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Cigarette taxes, prices, and disparities in current smoking in the United States

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ABSTRACT

Increasing cigarette taxes has been the cornerstone of tobacco control policy. Recent work has argued that raising cigarette taxes alone may no longer be an effective strategy for lowering smoking rates. We largely confirm these findings but also find that increases in price continue to predict lower smoking participation in most model specifications. We argue that raising cigarette prices via taxation remains an effective public health policy. We discuss the advantages of homogeneous tax environments and minimum price laws for eliminating opportunities for consumers to offset tax increases by searching for lowest taxes.

I. Introduction

Tobacco, chiefly due to cigarette smoking, remains the most significant cause of preventable death in the United States (U.S.), and its toll primarily falls on disadvantaged Americans (USHHS, 2014). Those with low education and income are more likely to smoke than the rest of the general population. In 2016, 29 percent of people with less than a high school degree smoked but only nine percent of people with a bachelor's degree did. Similarly, the smoking prevalence for adults below the poverty line was 29 percent but 16 percent among those above it (USHHS, 2017). Today's inequalities in smoking will translate into health disparities of tomorrow.

Prior research has shown that increasing cigarette taxes decreases smoking prevalence in the U.S. (Chaloupka, Yurekli, & Fong, 2012). However, several recent studies examining the associations between increased cigarette taxes and decreased smoking have challenged this consensus. Although some have confirmed the previously reported link (Cotti, Nesson, & Tefft, 2016; Goldin & Homonoff, 2013), others have found the relationship to be weak or nonexistent (Callison and Kaestner, 2014). Our study contributes to this conversation by re-evaluating the relationship between cigarette taxes and prices and current smoking in the U.S. population using multiple measures of tax and price in a large nationally representative dataset collected between 2003 and 2015. We focus on differential effects by socioeconomic status (SES) and the consequences for health equity. We ask: are state taxes, average retail prices, and self-reported prices associated with changes in the prevalence of current smoking? We hypothesize associations between all three measures and decreased smoking, although we anticipate effects from changing state taxes will be smaller than the effects from changing price because change in price is more proximal to the consumer's experience.

The effectiveness of tobacco taxes has major implications for health disparities. Despite previous research documenting the greater effectiveness of taxes in reducing smoking among lower income people (Chaloupka & Warner, 2000), disparities in smoking by poverty status and educational attainment have not decreased in recent decades (Center for Disease Control and Protection, 2016; Pampel, 2009). Indeed, the faster decrease in smoking among socioeconomically advantaged people may have even widened disparities (Center for Disease Control and Protection, 2016). If the inverse association between tax responsiveness and SES no longer holds, as some have recently suggested (Sharbaugh et al., 2018), higher smoking rates in socioeconomically disadvantaged populations will persist despite higher taxes.

In states and smaller areas that have most vigorously embraced tobacco taxes as a tobacco control strategy, tobacco taxes represent a substantial financial burden for socioeconomically disadvantaged smokers. For example, a study of the financial burden of cigarette

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smoking in New York State found that, in 2010/2011, smokers in households with annual incomes less than $30,000 spent about 24 percent of their household income on cigarettes—a 100 percent increase in constant dollars in comparison to data collected in 2003 and 2004 (Farrelly, Nonnemaker, & Watson, 2012). High smoking rates among disadvantaged populations coupled with high taxes may lead to adverse population health consequences, as smokers spend an ever-larger share of their financial resources on cigarettes and cut back on purchasing other goods and services (Guillaumier, Bonevski, & Paul, 2015).

In addition to comparing the effect of the three measures in the U.S. population overall, our paper evaluates the relationship between the three tax and price measures and current smoking by education and income. We hypothesize that lower income and less educated smokers will be most sensitive to changes in all three measures.

II. Background

The first evidence of cigarette taxes' positive population health benefit appeared in the 1970s, when a wave of studies using aggregate data on cigarette sales and cigarette prices and taxes showed that consumption declines with higher cost. In a review of the literature published before 2000, Chaloupka and Warner concluded that aggregate-level studies had "produced estimates of the price elasticity of cigarette demand generally falling in a relatively narrow range centered on −0.4" (2000, p. 5), which translates to a 10 percent cigarette price increase associated with a 4 percent cigarette consumption decrease. Estimates based on more recent work have provided less consistent evidence that smoking is responsive to tax or price variations, even though tax increases after the year 2000 were much larger than those implemented before. For example, Maclean, Webber, and Marti (2014) showed that only smokers in the 20th to 50th smoking intensity percentiles, that is smoking between 8 and 15 cigarettes daily, were responsive to tax increases, and even their measured responsiveness was far lower than would be anticipated from prior literature: a one-dollar tax increase was associated with a 3.5 percent reduction in the number of cigarettes. In separate studies, Maclean, Kessler, and Kenkel (2016) examined tax responsiveness among older adults. Again, their results showed only modest responsiveness. One-dollar tax increase was associated with a 3.8 to 5.2 percent reduction in cigarettes smoked per day, a consumption elasticity of −0.03 to −0.04. Kalousova, using the same longitudinal data, confirmed low sensitiveness of older adults to increases in cigarette retail prices (2020).

There are three main explanations for the recent inconsistent research findings on the relationship between tobacco taxes and adult smoking. The first explanation is simply that tobacco taxes have become less effective in lowering smoking in the U.S. over time, due to population changes and new tax avoidance strategies. Among older cohorts that experienced the first public policies and campaigns about the harmfulness of cigarette smoking starting in the 1960s, the more educated quit at relatively higher rates (Pampel, 2005). Today's population of smokers is considerably more disadvantaged than the smokers of the 1970's and 1980's (Pampel, 2005), when much of the data used in older studies were gathered. Moreover, smoking among youth, who have traditionally been the population most sensitive to tax and price increases (Chaloupka & Warner, 2000), is already at an all-time low (Johnston, O'Malley, Miech, Bachman, & Schulenberg, 2016). A greater share of today's smokers also may be more committed smokers or "hardened" (Hughes, 2011), who have lower ability or willingness to quit (Warner & Burns, 2003). For hardened smokers, cigarettes would become even less elastic goods, weakening the effectiveness of taxes. However, the evidence of hardening has been mixed. A recent national-level study found no evidence of hardening at the population level, but increased smoking drive and continuity-related dependence among women and low-income smokers, suggesting that hardening may have occurred in subpopulations of more vulnerable smokers (Smith, Rose, Mazure, Giovino, & McKee, 2014). Other studies, using different datasets, showed that not hardening but softening, meaning more quit attempts and lower consumption, has been taking place in the United States (Kulik & Glantz, 2016). The scientific debate is still ongoing. Finally, cigarette taxes may have become less effective because smokers have become more motivated and developed more strategies to avoid paying more for their cigarettes after taxes are implemented (National Research Council, 2015). With near-universal internet access, it has become easier for consumers to find out where to buy discount products (Sharma, Fix, Delnevo, Cummings, & O'Connor, 2016) and for producers to target discount coupons and other forms of direct-to-consumer advertising at current or prospective customers, which can lead to large reductions in cost (Pesko et al., 2014).

A second explanation for the inconsistency of tax effects in current studies could be due to improvements in statistical methods used in this area of study, as Callison and Kaestner (2014) argue. The authors show that the association between cigarette taxes and smoking participation and intensity is negative but small, and typically not statistically significant. According to their estimates, using the TUS-CPS data (Tobacco Use Supplement - Current Population Survey), a 100 percent increase in cigarette taxes would only decrease smoking intensity by 5 percent. Drawing on a review by Gallet and List (2003), Callison and Kaestner suggest that the findings are not surprising because there is scant evidence for the associations between cigarette taxes and smoking in adults during any period by studies that used appropriate statistical methods and that the "paucity of evidence regarding the association between tobacco taxes and adult cigarette consumption" is "inconsistent with the widespread support for taxes as a way to reduce smoking" (Callison & Kaestner, 2014, p. 155).

The third explanation is that our measurement tools have been blunted by the growing substate heterogeneity in cigarette taxes and prices (Pesko, Tauras, & Chaloupka, 2016). When examining the relationship between taxes and smoking, most researchers have either used the state tax level directly as a predictor of smoking or they have used the average state retail price for a pack of cigarettes each year, arguing that average state retail price is a more meaningful proximal measure of the financial burden experienced by consumers. The indicator customarily used for the latter case is the average state retail price collected and distributed by Orzechowski and Walker (The Tax Burden of Tobacco, 2018), but neither state taxes nor average retail prices may adequately capture the changes in cigarette costs for smokers. While many smokers will be afflicted by state tax increases, others—especially those living near tax-exempt Native American reservations—may continue to purchase cigarettes at the same low prices. For example, in New York State, which has the highest state excise taxes, 17 percent of the smokers said they purchased their last pack of cigarettes from a Native American reservation (Chaloupka et al., 2015). In such complex substate tax landscapes, the opportunities for tax avoidance are plentiful. Neither state tax measures nor average retail prices adequately capture the resulting heterogeneity, which may lead to biased estimates.

Implications for disparities

Adjudicating between the three explanations is essential for evaluating how changes in tobacco taxes and prices impact smoking among vulnerable subpopulations that have higher smoking rates. Consider, for example, the case of low-income Americans, a population for whom most of prior literature shows greater price sensitivity than for higher income Americans (but see Sharbaugh et al., 2018), yet one that persistently has the highest smoking rate (Center for Disease Control and Protection, 2016). If we find that higher taxes or prices are not associated with lower smoking participation in the general population but continue to be effective among the low-income people, the population benefit would still be large. We may speculate that the remaining smokers in the medium- and high-income groups may have become cost insensitive but, because low-income Americans have the highest smoking prevalence, raising taxes continues to confer a large population

benefit. In an alternative scenario, if we find that increased taxes are not associated with decreased smoking participation among low-income adults, but increased prices are, we may hypothesize that this subpopulation has remained responsive to cigarette cost increases but that changes in state taxes may not reflect their purchase prices, likely because they are able to effectively avoid them. Past evidence shows that both low SES and high SES smokers engage in price avoidance, but low SES smokers have about 25 percent greater odds of doing so (Licht et al., 2011). Should we discover that changes in neither taxes nor prices are associated with a decrease in smoking among low-income Americans, we can speculate that the remaining smokers are unable to quit. Such findings would lead to a debate about the appropriateness of continuing to raise cigarette taxes and impose a large financial burden on disadvantaged people who are not able to quit.

Present study

Our study contributes to this literature by investigating two research questions using the Tobacco Use Supplement of the Current Population Survey data collected between 2003 and 2015. First, we ask: What are the associations between adult smoking participation and state taxes, average retail prices, and self-reported local prices? Second, considering each of the three measures in turn, we ask: How do the associations between the measure in question and smoking participation vary by education and income? We close by contrasting the conclusions about the relationship between prices, taxes, and current smoking that researchers may draw by using any one of the three measures and what implication their use has for the measurement of the link between prices, taxes and disparities in smoking.

III. Methods

Data

Individual data

We used data collected by the Tobacco Use Supplement to the Current Population Survey (TUS-CPS) in 2003, 2006/2007, 2010/2011, and 2014/2015, which we downloaded from the IPUMS data repository (Ruggles, Genadek, Goeken, Grover, & Sobek, 2017). The CPS collects data from American residents in noninstitutionalized households by a rotating monthly panel design. The primary goal of the CPS is to monitor employment and labor force participation. In addition, the CPS periodically interviews respondents about other supplemental topics pertaining to their economic, social, and health conditions, including tobacco use in the TUS. Most respondents (64 percent) answered the TUS by telephone and the rest in person. The supplement covers the use of tobacco products, personal tobacco-use history, and attitudes toward tobacco use and tobacco control policies (U.SDepartment of Commerce, 2016). The supplementary data are gathered three times from three different groups of respondents within each supplement wave. The TUS-CPS includes a longitudinal cohort that was interviewed twice, in May 2010 and in May 2011. The repeat observations were not used in our analysis. Some parts of the TUS questionnaire are administered to any designated household proxy respondent who answered questions about other household members, while other parts are only administered to self-respondents, that is, respondents only report about their own tobacco use. Because smoking may be subject to desirability bias and not all household members may be well-informed about each other's smoking, this study uses only data collected from self-respondents.

Individual measures

Smoking. In every TUS wave, respondents were asked: "Have you smoked at least 100 cigarettes in your entire life?" Respondents who identified themselves as ever having been a smoker received a follow-up question that asked: "Do you now smoke cigarettes every day, some days, or not at all?" If the respondent gave an answer other than "not at all", they were classified as a smoker. Seventeen percent of the analytic response sample were classified as current smokers.

Sociodemographic characteristics. All respondents were asked for the highest educational credential they obtained and were categorized as having less than a high school degree, a GED or a high school degree, some college, or a bachelor's degree or higher. Income information was collected by asking respondents to select one of sixteen categories that best represented their total family income during the last 12 months, ranging from less than $5,000 to $150,000 or more. We subsequently categorized respondents as having an income of less than $15,000, between $15,000 and $29,999, between $30,000 and $49,999, between $50,000 and $74,999, and $75,000 or more. To assign respondents to racial/ethnic groups, we constructed a categorical four-way variable indicating whether a respondent was a non-Hispanic White, a non-Hispanic Black, from another non-Hispanic race or multiracial, or Hispanic. Gender was self-identified male or female, and age was reported in years.

State and area-level data

Tax and Price Data and Measures. We constructed three measures of tax and price for each survey year. We obtained data about state cigarette taxation and the average retail price per cigarette pack from the CDC. The state tobacco tax data that we used were compiled by the Office for Smoking and Health. Retail price data were combined by Orzechowski and Walker in *The Tax Burden on Tobacco* (The Tax Burden of Tobacco, 2018). For our third measure, we used TUS survey responses regarding how much smokers paid for their last pack or carton of cigarettes after applying any coupons or discounts to construct local self-reported cigarette pack prices following the procedure outlined by Pesko et al. (2016), which adjusts the self-reported price for both intensity and number of smokers in the local area. Local areas with fewer than 20 smokers were excluded. Each respondent's own values were excluded from the calculation of the local area price that was assigned to them. The price for area a is calculated by averaging the last price each individual paid for a pack of cigarettes (cartons adjusted to packs) multiplied by the ratio of that individual's monthly cigarette consumption to the average consumption in the area as:

$$Price_a = \sum_{i=1}^{n_a} \frac{Last\ Price_i * \frac{Last\ month's\ cigarette\ consumption_i}{Last\ month's\ average\ cigarette\ consumption_a}}{n_a}$$

We calculated the local self-reported cigarette pack price measure at the county and core-based statistical area (CBSA) levels for each month and year. Respondents who did not have geographic markers for county or for CBSA were assigned to a residual category based on their state of residence. All three measures were standardized to the 2000 Current Price Index for Urban Consumers. Fig. 1 shows the mean level of tax and

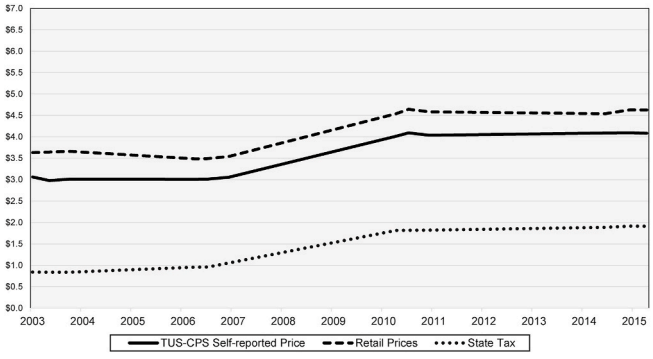

Fig. 1. State cigarette taxes, self-reported cigarette price per pack, and retail price over study period in real dollars.

price measures over time. Fig. 2 shows their spatial distribution.

Other State-level Data and Measures. To account for other state characteristics that might influence smoking and the associations between smoking and cigarette taxes and prices, we included additional state-level controls. We obtained seasonally-adjusted state civilian unemployment rates from the U.S. Bureau of Labor Statistics (2018) and data on the percentage of Hispanics in each state (2018) and state poverty rate from the U.S. Census Bureau statistical tables (2017). We downloaded state-level data on tobacco control spending per capita from the CDC (2016). We calculated the share of the population that was covered by comprehensive smoke-free laws using data on smoke-free laws from the American Nonsmokers' Rights Foundation (ANRF) Tobacco Control Laws Database (American Nonsmokers' Rights Foundation, 2018b). We considered such laws to be present only if they met the ANRF criteria for being labeled "100 percent smoke-free" (American Nonsmokers' Rights Foundation, 2018a). Based on methods used in previous literature (Gonzalez, Sanders-Jackson, & Glantz, 2014), we combined data on smoke-free laws passed at the city, county, and state levels with the U.S. Census Bureau's "City and Town Population Totals" intercensal and postcensal datasets to calculate the percentage of each state's population that was covered by smoke-free laws in workplaces and hospitality venues for each month and year that the TUS-CPS survey was administered. Finally, to measure tax avoidance and general attitudes toward smoking restrictions in a state, we calculated the percentage of smokers and the total state population that reported tax avoidance and of the overall population that supported smoke-free bars in the TUS-CPS.

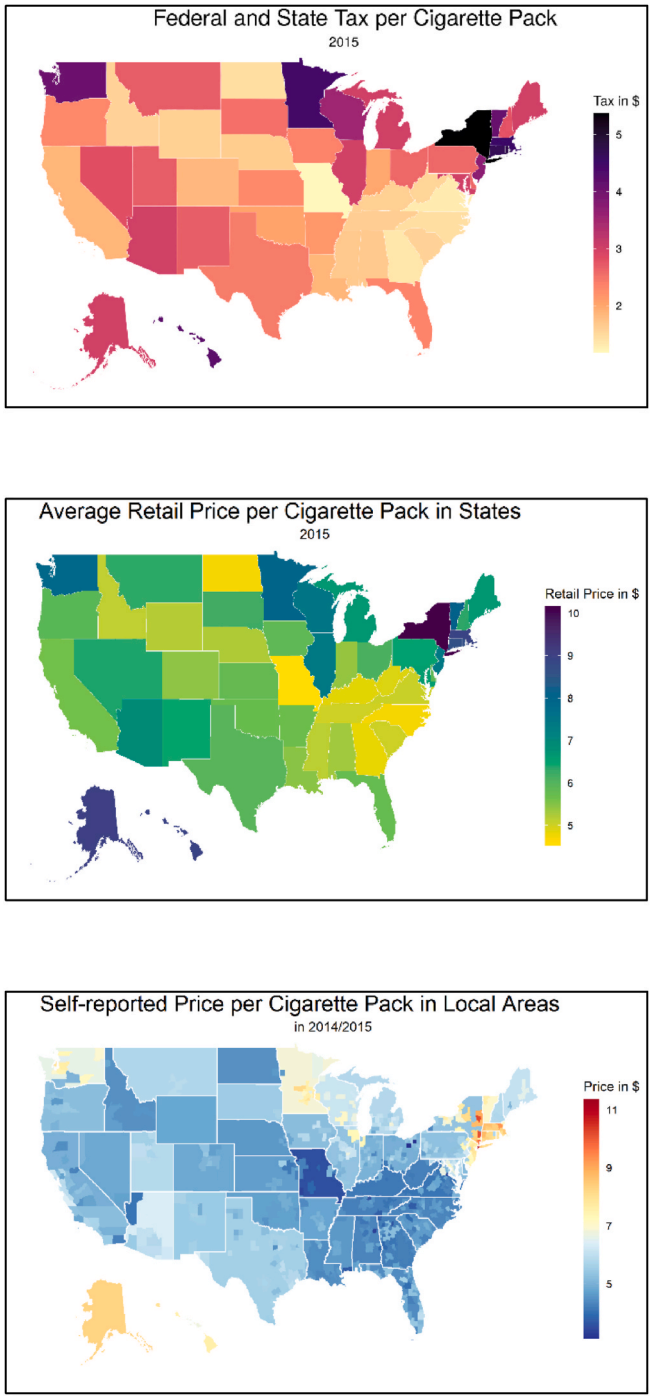

Fig. 2. Spatial distribution of state and federal cigarette taxes, retail price, and self-reported cigarette price per pack in 2015.

Analytic Sample. We limited our analysis to respondents who were at least 25 years old and who were not missing data for any variables required for constructing our measures, that is, 602,360 respondents with valid weights. We imposed the age restriction to avoid erroneously classifying experimental smokers as established smokers and to ensure that the majority had attained their final educational level. Most missing sociodemographic variables were imputed by the U.S. Census Bureau, but we lost 6 percent of the respondents due to missing data on income, which was not imputed in the 2003 and 2006/2007 waves (N = 564,585). In a sensitivity analysis, we imputed income data for the households that had missing income data in 2003 or 2006/2007. The results using imputed data were not appreciably different from those using unimputed data. We report the results from the unimputed analysis; the results from models using the imputed data are available on request. Less than one percent did not report their smoking status, and we excluded these observations as well (N = 562,156). In very small geographic areas, the selected group of respondents sometimes did not include any smokers or only included smokers who subsequently refused to answer questions about their smoking intensity or report the price they paid for their last pack of cigarettes. This precluded us from calculating the adjusted self-reported price measure and led to the exclusion of additional respondents. Our final analytic sample consists of 559,544 respondents; that is, 86 percent of the age-eligible self-response sample.

Analytic strategy

We estimated linear probability models predicting current smoking by the three measures of tax and price with controls for individual characteristics, time-variant state characteristics, and fixed effects for state and year. Because of the well-documented concerns about the interpretability of interaction terms in nonlinear models (Ai & Norton, 2003; Greene, 2010; Mood, 2010), we provide results from linear probability models in our main tables. Results from logistic regression models, which yield substantively identical conclusions, are available on request. By modelling state and year effects separately, we control for time-invariant between-group (state) variation as well as year-specific influences on smoking prevalence. The addition of state characteristics specific to each year allowed us to control for important time-variant influences on smoking that may differ between states. All models were estimated for the population overall and stratified by age groups into younger adults, prime-age adults, and older adults (25–39, 40 to 54, and 55+, respectively). In models evaluating variation by sociodemographic characteristics, we included an interaction between each SES characteristic and the tax or price measure and included additional interactions between the specific SES characteristic and year indicator and state indicator to control for time trends and state trends in inequalities. Differences between two or more regression coefficients, or whether they were different from zero, was assessed using Wald tests. As supplementary analysis, discussed in detail in *Supplementary Analysis* section, we also estimated smoking consumption models.

All models were estimated using Stata 15.1, accounting for the complex sample design for both point estimation, hypothesis testing, and confidence interval construction. This estimation procedure also implicitly accounts for the heteroscedasticity in the linear probability models.

IV. Results

Table 1 shows weighted descriptive characteristics for the analytic sample stratified by whether the respondent was a smoker. The first part of the table shows individual characteristics, the second state-level characteristics.

Table 2 shows the results from unadjusted (Models 1–3) and adjusted (Models 4–6) linear probability models predicting current smoking by state taxes, cigarette pack average retail prices, and self-reported cigarette prices in the local area. In unadjusted models not stratified by age, we found that only the self-reported price is statistically significantly associated with current smoking. In Model 4, where we predicted current smoking by state tax, we observed that the association between state tax and current smoking has persisted after adjustment in the youngest age group (25–39). A one dollar increase in the state tax was associated with a 0.9 percentage point decrease in current smoking for this group, implying −0.01 participation elasticity. In Model 5, which estimated current smoking by retail price, we no longer found statistically significant associations in any age group. In Model 6, examining the association between the self-reported local price and current smoking among all ages, we again found a negative association. A one dollar increase in local price was associated with a 0.6 percentage point decrease in current smoking, an elasticity of −0.13. We can put this estimate into population context. A one dollar increase in the self-reported local price was linked to an estimated 0.5 percentage point decrease in current smoking among adults aged 40 to 54, an elasticity of −0.06, and a 0.9 decrease among those aged 55 and older, an elasticity of −0.27. Table 2 with all control variables other than state and year fixed effects is included as Appendix D.

Table 1
Descriptive characteristics of the 2003–2015 CPS-TUS analytic sample.

	Overall	Non-smoker (83%)	Smoker (17%)	p for diff
Individual characteristics				
Education				
Less than High School	13%	12%	17%	<0.001
High School Graduate	29%	27%	39%	
Some College	27%	26%	30%	
College+	32%	35%	14%	
Income				
Less than $15,000	13%	11%	20%	<0.001
$15,000–29,999	17%	16%	21%	
$30,000–49,999	21%	20%	24%	
$50,000–74,999	19%	20%	18%	
$75,000+	30%	33%	17%	
Race/ethnicity				
Non-Hispanic White	69%	68%	74%	<0.001
Non-Hispanic Black	11%	11%	11%	
Hispanic	13%	14%	9%	
Non-Hispanic Other	7%	7%	5%	
Age (mean in years)	49.42	50.15	45.81	<0.001
SD	(15.35)	(15.66)	(13.11)	
Male	48%	47%	54%	<0.001
State characteristics				
State tax	1.45	1.47	1.36	<0.001
SD	(0.78)	(0.78)	(0.75)	
Retail price per cigarette pack	4.15	4.17	4.04	<0.001
SD	(0.98)	(0.99)	(0.95)	
Self-reported price per cigarette pack	3.60	3.64	3.44	<0.001
SD	(1.05)	(1.06)	(0.99)	
Percent Unemployed in a State	7%	7%	7%	<0.001
Percent Hispanic in State	16%	16%	14%	<0.001
Percent in Poverty in State	14%	14%	14%	0.043
Percent Covered by Smoke-free Laws in State	34%	35%	30%	<0.001
Tobacco Control Spending per Capita in State (in $)	1.86	1.86	1.87	0.013
SD	(1.82)	(1.80)	(1.95)	
Percent Support Smoke-free Bars in State	49%	49%	46%	<0.001
Tax Avoidance	5%	5%	5%	0.151
N	559,544	464,233	95,311	

Table 3 shows results from separate models predicting current smoking by state tax interacted in turn with education and income. In Model 7, interacting state tax with education, smoking decreases more sharply among high school graduates and people with some college as taxes grow, in contrast to college graduates, whose smoking prevalence does not change significantly in response to increased state taxes. In models stratified by age, we observe that the pattern was driven by prime-age adults (40–54): higher state taxes were associated with a one percentage point increase in current smoking among college graduates (0.014) but a 0.4 percentage point decrease among people with less than a high school education, a 0.5 percentage point increase in smoking for high school graduates and a 0.3 percentage point increase for people with some college.

In Model 8, where we interacted state tax with household income, we found that the association between state taxes and current smoking varies by income, and again that the variation is driven by prime-age adults. In this age group, a one dollar increase in state tax was associated with approximately a one percentage point increase in smoking in the highest income group ($75,000+), and, in contrast, one percentage point decrease in the lowest income group (income less than $15,000).

In Table 4, we use the average state retail price as our main predictor. The models show patterns similar to those displayed in Table 3 but differ in magnitude. In Model 9, which tests the interactions between education level and retail price, the education variation again appears to be driven by the variation in the prime-age adult group, where a one dollar increase in price was associated with 1.1 percentage point increase in smoking among the college educated, but a 0.7 percentage point decrease among those with less than a high school degree.

In Model 10, testing the interactions between average state retail price and income, we found a one-dollar increase was associated with a one percentage point increase in smoking in the highest income group in contrast to roughly the same magnitude of decrease in smoking in the lowest income group. Decreases in the middle-income categories were statistically significantly different from the increase we observed in the highest income category. However, additional Wald tests showed that while the middle-income coefficients are different from the high-income coefficient, they are not different from zero.

In the final table, Table 5, we examined how the relationship between self-reported local price and smoking varied by education and income. We found that education modified the association between local prices and smoking in all age groups. The slope was the steepest among the least educated. In the youngest group, an increase in cigarette prices was not associated with a decrease in smoking among college graduates, but we found a 1.2 percentage point decrease among those with less than a high school degree and 1.1 percentage point decrease among high school graduates. In the prime-age adult group, we observed a slight increase (0.4 percentage points) in smoking for the college-educated group associated with a one-dollar local price increase, and a decrease for those in the other educational categories. A one dollar price increase was associated with a 2.5 percentage point decrease in smoking among those with less than a high school degree, a 0.9 percentage point

Table 2
Linear probability regression models predicting current smoking by state tax, retail price, and self-reported price. Models 1–3 control for state and year efects. Models 4–6 control for individual and state characteristics, state and year effects.

	Model 1				Model 2				Model 3			
	All ages	25–39 years	40–54 years	55+ years	All ages	25–39 years	40–54 years	55+ years	All ages	25–39 years	40–54 years	55+ years
State Tax	−0.003 [-0.007, 0.001]	−0.014[b] [-0.022, −0.006]	0.005 [-0.002, 0.013]	0.001 [-0.004, 0.007]								
Retail Price					−0.001 [-0.004, 0.003]	−0.009[a] [-0.016, −0.001]	0.004 [-0.004, 0.011]	0.004 [-0.001, 0.009]				
Self-reported Price									−0.017[c] [-0.019, −0.015]	−0.021[c] [-0.025, −0.016]	−0.020[c] [-0.024, −0.016]	−0.015[c] [-0.017, −0.011]
	Model 4				**Model 5**				**Model 6**			
State Tax	−0.001 [-0.005, 0.003]	−0.009[c] [-0.017, 0.000]	0.007 [-0.001, 0.015]	0.000 [-0.005, 0.006]								
Retail Price					0.001 [-0.003, 0.005]	−0.003 [-0.011, 0.004]	0.006 [-0.002, 0.013]	0.003 [-0.002, 0.009]				
Self-reported Price									−0.006[c] [-0.008, −0.004]	−0.003 [-0.007, 0.001]	−0.005[a] [-0.009, −0.001]	−0.009[c] [-0.011, −0.006]
N	559,544	158,301	177,868	223,375	559,544	158,301	166,188	223,375	559,544	158,301	177,868	223,375

Note: Individual-level controls include age, income, gender, race, and age. State-level controls include unemployment rate, percent Hispanic, poverty rate, smoke-free coverage, tobacco control spending per capita, popular support for smoke-free bars, tax avoidance. Models also include controls for state and year effects.
[a] $p<0.05$.
[b] $p<0.01$.
[c] $p<0.001$.

decrease among high school graduates, and a 0.7 decrease among those with some college. For the oldest age group, an increase in cigarette prices was associated with a statistically significant decrease in smoking in all educational categories.

In Model 12, where we evaluated how the associations between self-reported prices and smoking were modified by income, we found evidence of modification in all age groups. For the younger and prime age adulthood groups, an increase in price was not associated with a change in smoking among people with household incomes greater than $75,000, but we found large changes among lower-income people. For younger adults with household incomes less than $15,000, a one-dollar price increase was associated with 2 percentage point decrease in smoking. For those in households with incomes between $15,000 and $29,999, a one-dollar increase was associated with a 1.2 percentage point decrease. Lowest income prime-age adults were similarly more sensitive. One-dollar increase was associated with a 2.4 percentage point decrease in the lowest income group, 2.1 percentage point decrease in the second to lowest group, and 0.8 percentage point decrease for people in households with incomes between $30,000 and 49,999. An increase in price was associated with a decrease in smoking for all income groups of older adults.

In additional figures included in Appendices 1 - 3, we used models 7–12 to estimate predicted probabilities of smoking across measures and education and income for the three age groups.

Supplementary analysis

Our study has estimated the effect of taxes/prices on smoking participation, but a significant portion of the relevant literature has estimated cigarette consumption (smoking intensity) conditional on participation. In order to examine how our results related to this stream of literature, we conducted supplementary analysis analyzing the effect of cigarette tax vs. price on smoking intensity conditional on smoking. Our results generally mirrored those of the smoking participation models. Like in the main participation models, average state retail price was not associated with cigarette consumption. Moreover, state cigarette taxes were not associated with a decrease in smoking intensity in either adjusted or unadjusted models. Self-reported local price continued to be negatively associated with smoking. In the fully adjusted models, one dollar increase in cigarette price was associated with a decrease of 0.23 cigarettes smoked daily, which translates to a conditional demand elasticity of −0.05. The supplementary results are available on request.

V. Limitations

We used a large, high-quality, nationally representative dataset collected over an extended period to consider broad population-level associations between cigarette taxes and prices and current smoking; however, we could not incorporate data on a small number of local areas where no smokers were interviewed or where all smokers refused to answer the questions that were used to construct the measures of local

Table 3
Linear probability regression models predicting current smoking by state cigarette tax with an interaction between tax and education, tax and income, and tax and race/ethnicity and controls for other individual and state characteristics.

	All ages		25–39 years		40–54 years		55+ years	
	Model 7							
State Tax	−0.002		−0.004		0.002		−0.001	
	[-0.007, 0.004]		[-0.014, 0.006]		[-0.008, 0.012]		[-0.009, 0.007]	
Education (College + reference)								
Less than High School	0.148[c]		0.268[c]		0.221[c]		0.029	
	[0.119, 0.177]		[0.200, 0.336]		[0.157, 0.286]		[-0.007, 0.065]	
High School Graduate	0.124[c]		0.163[c]		0.157[c]		0.027	
	[0.102, 0.147]		[0.118, 0.208]		[0.118, 0.196]		[-0.005, 0.060]	
Some College	0.102[c]		0.143[c]		0.109[c]		0.034	
	[0.079, 0.125]		[0.098, 0.188]		[0.071, 0.147]		[-0.001, 0.069]	
Education[a]tax Interaction								
Less than High School[a]tax	0.000	n.s	−0.006	n.s.	0.005	n.s.	0.002	n.s.
	[-0.014, 0.014]		[-0.036, 0.025]		[-0.024, 0.035]		[-0.015, 0.018]	
High School Graduate[a]tax	0.005		0.001		0.008		0.001	
	[-0.005, 0.014]		[-0.020, 0.021]		[-0.010, 0.026]		[-0.011, 0.014]	
Some College[a]tax	−0.003		−0.017		0.004		0.002	
	[-0.013, 0.007]		[-0.035, 0.001]		[-0.013, 0.021]		[-0.012, 0.016]	
	Model 8							
State Tax	−0.005		−0.011		−0.003		−0.003	
	[-0.011, 0.001]		[-0.022, 0.000]		[-0.012, 0.007]		[-0.012, 0.007]	
Income ($75,000+ reference)								
Less than $15,000	0.114[c]		0.156[c]		0.176[c]		0.089[c]	
	[0.085, 0.143]		[0.096, 0.216]		[0.119, 0.233]		[0.049, 0.129]	
$15,000–29,999	0.117[c]		0.147[c]		0.176[c]		0.092[c]	
	[0.089, 0.145]		[0.089, 0.205]		[0.120, 0.231]		[0.054, 0.130]	
$30,000–49,999	0.061[c]		0.111[c]		0.080[b]		0.025	
	[0.036, 0.087]		[0.058, 0.163]		[0.033, 0.126]		[-0.011, 0.061]	
$50,000–74,999	0.025		0.029		0.037		0.023	
	[-0.002, 0.051]		[-0.021, 0.079]		[-0.009, 0.083]		[-0.018, 0.064]	
Income [a]tax Interaction								
Less than $15,000[a]tax	−0.001	n.s	−0.010	n.s.	−0.001	[a]	0.005	n.s.
	[-0.014, 0.013]		[-0.039, 0.019]		[-0.031, 0.029]		[-0.012, 0.022]	
$15,000–29,999[a]tax	0.006		−0.004		0.031[a]		−0.001	
	[-0.006, 0.018]		[-0.028, 0.021]		[0.006, 0.057]		[-0.017, 0.015]	
$30,000–49,999[a]tax	0.006		0.007		0.007		0.004	
	[-0.005, 0.017]		[-0.014, 0.028]		[-0.014, 0.028]		[-0.010, 0.019]	
$50,000–74,999[a]tax	0.010		0.010		0.022[a]		0.005	
	[-0.004, 0.021]		[-0.010, 0.029]		[0.003, 0.041]		[-0.010, 0.021]	
N	559,544		158,301		177,868		223,375	

Note: Individual-level controls include age, income, gender, race, and age. State-level controls include unemployment rate, percent Hispanic, poverty rate, smoke-free coverage, tobacco control spending per capita, popular support for smoke-free bars, tax avoidance. Models also include controls for state and year effects and interactions between state fixed effects and education/income and year fixed effects and education/income.

[a] $p<0.05$.
[b] $p<0.01$.
[c] $p<0.001$.

price. It is likely that such areas systematically differed from those that included responses from smokers. For example, our local price assignment has excluded some rural areas with very low population density and fewer than 20 smokers in total. The observations were incorporated into the next higher-level geographic unit. We were also unable to directly measure excise taxes on cigarettes independently levied by municipalities or counties. We found no available data that accurately capture local cigarette taxes over time and with enough geographic precision. For these reasons, we limited our tax measurement to the state level. We assume that the smaller area self-reported price measure captures taxes levied at all levels.

Large changes unfolded on the tobacco control landscape over our study period, which means our results need to be interpreted with caution. The effects of taxes and prices on current smoking may have been time-variant. We estimated new fully adjusted models (based on original models 4–6) with an interaction between data collection wave and the main predictor. We then used Wald tests to evaluate whether the coefficient estimated for each wave indicator and main predictor interaction was statistically significantly different from the wave and main predictor interaction that preceded it. We found a statistically significant difference in the effects of tax and price between the last two waves, i.e. 2010/2011 and 2014/15, which means that the effect of tax and price on current smoking may have changed in this period.

To more closely inspect the issue, we stratified all models into two periods, 2003 to 2011 and 2014 to 2015. The models that used average retail price as the main predictor showed price was not statistically significant in either period and coefficients were substantively similar in both. For self-reported local price, we found statistically significant negative relationship in both pre-2014 and 2014/2015 time periods that were similar in magnitude. The estimated participation elasticity was −0.14 in the first period and −0.16 in the second. We found some evidence that responsiveness to state taxes has varied by period more than the other two measures did. In the first period, we found a statistically significant association between state taxes and smoking. A one-dollar increase was associated with a 0.1 percentage point decrease in current smoking, which translates to a participation elasticity of −0.03. However, we found no association between state taxes and smoking in the 2014 and 2015 wave. The estimated coefficient in the later period

Table 4
Linear probability regression models predicting current smoking by retail cigarette price with an interaction between price and education, price and income, and price and race/ethnicity and controls for other individual and state characteristics.

	All ages		25–39 years		40–54 years		55+ years	
	Model 9							
Retail Price	−0.002		0.000		0.000		−0.002	
	[-0.007, 0.003]		[-0.009, 0.009]		[-0.009, 0.008]		[-0.009, 0.005]	
Education (College + reference)								
Less than High School	0.160[c]		0.310[c]		0.219[c]		0.030	
	[0.111, 0.208]		[0.199, 0.421]		[0.113, 0.325]		[-0.028, 0.088]	
High School Graduate	0.093[c]		0.145[c]		0.1185[c]		−0.002	
	[0.059, 0.127]		[0.072, 0.218]		[0.055, 0.181]		[-0.048, 0.045]	
Some College	0.099[c]		0.170[c]		0.099[c]		0.014	
	[0.065, 0.134]		[0.104, 0.237]		[0.039, 0.159]		[-0.037, 0.066]	
Education[a]Price Interaction								
Less than High School[a]Price	−0.004	n.s.	−0.015	n.s.	0.001	n.s.	0.000	n.s.
	[-0.017, 0.009]		[-0.044, 0.015]		[-0.027, 0.030]		[-0.016, 0.015]	
High School Graduate[a]Price	0.011[a]		0.006		0.014		0.010	
	[0.002, 0.020]		[-0.013, 0.025]		[-0.003, 0.030]		[-0.002, 0.022]	
Some College[a]Price	0.001		−0.011		0.004		0.007	
	[-0.008, 0.010]		[-0.027, 0.006]		[-0.012, 0.019]		[-0.006, 0.020]	
	Model 10							
Retail Price	−0.002		−0.006		−0.002		0.001	
	[-0.008, 0.003]		[-0.016, 0.005]		[-0.011, 0.007]		[-0.008, 0.010]	
Income ($75,000+ reference)								
Less than $15,000	0.116[c]		0.202[c]		0.165[b]		0.072[a]	
	[0.068, 0.164]		[0.101, 0.302]		[0.064, 0.265]		[0.011, 0.133]	
$15,000–29,999	0.098[c]		0.144[b]		0.083		0.100[b]	
	[0.055, 0.141]		[0.055, 0.234]		[-0.007, 0.174]		[0.043, 0.157]	
$30,000–49,999	0.043[a]		0.085[a]		0.068		0.009	
	[0.004, 0.082]		[0.008, 0.163]		[-0.005, 0.141]		[-0.044, 0.063]	
$50,000–74,999	0.011		0.005		0.013		0.016	
	[-0.028, 0.049]		[-0.069, 0.078]		[-0.055, 0.082]		[-0.043, 0.074]	
Income [a]Price Interaction								
Less than $15,000[a]Price	−0.010[b]	n.s.	−0.016	n.s.	0.004	n.s.	0.006	n.s.
	[-0.014, −0.012]		[-0.044, 0.011]		[-0.025, −0.032]		[-0.010, 0.022]	
$15,000–29,999[a]Price	0.007		0.000		0.034[b]		−0.003	
	[-0.004, 0.018]		[-0.023, 0.023]		[0.010, 0.058]		[-0.017, 0.012]	
$30,000–49,999[a]Price	0.007		0.009		0.005		0.006	
	[-0.003, 0.017]		[-0.010, 0.029]		[-0.015, 0.024]		[-0.008, 0.020]	
$50,000–74,999[a]Price	0.006		0.009		0.010		0.003	
	[-0.004, 0.015]		[-0.009, 0.027]		[-0.008, 0.027]		[-0.011, 0.017]	
N	559,544		158,301		177,868		223,375	

Note: Individual-level controls include age, income, gender, race, and age. State-level controls include unemployment rate, percent Hispanic, poverty rate, smoke-free coverage, tobacco control spending per capita, popular support for smoke-free bars, tax avoidance. Models also include controls for state and year effects and interactions between state fixed effects and education/income and year fixed effects and education/income.

[a] $p<0.05$.
[b] $p<0.01$.
[c] $p<0.001$.

was effectively zero. The results suggest that the effect of taxes may have changed over the study period, but not the effect of local prices.

Our study has only focused on the effects of cigarette taxes and prices on smoking prevalence. However, higher taxes and prices may not only influence cigarette smoking, they may also impact whether and to what extent smokers and former smokers use other tobacco products (Jawad, Lee, Glantz, & Millett, 2018). For example, when prices of cigarettes increase sharply, an established smoker may decrease their cigarette consumption and partially turn to cheaper smokeless or other combustible (e.g., little cigars or cigarillos) products, or electronic nicotine delivery systems in the later time period, to maintain a similar level of nicotine intake. Such situations would result in dual product use, which is associated with higher overall levels of nicotine addiction (Tomar, Alpert, & Connolly, 2010). Alternatively, the same smoker may quit cigarettes entirely and fully transition to other tobacco products. Such a step would likely have positive effects on their health, although not as large as complete cessation (Levy et al., 2004). Our study has not accounted for other tobacco products' use or transitions to other tobacco products and it therefore provides only a partial account of cigarette taxes and prices effects on tobacco consumption.

The final limitation of this study is its use of self-reported measures. Cigarette smoking is a survey interview topic that may be subject to social desirability bias. Especially in areas where anti-smoking sentiment is high, current smokers may be inclined to not disclose smoking. Because strong anti-smoking sentiment is likely correlated with higher taxes and prices, such systematic bias would lead to overestimation of the effect of cigarette taxes and prices on current smoking. One possible strategy for evaluating the extent of this bias in future research is to use biomarkers for smoking, which could help identify respondents who are "likely smokers" based on their serum cotinine levels but who self-report as nonsmokers. In a study using National Health and Nutrition Examination Survey data with biomarkers, Nesson finds higher cigarette taxes to be associated with lower serum cotinine levels among smokers, but also a greater incidence of smoking status misreporting (Nesson, 2017). Because the TUS-CPS does not collect biomarkers, we are unable to evaluate the extent to which social desirability bias influenced our estimates. Furthermore, the key predictor of smoking identified in this study were average local prices. The measure was calculated based on prices reported by smokers living in local areas. Because the prices were only collected from self-identified smokers and because not all smokers may be able to recall prices accurately, they are subject to both social desirability and recall biases.

Table 5
Linear probability regression models predicting current smoking by self-reported cigarette price with an interaction between price and education, price and income, and price and race/ethnicity and controls for other individual and state characteristics.

	All ages	25–39 years	40–54 years	55+ years
	Model 11			
Self-reported Price	0.000	0.005[a]	0.002	−0.002
	[-0.002, 0.003]	[0.001, 0.010]	[-0.003, 0.006]	[-0.005, 0.002]
Education (College + reference)				
Less than High School	0.186[c]	0.317[c]	0.293[c]	0.061[b]
	[0.153, 0.220]	[0.240, 0.395]	[0.220, 0.366]	[0.020, 0.102]
High School Graduate	0.154[c]	0.211[c]	0.189[c]	0.053[b]
	[0.130, 0.179]	[0.161, 0.262]	[0.145, 0.233]	[0.018, 0.088]
Some College	0.117[c]	0.155[c]	0.124	0.052[b]
	[0.091, 0.142]	[0.106, 0.205]	[0.082, 0.167]	[0.014, 0.090]
Education[a]Price Interaction				
Less than High School[a]Price	−0.017[c] [c]	−0.022[b] [c]	−0.031[c] [c]	−0.014[b] [c]
	[-0.024, −0.010]	[-0.039, −0.006]	[-0.047, −0.016]	[-0.023, −0.005]
High School Graduate[a]Price	−0.013[c]	−0.021[c]	−0.013[b]	−0.011[c]
	[-0.018, −0.008]	[-0.032, −0.011]	[-0.022, −0.004]	[-0.018, −0.005]
Some College[a]Price	−0.007[b]	−0.007	−0.006	−0.008[a]
	[-0.012, −0.002]	[-0.016, 0.002]	[-0.015, −0.002]	[-0.014, −0.001]
	Model 12			
Self-reported Price	0.000	0.005	0.004	−0.003
	[-0.002, 0.003]	[-0.001, 0.010]	[-0.001, 0.008]	[-0.007, 0.001]
Income ($75,000+ reference)				
Less than $15,000	0.169[c]	0.254[c]	0.234[c]	0.148[c]
	[0.137, 0.202]	[0.186, 0.322]	[0.168, 0.300]	[0.131, 0.166]
$15,000–29,999	0.153[c]	0.190[c]	0.254[c]	0.102[c]
	[0.122, 0.184]	[0.125, 0.254]	[0.191, 0.317]	[0.086, 0.118]
$30,000–49,999	0.073[c]	0.112[c]	0.108[c]	0.074[c]
	[0.045, 0.102]	[0.055, 0.170]	[0.056, 0.160]	[0.059, 0.089]
$50,000–74,999	0.030[a]	0.020	0.052[a]	0.042[c]
	[0.001, 0.059]	[-0.035, 0.075]	[0.001, 0.102]	[0.025, 0.058]
Income [a]Price Interaction				
Less than $15,000[a]Price	−0.025[c] [c]	−0.044[c] [c]	−0.026[b] [c]	−0.015[b] [a]
	[-0.032, −0.018]	[-0.058, −0.030]	[-0.041, −0.010]	[-0.025, −0.006]
$15,000–29,999[a]Price	−0.016[c]	−0.019[b]	−0.032[c]	−0.010[b]
	[-0.022, −0.009]	[-0.032, −0.006]	[-0.045, −0.018]	[-0.018, −0.003]
$30,000–49,999[a]Price	−0.005	0.000	−0.012[a]	−0.006[a]
	[-0.010, 0.001]	[-0.011, 0.011]	[-0.022, −0.001]	[-0.013, 0.001]
$50,000–74,999[a]Price	−0.001	0.005	−0.004	−0.003
	[-0.006, 0.004]	[-0.006, 0.015]	[-0.014, 0.006]	[-0.010, 0.005]
N	559,544	158,301	177,868	223,375

Note: Individual-level controls include age, income, gender, race, and age. State-level controls include unemployment rate, percent Hispanic, poverty rate, smoke-free coverage, tobacco control spending per capita, popular support for smoke-free bars, tax avoidance. Models also include controls for state and year effects and interactions between state fixed effects and education/income and year fixed effects and education/income.

[a] $p<0.05$.
[b] $p<0.01$.
[c] $p<0.000$.

VI. Discussion

During the first two decades of the twenty-first century, cigarette taxes and prices have rapidly increased. Smoking has dropped precipitously over the same period (USHHS, 2014). It has become accepted wisdom in the public health community that increases in tobacco taxes are associated with decreases in cigarette smoking (*2018* Global progress report on implementation of the WHO Framework Convention on Tobacco Control, 2018). Recent work has taken an issue with our understanding of the relationship between cigarette taxes and smoking, and argued that the evidence for a positive effect of tobacco taxes on today's adult smoking in the United States is weak, and even that strong evidence of their positive effect on adult smoking may have never existed (Callison & Kaestner, 2014). We contributed to this debate by using a large nationally representative dataset to re-evaluate the associations between cigarette taxes and adult smoking in the U.S. population. In addition, we contrast these with the associations between average state retail prices and self-reported prices and adult smoking. We hypothesized that even though these measures are sometimes used interchangeably in the literature, their relationship to smoking may have diverged, and their divergence may contribute to explaining why some researchers continue to observe an association between cigarette taxes and smoking while others do not.

Our results partially align with those of Callison and Kaestner (2014). We found a small, negative, statistically non-significant association between cigarette taxes and smoking in the overall U.S. population between 2003 and 2015. In the youngest adult age group (25–39 years), the estimated association was larger and statistically significant. The latter finding aligns with prior work that has found younger people to be more tax responsive than older people, though this finding has usually been documented among teenagers and the youngest adults (Chaloupka & Warner, 2000). Using the average state retail price for cigarettes, an often-used measure from the Tax Burden of Tobacco, as the main predictor, we found no statistically significant associations in any age group in the fully adjusted models. Our results differed markedly when we used local self-reported prices as main predictor. Across models, we found negative associations between the self-reported prices of cigarettes and smoking, which were almost always statistically significant. These results align with the past stream of research that has found that more expensive cigarettes translate to a decrease in smoking at the

population level (Chaloupka et al., 2012; Pesko et al., 2016), but the estimated price elasticity of −0.13 is much lower than the prior literature consensus of −0.4 (Chaloupka & Warner, 2000).

In the second part of our study, we delved more deeply into the results' implications for disparities. We found that gradients in education and income sensitivity comply with our theoretical expectations when using self-reported price as the main predictor in models for all age groups. People with lower education and lesser income were more sensitive to price increases. We did not find greater responsiveness among the socioeconomically disadvantaged when average state retail price or tax were used as main predictors. This suggests that self-reported local prices better capture changes in real cost of cigarettes than the other two measures. For example, people with less than a high school degree and those with a college degree were no different in their responsiveness to state taxes or retail price but were differentially sensitive when using self-reported price as the main predictor.

Our study shows a heterogeneous responsiveness to cigarette prices across SES groups, but less so when evaluating taxes. The pattern in differential responsiveness to taxes vs. prices may be explained by both supply and demand factors. On the supply side, it may be the case that taxes are not shifted onto smokers equally. Cigarette producers and retailers can introduce discounts and coupons that partially mitigate the impact of taxes. If such discount opportunities are targeted at disadvantaged adults, they will offset some of the impact of tax changes. Cigarette taxes alone may be an insufficient tool for further reducing existing disparities. Policies setting minimum price levels have the potential to reduce such discounts and more effectively close SES gaps in smoking (Golden, Farrelly, Luke, & Ribisl, 2016).

Second, on the demand side, consumers are able to buy cigarettes from across state borders, in Native American reservations, or over the internet. They may also switch to cheaper products to compensate for increased taxes. Indeed, past work has shown that heavier smokers and smokers who buy cartons and shop outside of their state of residence pay fewer cigarette taxes than lighter smokers (DeCicca, Kenkel, & Liu, 2013). Higher taxes at the federal level would mitigate these options. If people with lower socioeconomic resources are more motivated and more successful in implementing price avoidance strategies, tax increases alone will confer limited benefits. Prior evidence suggests that both high and low SES smokers engage in price avoidance, but low SES smokers have 25 percent greater odds of doing so (Licht et al., 2011). Finally, within-state tax heterogeneity may also play a role. The consumer response to an additional state-level increase could be conditional on the prior tax level within their local area. If the distribution of local-level taxes varies by the sociodemographic profile of the local population, this may also obscure a socioeconomic gradient in state tax responsiveness.

VII. Conclusion

The United States has a highly complex tobacco tax environment. The complexity has allowed some local areas to take an activist stance and raise taxes well beyond state levels. The flip side of the complexity is greater opportunity for consumer choice. A complex tax environment allows consumers to "shop for tax" and buy cigarettes from areas with lower taxes. We see the results of our study as evidence that the positive effects of state taxes as a tool for tobacco control may be masked—and potentially undermined—by within–state and cross-state heterogeneity. As a predictor of behavioral change, the state-level retail price faces a similar set of limitations. In contrast, local self-reported prices likely capture local prevailing taxes, state taxes, the cigarette product mixture in the area, as well as tax avoidance behaviors. A change in the local price best approximates the amount of any new costs that are imposed on the consumer beyond what she or he is unable or unwilling to avoid.

Smokers with fewer socioeconomic resources are likely to be more motivated to avoid higher taxes. Our results suggest that higher cigarette taxes that do not translate to higher price for the consumer are not likely to contribute to the closing of the SES disparities in smoking. In addition to our measurement recommendation for researchers, we suggest that minimum-price laws be considered by policy makers in addition to raising taxes. Establishing (and enforcing) floor prices for cigarettes, not modifiable by retailer or manufacturer discounts, would increase the probability that smokers experience an unavoidable increase in cost as a result of a tax increase. Prior research suggests that minimum price laws may be a step toward closing the socioeconomic gap in smoking (Golden et al., 2016). Their prospects for success will be strengthened if minimum price laws become a policy universal to all U.S. states and territories, so that even motivated shoppers will not be able to circumvent them.

Conflict of interest

Lucie Kalousova, David Levy, Andrea Titus, Rafael Meza, James Thrasher, Michael Elliott, and Nancy Fleischer declare they have no conflict of interest.

There are no financial conflicts of interest to disclose.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssmph.2020.100686.

Ethics approval

The study used public and fully deidentified dataset and involved no human contact. It is exempt from IRB review.

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