.023 percentage points, respectively. For the daily cigarette smoking ≥ 20 sticks, both Ruhm and our replicated estimates correspond to 0.9% and

1.0% depending on how the marginal effects are calculated. For daily cigarette smoking ≥ 40 sticks, Ruhm's estimate corresponds to 0.9% to 1.4%, while our estimate ranges from 1.3% to 1.7%. Because we do not consider daily smoking ≥ 20 and ≥ 40 sticks of cigarettes in the full sample analysis due to data unavailability, we do not explore further the differences between our replicated estimates and Ruhm's estimates for daily smoking ≥ 40 sticks of cigarettes.

3.2. Main analysis

Alongside the initial sample of 1,490,293 individuals organized between 1987 and 2000, we compiled an additional 7,944,682 individuals surveyed between 2001 and 2021. Consequently, our final dataset includes 9,434,975 individuals surveyed across $1987 - 2021$. The last two columns of Table 1 show the full sample weighted and unweighted means. The $1987 - 2021$ BRFSS sample shows a continuous decline in current smoking prevalence. The sample indicates that approximately 18% of individuals in the sample were current smokers. However, after accounting for sample weighting, the current smoking prevalence increases to 20%. The individuals in the full sample are older than those in the $1987 - 2000$ sample (mean ages: 53 vs 46 years), suggesting the BRFSS surveyed older individuals in recent years. The proportion of all racial groups increased in the full sample, except white individuals. The proportion of persons of non-Hispanic Black race increased from 9.4% to 10.3%, other race/ethnicity (non-white non-Hispanic) increased from 3.6% to 6.2%, and Hispanic origin increased from 9.1% to 12.7%. On the other hand, the proportion of individuals of white race/ethnicity decreased from 77.9% to 70.8%. In the full sample, the proportion of individuals with high school diploma or lower levels of education decreased from 48.7% to 43.9%, while those with at least some college degrees increased from 51.1% to 55.8%. Compared to the individuals in the $1987-2000$ survey cohorts, those in the full sample were more likely to be never married or divorced/separated (30% vs 32.6%) or less likely to be married/cohabitating (62.5% vs 60.3%).

The measure of economic conditions, proxied by the percentage of state civilian non-institutionalized monthly employment (henceforth "employment rate"), is relatively smaller in the full sample than in the sample used in Ruhm's study. While the average employment rate from 1987 to 2000 was 64.1%, it declined to 61.3% in the full sample. Similar to the figure in Ruhm's study, we plotted Figure 1 to demonstrate the relationship between the employment rate and cigarette smoking, normalized to 100 in 1987 values. The employment rate was reasonably stable during the study period, with a slight dip during the Great Depression

and the COVID-19 pandemic. In contrast, the current cigarette smoking rate declined slowly during the sample period used in Ruhm's study (1987 to 2000). Despite the stable employment rates between 2001 and 2021, there was a drastic decline in the current cigarette smoking rate by about 40 percentage points. Such a sharp decline in the current cigarette smoking rate after 2000 while the employment rate continued to be stable may suggest that the findings in Ruhm's study may have changed. Also, the three major economic shocks (the 2001 recession, the Great Recession, and the COVID-19 pandemic) could change the relationship between economic conditions and cigarette smoking. We devote the rest of this section to testing the hypothesis of whether the current cigarette smoking and employment relationship has been stable over time and exploring possible heterogeneity.

In Table 3, we provide the regression results from the full sample and other sub-samples ($1987-2010$, $2001-2021$, $2011-2021$, and $2017-2021$). We do not use sampling weights in the regressions in the left panel. Because sampling weights are important in the recent surveys, we use them in the some specifications and report the results in the right panel of Table 3. Robust standard errors, calculated assuming that observations are independent across months and states but not within states and each month, are reported in parentheses. The columns marked (a) and (b) show the percent change in current smoking when predicted effects are evaluated at the sample means of the regressors or calculated for each person and averaged across all sample members, respectively.

All the estimates from the specifications that did not use sampling weights show a statistically significant positive association between current cigarette smoking and employment rate. Compared to the findings from $1987-2000$, the estimate is similar in the full sample. Particularly, a one-point increase in employment rate increases current cigarette smoking by 0.6%. The size of the estimate increased to 0.9% when we restricted the sample from $1987-2010$. However, other sub-samples that used data from years after 2000 show a consistently diminishing relationship between employment rate and economic conditions. Specifically, a one-point increase in employment rate increases current cigarette smoking by 0.3% in both the $2001-2021$ and $2011-2021$ sub-samples and 0.2% in the $2017-2021$ sub-sample. These estimates suggest that if we fail to account for sampling weight in the estimation similar to the approach in Ruhm's study, the relationship between economic condition and smoking attenuates as we limit the sample to more recent years.

On the other hand, accounting for sampling weights in the regressions leads to a positive

and statistically significant estimate of 0.4% in the full sample, 0.6% in the $1987-2010$ sub-sample, and 0.5% in the $2001-2021$ sub-sample. We consistently find evidence of attenuation among the $2011-2021$ and $2017-2021$ sub-samples similar to the findings from the regressions that did not use sampling weights; however, the estimates from these groups are imprecise zeros.

Comparing the estimates in Table 3 from the full sample to those in the sub-samples suggests an attenuated relationship between the employment rate and current cigarette smoking as the newer surveys are used for the analysis. We explore the hypothesis of a differential relationship between smoking and employment rate by providing coefficient plots from equation (2) to show dynamics. Figure 2 shows the marginal effect estimate and 95% confidence interval corresponding to the estimate for each year from 1987 to 2021. The plots confirm the finding that the association between a one-point increase in employment rate and current smoking attenuates surveys from recent years. From the regression model that did not account for sampling weights, we find consistently decreasing estimates over time which are statistically indifferent from 0 after 2011. After using sampling weights, we find stability in the estimates before 2011, after which we find consistently decreasing estimates over time.

Figure 2(b) suggests the attenuation began after the Family Smoking Prevention and Tobacco Control Act was signed into law in June 2009 (US Food and Administration, 2020). The law gave the US FDA the authority to regulate the manufacture, distribution, and marketing of tobacco products. Additionally, electronic cigarettes were introduced on the US market in 2007, and they increased in popularity over time and became the preferred tobacco product among youth by 2014 (US Department of Health and Human Services, 2016). Based on these discussions, the remaining subsections focus on the overall sample and subsample from 2011 to 2021.

3.2.1 Robustness Checks

One concern is whether not accounting for state tobacco control policies in the models leads to an omitted variable bias in the estimates reported in Table 3. Policymakers have recently implemented several tobacco control policies aimed at reducing cigarette smoking, which may influence the relationship between cigarette smoking and economic conditions. These regulations and programs include cigarette excise taxes, youth access policies (e.g., tobacco 21 laws), flavor bans, and other tobacco control policies (Farrelly et al., 2017), increased expenditure on tobacco control programs (Huang and Chaloupka, 2014; Ciecierski et al., 2011), and State

Medicaid smoking cessation programs (Greene et al., 2014). Given that these tobacco control policies can change over time, relying solely on state and year-fixed effects or state-specific linear time trends may not adequately capture the impacts of such policies on the estimates.

To address this concern, we include state-level cigarette excise taxes and state Medicaid expansion status[3] to account for tobacco control policies. We organized state-level cigarette excise taxes from The Tax Burden on Tobacco, Centers for Disease Control and Prevention (Orzechowski and Walker, 2019). For tax data not available after 2019, we supplement the dataset with tax information from the Alcohol and Trade Bureau of the US Department of Treasury. Previous studies have demonstrated that cigarette excise tax, which may be correlated with economic conditions, affects cigarette smoking (Charles and DeCicca, 2008). State Medicaid expansion includes cigarette cessation programs that can be correlated with economic conditions.

The first row of Table 4 shows the estimates after accounting for state tobacco control policies as additional covariates in the models. However, including the additional control variables in the models did not significantly affect the results.

It could be possible that changes in macroeconomic conditions have differential impacts on individuals with different levels of demographic characteristics. In another set of robustness checks, we consider specifications that include interactions between age categories and sex, age categories and race/ethnicity, sex and race/ethnicity, sex and marital status, and sex and education. The second row of Table 4 presents the estimates from this specification; however, they are not different from those in Table 3 based on the main specification.

One possible source of omitted variable bias is our failure to account for income, which strongly correlates with macroeconomic conditions and affects cigarette smoking. However, despite the fact that BRFSS provides information on household income in groups (e.g., $<$ US$ 10,000, US$ 10,000–14,999, US$ 15,000–19,999, ..., US$ 50,000–74,999 and $\geq 75,000$), we did not account for income in the main specification since unobserved factors that affect cigarette smoking may determine income, creating endogeneity concerns. In an alternative analysis, we have now included a measure of household income as an additional control to address changes in household budgets influenced by economic conditions. To mitigate the endogeneity concerns, we use the weighted averages for respondents in the state with the same race, sex, age, and education converted to 2019 constant dollars using the all-items Consumer Price Index from the US Bureau of Labor Statistics. Within each state, we categorize the real average incomes for 64

[3]https://www.medicaid.gov/state-overviews/index.html

groups stratified by race (Black, white, Hispanic, and other races), sex (male versus female), age (18–34, 25–54, 55–64, 65 and over), and education (no college versus college graduate). We also assign the average household income within each bucket to individuals with missing household income. However, the estimates obtained from this specification, which includes a measure of household income as reported in the third row of Table 4, do not significantly different from the main estimates in Table 3.

In addition, we examine the impact of various combinations of additional controls related to tobacco control policies, demographic characteristics, and household income on the main estimates. We report these findings in columns four to seven of Table 4. However, it is worth noting that these estimates are not significantly different from the main estimates presented in Table 3.

Since state-specific linear time trends may reduce the variation in employment rate, we replace it with survey-year fixed effects to account for changes in the national smoking rate over time. We estimate two specifications. The first model replaces the state-specific linear time trends with the survey year fixed effects; however, the estimates from this specification do not differ significantly from those reported in Table 3. The second model includes all the additional control variables described in this subsection and replaces the state-specific linear time trends with the survey year fixed effects. We now find from the new specification that the estimate from the overall sample decreases from 0.4% to 0.2% and loses its precision to a statistically significant level of 10%.

3.3. Heterogeneity

We explore heterogeneity across different demographic groups by gender, age, race, and education. In Table 5, we present the full sample ($1987-2021$) estimates in the left panel and the estimates for the $2011-2021$ sub-sample in the right panel. For the analysis by gender, we stratify the sample into males and females. The current smoking rate among males is 22.2% while that of females is 18.1% in the $1987-2021$ sample but smaller in the $2011-2021$ sub-sample (males: 18.9% and females: 14.7%). In both samples, we do not find any evidence of meaningful heterogeneity by gender; however, the estimates from the gender-specific sub-samples based on the $1987-2021$ surveys are lower than the estimate (0.6%) from the pooled sample. Specifically, the predicted effect of a one-point increase in employment rate increases the probability of current cigarette smoking by 0.3% among males and 0.4% among females.

In Table 5, we present the results by age groups, dividing individuals into 18-34-year-olds, 35-64-year-olds, and elderly persons aged 65 years or above. The smoking rates are 23% for individuals aged 18-34 years, 21.9% for persons aged 35-64 years, and 9.8% for elderly individuals. In contrast, smoking rates in the recent surveys ($2011-2021$) by age groups are similar among individuals of ages 18-34 years (18.2%) and 35-64 years (19%) but lower at 8.9% among elderly persons. We find that a one-point increase in employment rate increases current cigarette smoking by 1.1% among individuals aged 18-34 years in the full sample. However, the estimate declines sharply to 0.4% for individuals aged 35-64 years and lacks precision among the elderly persons. In contrast, the estimate is only statistically significant among adults aged 18-34 years from the $2011-2021$ surveys. Among this group, we find that a one-point increase in employment rate increases current cigarette smoking by 1.7%.

We study the association between the employment rate and cigarette smoking by race and ethnicity (white persons, Blacks, Hispanics, and other racial groups). In the overall sample, the smoking rate is highest and comparable between white (20.8%) and Black (21.1%) persons, followed by other races/ethnicity (17.9%), whereas Hispanics have the lowest smoking rate of approximately 16%. Consistent with the downward trends in smoking, data from the 2011-2021 surveys reveal a reduction in smoking across all racial/ethnic groups. However, Black individuals have the highest smoking rate of 19%, followed by white persons (17.5%) and individuals from other races/ethnicity (14.5%), and the lowest is among Hispanics (13.1%). The association between a one-point rise in employment rate and current cigarette smoking is statistically and economically significant among Black individuals in both the overall sample and the $2011-2021$ sub-sample, with an estimated increase of approximately 1.2% increase. Persons of other races/ethnicity have a lower estimate of 0.8%, while we find the lowest estimate at approximately 0.2% among white individuals. There were no statistically significant associations between the employment rate and cigarette smoking among all other racial/ethnic groups in the overall sample and recent surveys.

Finally, we also explore heterogeneity in the association between the employment rate and cigarette smoking along the dimension of education. We categorize education levels into three groups: individuals with a high school diploma or lower, some college education, and a college degree or higher. Both the overall sample and the 2011-2021 subset demonstrate that as education level increases. Among individuals with a high school diploma or lower, the smoking rate is 26.4% in the overall sample and 23.2% in the latter dataset. For those with

some college education, the smoking rate is 20.1% in the full sample and 16.7% in the subsample. For individuals with a college degree or higher, only 10.2% and 6.8% of the full sample and subsample, respectively, are smokers. In the overall sample, we find a positive association between the employment rate and cigarette smoking among individuals with some college degrees (0.4%) and those with college degrees or better (0.8%). However, when considering individuals surveyed from 2011 to 2021, while we find a positive and statistically significant association among those with college degrees or better levels of education (1%), there is a statistically significant negative association among those with high school diplomas or lower levels of education (-0.4%). There are no statistically significant estimates among persons with high school diplomas or lower in the overall sample and those with some college degrees surveyed from 2011 to 2021.

4. Discussion

This study uses data from the 1987–2021 Behavioral Risk Surveillance System and data on employment rates from the US Bureau of Labor Statistics to estimate the association between economic conditions and cigarette smoking. Our finding supports the evidence that cigarette smoking increase when the economy improves. Specifically, we find that a one-point increase in employment rate is associated with a 0.4% increase in current cigarette smoking prevalence. This association is stronger among young adults aged 18-34 years (1.1%) than persons aged 35-64 years (0.4%); Black persons (1.4%) than white individuals (0.3%) or persons of other races/ethnicities (0.8%); and persons with a college education or better (0.8%) than those with some college education (0.4%). While we do not find any differences in the association between males (0.3%) and females (0.4%), there was no association among elderly persons aged ≥ 65, Hispanics, and individuals with high school diplomas or lower educational attainments.

We also find evidence of attenuation in the relationship between cigarette smoking and employment rate over time; therefore, there is no association between cigarette smoking and employment rate in more recent survey data from 2011 to 2021. Based on the 2011–2021 data, we only find positive associations among persons aged 18-34 years (1.7%), Black individuals (1.2%), and persons with a college or higher levels of education (1.1%), and a negative association among persons with high school diplomas or lower educational attainment (-0.4%). On the other hand, there are no associations between cigarette smoking and employment rate among only males or females, persons aged ≥ 35 years, white persons, Hispanics, individuals

from other races/ethnicities, and persons with some college education.

The finding of improvements in macroeconomic conditions being associated with increases in cigarette smoking is consistent with evidence from previous studies (Ruhm, 2005; Xu, 2013; Peng et al., 2022) but contrary to studies finding no change or decreases in cigarette smoking during good economic times (Goel, 2008; Currie et al., 2015; Kalousova and Burgard, 2014; Barnes et al., 2009; Dehejia and Lleras-Muney, 2004). However, our approach is similar to those used by Ruhm (2005) and Peng et al. (2022). While Ruhm (2005) used 1987–2000 BRFSS data, Peng et al. (2022) used 2004 to 2017 Selected Metropolitan/Micropolitan Area Risk Trends (SMART) data. The former study used data collected up to two decades ago and may not be relevant in the current tobacco landscape due to several tobacco control policies implemented in recent years. The latter study used SMART BRFSS data that excluded MMSAs with less than 500 respondents, suggesting rural counties and MMSAs are less likely to be in the sample. However, because trends in smoking prevalence in recent years show higher rates in rural jurisdictions than in urban areas, especially after the year 2000, the findings may not be representative (Doogan et al., 2017).

The current study uses data from 1987-2021, covering all periods used in Ruhm (2005) and Peng et al. (2022). It allowed us to capture seasons with severe macroeconomic shocks, including the 2001 economic downturn, the 2009 Great Recession, and the recent COVID-19 pandemic. Additionally, the frequent changes in the tobacco landscape, including the electronic cigarette epidemic in recent years, make it relevant to include current data in the analysis.

The results from our analysis by sociodemographic groups based on the overall sample lead to findings inconsistent with those from other studies that used similar data, which are worth highlighting. First, our results by gender show no differences in the countercyclicality of cigarette smoking between males and females. In contrast, while Ruhm (2005) finds higher associations among females than males, Peng et al. (2022) find associations among only males and not females. Second, whereas Ruhm (2005) finds that lower educational attainment compared with higher levels of education is associated with stronger countercyclicality in cigarette smoking, Peng et al. (2022) did not find any differences in the associations by education. In contrast, we find that individuals with college or higher education levels experience a greater change in cigarette smoking when macroeconomic conditions change than those without a college education. Third, Ruhm (2005) finds associations among only white persons but not among Black individuals and Hispanics while Peng et al. (2022) find no difference in the as-

sociations between white and nonwhite persons. In comparison, we find that the strongest association is among Black persons followed by individuals from other races/ethnicities before whites, while no association exists among Hispanics.

The study has several limitations. First, the analysis uses self-reported survey data subject to recollection error and misreporting that can be nontrivial. If there is misreporting in the cigarette smoking responses and is associated with changes in macroeconomic conditions, then there could be biases in the results. Second, the response rates in the BRFSS data are usually lower than 50%. However, while BRFSS does not provide information on the characteristics of non-respondents, we cannot identify any systematic relationship between response rate and sociodemographic characteristics and cigarette smoking. Third, unobserved individual-level heterogeneity correlated with changes in economic conditions affecting cigarette smoking can be another source of bias in the estimates. Given that our data is pooled cross-section and not a panel, we cannot account for person-level characteristics that were unavailable in the data. Fourth, income and education may be endogenous in the model leading to biased estimates since smoking rates are higher among low-income households and persons with lower levels of education than among high-income households and individuals with higher levels of education. On the other hand, cigarette smoking eventually affects income and education through health. Persons affected by smoking-related diseases may have less market and productive hours for work and formal training. For this reason, we have interpreted the results as associations and not causal.

Despite these limitations, we conclude that policies seeking to reduce cigarette smoking during good economic times should focus on young adults aged 18-34 years, Black persons, and individuals with college or higher levels of education. On the other hand, policies seeking to reduce cigarette smoking during bad macroeconomic conditions should focus on persons with high school diplomas or lower levels of education.

References

Asare, S., Majmundar, A., Islami, F., Bandi, P., Fedewa, S., Westmaas, L. J., and Nargis, N. (2021). Changes in cigarette sales in the united states during the covid-19 pandemic. Annals of Internal Medicine.

Barnes, M. G., Smith, T. G., et al. (2009). Tobacco use as response to economic insecurity: Evidence from the national longitudinal survey of youth. The BE Journal of Economic Analysis & Policy, 9(1):47.

Boen, C. and Yang, Y. C. (2016). The physiological impacts of wealth shocks in late life: Evidence from the great recession. Social Science & Medicine, 150:221–230.

Catalano, R. (1991). The health effects of economic insecurity. American Journal of Public Health, 81(9):1148–1152.

Catalano, R. and Dooley, D. (1983). The health effects of economic instability: A test of the economic stress hypothesis. In Influence of Economic Instability on Health, pages 225–262. Springer.

Catalano, R., Goldman-Mellor, S., Saxton, K., Margerison-Zilko, C., Subbaraman, M., LeWinn, K., and Anderson, E. (2011). The health effects of economic decline. Annual review of public health, 32:431–450.

Centers for Disease Control and Prevention (2022). Current cigarette smoking among adults in the united states.

Centers for Disease Control and Prevention (2023). Fast facts and fact sheets.

Chandra, S. and Chaloupka, F. J. (2003). Seasonality in cigarette sales: patterns and implications for tobacco control. Tobacco Control, 12(1):105–107.

Charles, K. K. and DeCicca, P. (2008). Local labor market fluctuations and health: is there a connection and for whom? Journal of health economics, 27(6):1532–1550.

Ciecierski, C. C., Chatterji, P., Chaloupka, F. J., and Wechsler, H. (2011). Do state expenditures on tobacco control programs decrease use of tobacco products among college students? Health Economics, 20(3):253–272.

Cunningham, E. (2018). Great recession, great recovery-trends from the current population survey. Monthly Lab. Rev., 141:1.

Currie, J., Duque, V., and Garfinkel, I. (2015). The great recession and mothers' health. The Economic Journal, 125(588):F311–F346.

De Vogli, R. and Santinello, M. (2005). Unemployment and smoking: does psychosocial stress matter? Tobacco control, 14(6):389–395.

Dehejia, R. and Lleras-Muney, A. (2004). Booms, busts, and babies' health. The Quarterly Journal of Economics, 119(3):1091–1130.

Doogan, N., Roberts, M., Wewers, M., Stanton, C., Keith, D., Gaalema, D., Kurti, A., Redner, R., Cepeda-Benito, A., Bunn, J., et al. (2017). A growing geographic disparity: rural and urban cigarette smoking trends in the united states. Preventive medicine, 104:79–85.

Falba, T., Teng, H.-M., Sindelar, J. L., and Gallo, W. T. (2005). The effect of involuntary job loss on smoking intensity and relapse. Addiction, 100(9):1330–1339.

Farrelly, M. C., Chaloupka, F. J., Berg, C. J., Emery, S. L., Henriksen, L., Ling, P., Leischow, S. J., Luke, D. A., Kegler, M. C., Zhu, S.-H., et al. (2017). Taking stock of tobacco control program and policy science and impact in the united states. Journal of addictive behaviors and therapy, 1(2).

Gallus, S., Ghislandi, S., and Muttarak, R. (2015). Effects of the economic crisis on smoking prevalence and number of smokers in the usa. Tobacco control, 24(1):82–88.

Goel, R. K. (2008). Unemployment, insurance and smoking. Applied Economics, 40(20):2593–2599.

Golden, S. D. and Perreira, K. M. (2015). Losing jobs and lighting up: Employment experiences and smoking in the great recession. Social Science & Medicine, 138:110–118.

Greene, J., Sacks, R. M., and McMenamin, S. B. (2014). The impact of tobacco dependence treatment coverage and copayments in medicaid. American journal of preventive medicine, 46(4):331–336.

Huang, J. and Chaloupka, F. (2014). State tobacco control and prevention expenditures: Fy 2008–2011. University of Illinois at Chicago Working Paper.

Jung, Y., Oh, J., Huh, S., and Kawachi, I. (2013). The effects of employment conditions on smoking status and smoking intensity: The analysis of korean labor & income panel 8th–10th wave. PloS one, 8(2):e57109.

Kaiser, M., Bauer, J. M., and Sousa-Poza, A. (2017). Does unemployment lead to a less healthy lifestyle? Applied economics letters, 24(12):815–819.

Kalousova, L. and Burgard, S. A. (2014). Unemployment, measured and perceived decline of economic resources: contrasting three measures of recessionary hardships and their implications for adopting negative health behaviors. Social Science & Medicine, 106:28–34.

McClure, C. B., Valdimarsdóttir, U. A., Hauksdóttir, A., and Kawachi, I. (2012). Economic crisis and smoking behaviour: prospective cohort study in iceland. BMJ open, 2(5).

Montgomery, S. M., Cook, D. G., Bartley, M. J., and Wadsworth, M. E. (1998). Unemployment, cigarette smoking, alcohol consumption and body weight in young british men. The European Journal of Public Health, 8(1):21–27.

Nargis, N., Hussain, A. G., Asare, S., Xue, Z., Majmundar, A., Bandi, P., Islami, F., Yabroff, K. R., and Jemal, A. (2022). Economic loss attributable to cigarette smoking in the usa: an economic modelling study. The Lancet Public Health, 7(10):e834–e843.

Novo, M., Hammarström, A., and Janlert, U. (2000). Smoking habits—a question of trend or unemployment? a comparison of young men and women between boom and recession. Public Health, 114(6):460–463.

Orzechowski, W. and Walker, R. (2019). The tax burden on tobacco, 1970-2018. Centers for Disease Control and Prevention. Available at: https://chronicdata. cdc. gov/Policy/The-Tax-Burden-on-Tobacco-1970-2018/7nwe-3aj9.

Peng, L., Chen, J., and Guo, X. (2022). Macroeconomic conditions and health-related outcomes in the united states: A metropolitan and micropolitan statistical area-level analysis between 2004 and 2017. Health Economics, 31(1):3–20.

Ruhm, C. J. (2005). Healthy living in hard times. Journal of health economics, 24(2):341–363.

Ruhm, C. J. (2015). Recessions, healthy no more? Journal of health economics, 42:17–28.

Theodossiou, E. and Hipple, S. F. (2011). Unemployment remains high in 2010. Monthly Lab. Rev., 134:3.

US Department of Health and Human Services (2016). E-cigarette use among youth and young adults: a report of the surgeon general. Atlanta, GA: US Department of Health and Human Services, CDC, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.

US Food and Administration (2020). Family smoking prevention and tobacco control act - an overview.

Wang, Q., Shen, J. J., and Cochran, C. (2016). Unemployment rate, smoking in china: are they related? International journal of environmental research and public health, 13(1):113.

Xu, X. (2013). The business cycle and health behaviors. Social Science & Medicine, 77:126–136.

Figures

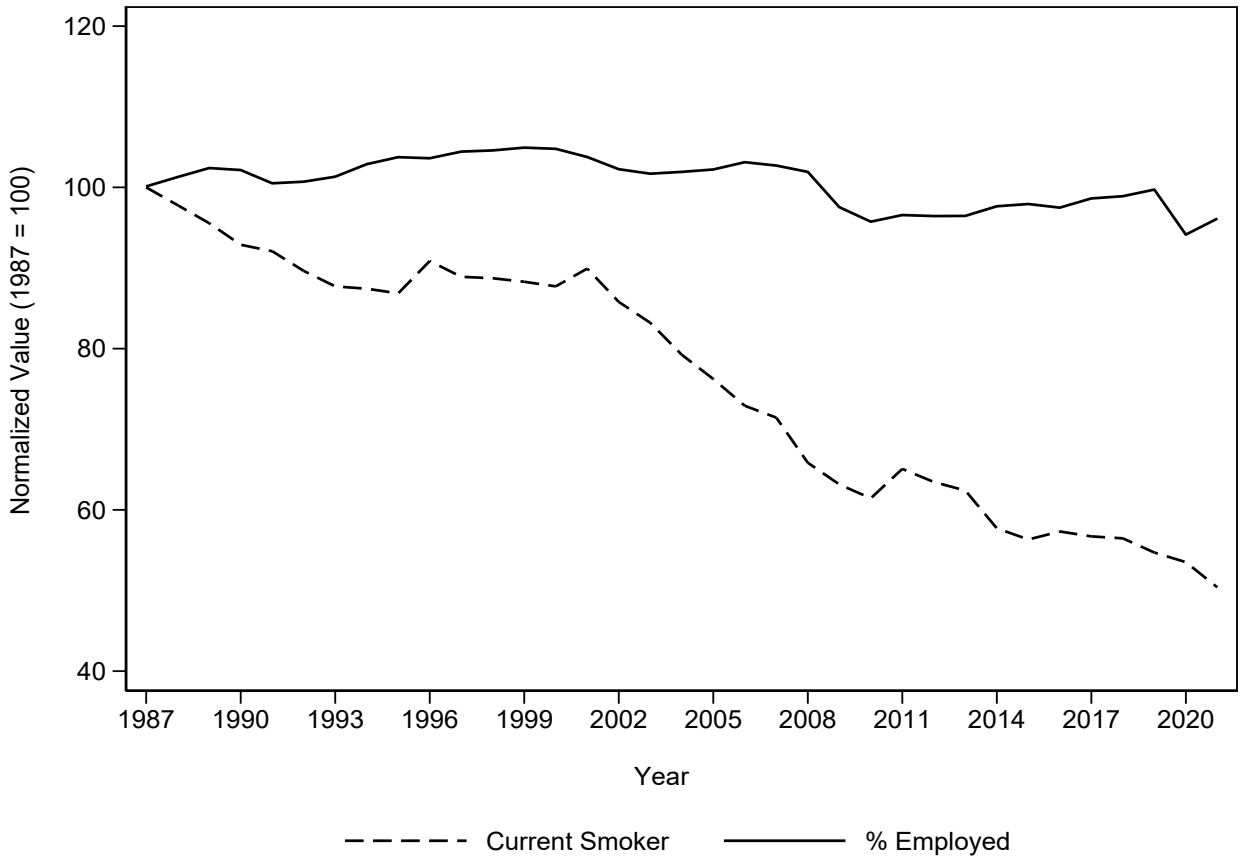
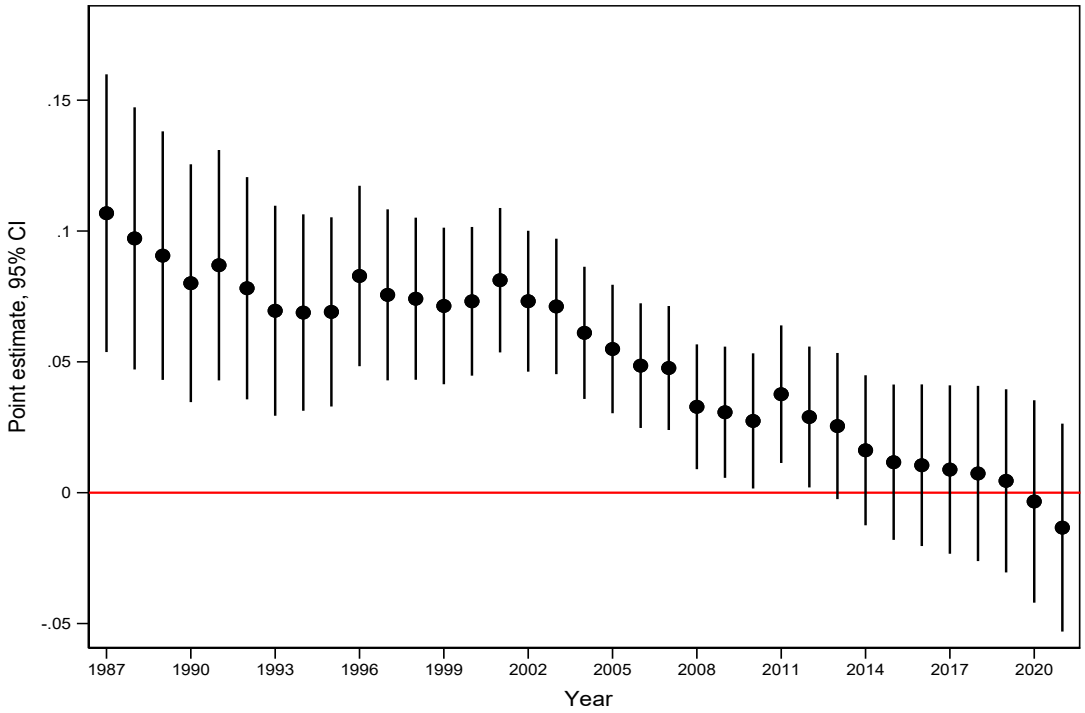


Figure 1: Trends in normalized current cigarette smoking and employment rate, BRFSS 1987-2021

(a) Without sampling weights



(b) With sampling weights

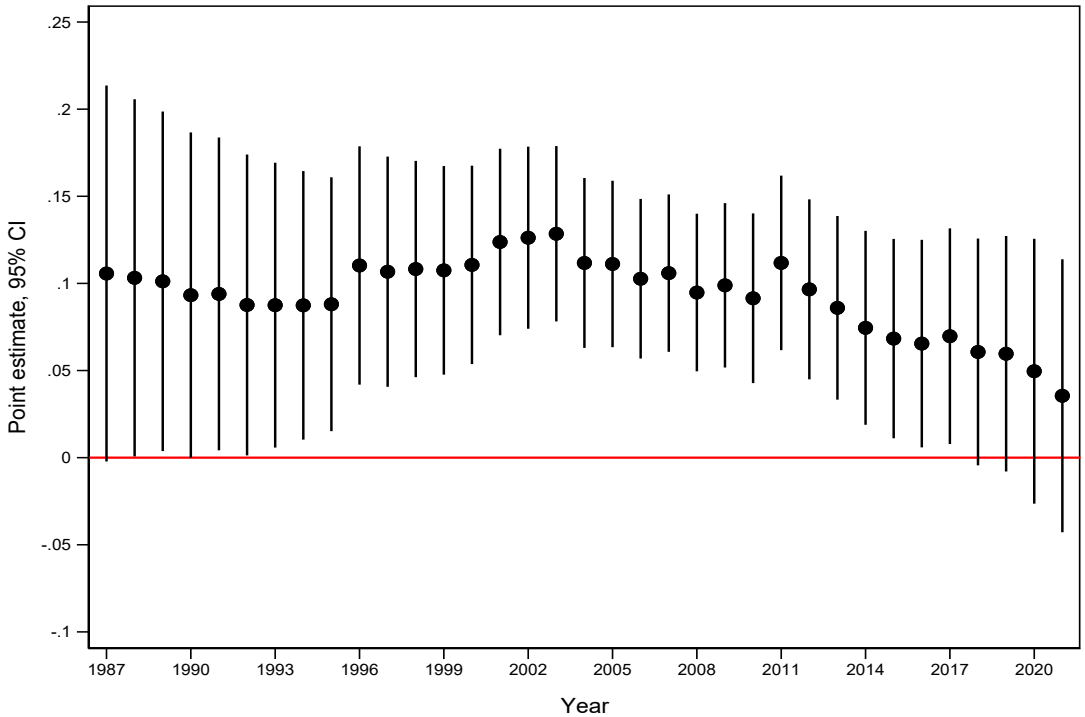


Figure 2: Trends of the relationship between employment rate and current cigarette smoking, BRFSS 1987-2021

Tables

Table 1. Summary statistics

	Ruhm sample (1987 - 2000)		Replicated sample (1987 - 2000)		Full sample (1987 - 2019)	
	Unweighted means	Weighted means	Unweighted means	Weighted means	Unweighted means	Weighted means
Cigarette Outcomes						
Current smoking	23.4%	23.4%	23.4%	23.3%	17.7%	20.1%
Smokes $\geq$ 20 sticks per day	11.6%	11.4%	11.6%	11.4%	-	-
Smokes $\geq$ 40 sticks per day	1.7%	1.7%	1.7%	1.7%	-	-
Age, in years	46.3	44.3	46.3	44.3	53.0	45.8
Female	49.3%	52%	58.5%	52%	58.9%	51.6%
Race and ethnicity						
Non-Hispanic Black	8.4%	9.4%	8.4%	9.4%	7.9%	10.3%
Other non-Hispanic nonwhite	3.8%	3.6%	3.9%	3.6%	5.9%	6.2%
Hispanic origin	5.5%	9.2%	5.5%	9.1%	6.5%	12.7%
White only	82.3%	77.8%	82.3%	77.9%	79.7%	70.8%
Education						
High school dropout	14.2%	15.1%	14.2%	15.1%	9.5%	13.5%
High school graduate	33.2%	33%	33.5%	33.6%	29.7%	30.4%
Some college	26.1%	25.8%	25.6%	25.2%	26.9%	27.6%
College graduate	26.3%	25.9%	26.5%	25.9%	33.7%	28.2%
Education not reported	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%

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Table 1 – Continued from the previous page

	Ruhm sample (1987 - 2000)		Replicated sample (1987 - 2000)		Full sample (1987 - 2019)	
	Unweighted means	Weighted means	Unweighted means	Weighted means	Unweighted means	Weighted means
Current marital status						
Never married	17.1%	19.1%	17.1%	19.1%	15.0%	20.8%
Married/cohabiting	56.9%	62.5%	56.9%	62.5%	56.5%	60.3%
Divorced/separated	14.9%	10.9%	14.9%	10.9%	15.8%	11.8%
Widowed	10.9%	7.3%	10.9%	7.3%	12.4%	6.9%
Marital status not reported	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%
State-level variable						
Employment rate	64.1%	62.9%	64.1%	62.9%	61.9%	61.3%
Observations, N	1,490,249	1,490,249	1,490,461	1,490,461	9,434,975	9,434,975

Table 2. Replicated Predicted effect of a one-point increase in the percent employed on lifestyle behaviors for Tobacco use in Ruhm (2005)

	Sample mean	Predicted effect	% change	
			(a)	(b)
Panel A: Original estimates from Ruhm (2005)				
Current smoking	0.2336	0.1317 (0.0287) [0.0489]	0.6	0.6
Smokes $\geq$ 20 cigarettes daily	0.1144	0.1044 (0.0194) [0.0349]	0.9	1.0
Smokes $\geq$ 40 cigarettes daily	0.0174	0.0155 (0.0055) [0.0065]	0.9	1.4
Panel B: Replicated estimates				
Current smoking	0.2332	0.1683 (0.0347) [0.0474]	0.7	0.7
Smokes $\geq$ 20 cigarettes daily	0.1142	0.1079 (0.0237) [0.0366]	0.9	1.0
Smokes $\geq$ 40 cigarettes daily	0.0173	0.0225 (0.0077) [0.0082]	1.3	1.7

Note: This table is the replicated results of cigarette outcomes in Table 2 of Ruhm (2005). Panel A corresponds to the original results from the study, whereas the replicated estimates are in Panel B. The table shows the predicted effects of a one-point increase in the state employment rate based on binary probit regression models and data from BRFSS and US BLS from 1987 to 2000. The models also include month, year, and state dummy variables and controls for age, sex, race/ethnicity, education, and marital status. The dependent variable means were calculated by incorporating sampling weights. Sample size is 1,490,293. Robust standard errors calculated assuming that observations are independent across months and states but not within states in a given month are reported in parentheses. Corresponding standard errors that assume independence across but not within states are shown in brackets. Percentage changes are computed by dividing the predicted effect by the dependent variable mean. In the column marked (a), predicted effects are evaluated at the regressor means. In the Column (b), they are calculated for each individual and then averaged across all sample members.

Table 3. Changes in the likelihood of current cigarette smoking among US adults (ages ≥ 18 years) associated with a one-point increase in the employment rate

	Unweighted estimates				Weighted estimates			
Sample period	Sample mean	Predicted effect	% change		Sample mean	Predicted effect	% change	
			(a)	(b)			(a)	(b)
1987 - 2021	0.1774	0.1141*** (0.0082)	0.6	0.6	0.2006	0.0751*** (0.0241)	0.4	0.4
1987 - 2010	0.2028	0.1812*** (0.0116)	0.9	0.9	0.2187	0.1354*** (0.0367)	0.6	0.6
2001 - 2021	0.1669	0.0453*** (0.0089)	0.3	0.3	0.1833	0.0850*** (0.0262)	0.5	0.5
2011 - 2021	0.1510	0.0443*** (0.0141)	0.3	0.3	0.1671	0.0145 (0.0296)	0.1	0.1
2017 - 2021	0.1419	0.0354** (0.0174)	0.2	0.2	0.1512	-0.0104 (0.0365)	-0.1	-0.1

Notes: The table shows the predicted effects of a one-point increase in the state employment rate based on binary probit regression models and data from BRFSS and US BLS from 1987 to 2021. The models also include month, year, and state dummy variables and controls for age, sex, race/ethnicity, education, and marital status. Sample sizes: 4,818,467 for $1987-2010$; 9,477,005 for $1987-2021$; 7,986,712 for $2001-2021$; 3,238,174 for $2001-2010$; and 4,658,538 for $2011-2021$. Robust standard errors calculated assuming that observations are independent across months and states but not within states in each month, are reported in parentheses. Predicted effects indicate the estimated percentage point change in the dependent variable, with other regressors evaluated at the sample means. Percentage changes are computed by dividing the predicted effect by the dependent variable mean. In the column marked (a), predicted effects are evaluated at the regressor means. In the Column (b), they are calculated for each individual and then averaged across all sample members. $^{***}P < 0.01$ $^{**}P < 0.05$ $^{*}P < 0.1$

Table 4. Robustness checks: Changes in the likelihood of current cigarette smoking among US adults (ages $\geq$ 18 years) associated with a one-point increase in the employment rate, BRFSS 1987–2021 and 2011-2021

	1987–2021 full sample			2011–2021 sub-sample		
Additional variables	Predicted effect	% change		Predicted effect	% change	
		(a)	(b)		(a)	(b)
Tobacco control policies (A)	0.0707***	0.4	0.3	0.0236	0.1	0.1
	(0.0258)			(0.0353)		
Additional controls (B)	0.0791***	0.4	0.4	0.0408	0.2	0.2
	(0.0223)			(0.0288)		
Household income (C)	0.0703***	0.4	0.3	0.0161	0.1	0.1
	(0.0238)			(0.0295)		
Controls in (A) & (B)	0.0798***	0.4	0.4	0.0564	0.3	0.3
	(0.0241)			(0.0342)		
Controls in (B) & (C)	0.0844***	0.4	0.4	0.0281	0.2	0.2
	(0.0245)			(0.0352)		
Controls in (A) & (C)	0.0791***	0.4	0.4	0.0412	0.2	0.2
	(0.0223)			(0.0287)		
Controls in (A), (B), & (C)	0.0667***	0.3	0.3	0.0213	0.1	0.1
	(0.0254)			(0.0350)		
Survey year fixed effect (D)	0.0504**	0.3	0.2	0.0076	0.0	0.0
	(0.0242)			(0.0316)		
Controls in (A), (B), (C), & (D)	0.0461*	0.2	0.2	0.0070	0.0	0.0
	(0.0239)			(0.0319)		

Notes: The table shows the predicted effects of a one-point increase in the state employment rate based on binary probit regression models and data from BRFSS and US BLS from 1987 to 2021 and 2011 to 2021. Each row represents a separate regression estimate, with the model accounting month, year, and state fixed effects, and age, sex, race/ethnicity, education, and marital status. The mean of current smoking is 0.2006 for the full sample (1987–2021) and 0.1671 for the 2011–2021 sub-sample. Robust standard errors calculated assuming that observations are independent across months and states but not within states in each month, are reported in parentheses. Predicted effects indicate the estimated percentage point change in the dependent variable, with other regressors evaluated at the sample means. Percentage changes are computed by dividing the predicted effect by the dependent variable mean. In the column marked (a), predicted effects are evaluated at the regressor means. In the Column (b), they are calculated for each individual and then averaged across all sample members. ***$P < 0.01$ **$P < 0.05$ *$P < 0.1$

Table 5. Heterogeneity: Changes in the likelihood of current cigarette smoking among US adults (ages ≥ 18 years) associated with a one-point increase in the employment rate

	Full sample (1987 – 2021)					Sub-sample (2011 – 2021)				
	Sample mean	Predicted effect	% Change (a)	% Change (b)	Obs., N	Sample mean	Predicted effect	% Change (a)	% Change (b)	Obs., N
Sex										
Males	0.2218	0.0652** (0.0278)	0.3	0.3	3,881,219	0.1889	0.0185 (0.0391)	0.1	0.1	1,983,902
Females	0.1808	0.0692** (0.0299)	0.4	0.4	5,553,756	0.1465	0.0087 (0.0367)	0.1	0.1	2,632,606
Ages, in years (y)										
18 – 34 y	0.2304	0.2451*** (0.0828)	1.1	1.1	1,731,627	0.1819	0.3092*** (0.1819)	1.7	1.7	730,368
35 – 64 y	0.2186	0.0818** (0.0394)	0.4	0.4	4,917,885	0.1900	0.0030 (0.0424)	0.0	0.0	2,287,388
$\geq$ 65 y	0.0979	0.0473 (0.0326)	0.5	0.4	2,785,463	0.0885	-0.0344 (0.0362)	-0.4	-0.4	1,598,752
Race and ethnicity										
Whites	0.2084	0.0526** (0.0245)	0.3	0.2	7,519,160	0.1745	-0.0028 (0.0310)	0.0	0.0	3,622,388
Blacks	0.2108	0.2888*** (0.0999)	1.4	1.4	749,130	0.1902	0.2308** (0.1012)	1.2	1.2	366,905
Hispanics	0.1597	0.0047 (0.1028)	0.0	0.0	612,998	0.1311	0.0821 (0.1311)	0.6	0.6	325,446
Other races	0.1793	0.1424* (0.0776)	0.8	0.8	553,687	0.1445	0.0175 (0.1067)	0.1	0.1	301,769
Education										
$\leq$ HS diploma	0.2636	0.0263 (0.0440)	0.1	0.1	3,713,974	0.2316	-0.1039** (0.0507)	-0.4	-0.5	1,641,088
Some college degree	0.2012	0.0807* (0.0443)	0.4	0.4	2,541,252	0.1673	-0.0243 (0.0596)	-0.1	-0.1	1,272,669
$\geq$ College degree	0.1016	0.0852*** (0.0263)	0.8	0.8	3,179,749	0.0675	0.0739** (0.0366)	1.1	1.0	1,702,751

Notes: The table shows the predicted effects of a one-point increase in the state employment rate based on binary probit regression models and data from BRFSS and US BLS from 1987 to 2021 and 2011 to 2021. Each row represents a separate regression estimate, with the model accounting month, year, and state fixed effects, and age, sex, race/ethnicity, education, and marital status accordingly. Robust standard errors calculated assuming that observations are independent across months and states but not within states in each month, are reported in parentheses. Predicted effects indicate the estimated percentage point change in the dependent variable, with other regressors evaluated at the sample means. Percentage changes are computed by dividing the predicted effect by the dependent variable mean. In the column marked (a), predicted effects are evaluated at the regressor means. In the Column (b), they are calculated for each individual and then averaged across all sample members. ***$P < 0.01$ **$P < 0.05$ *$P < 0.1$