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John A. Tauras
Megan C. Diaz
Barbara Schillo
Donna Vallone

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ABSTRACT

The rapid rise in e-cigarette use rates among high school students in the United States is a significant source of public policy concern for many states. This paper is the first study to examine the impact of state tobacco control spending on the demand for vaping products by high school students. The findings from this study provide strong evidence that funding for state tobacco control programs is associated with reduced vaping among youth and young adults in the US. These findings could help to inform decision making about how states should allocate scarce public resources.

John A. Tauras
University of Illinois at Chicago
Department of Economics (m/c 144)
College of Liberal Arts and Sciences
601 S. Morgan Street, Room 707
Chicago, IL 60607
and NBER
tauras@uic.edu

Megan C. Diaz
Truth Initiative
900 G Street, NW Fourth Floor
Washington, DC 20001
mdiaz@truthinitiative.org

Barbara Schillo
Truth Initiative
900 G Street, NW Fourth Floor
Washington, DC 20001
bschillo@truthinitiative.org

Donna Vallone
Truth Initiative
900 G Street, NW Fourth Floor
Washington, DC 20001
DVallone@truthinitiative.org

Introduction

Over the past two decades, significant progress has been made in reducing cigarette smoking among youth and young adults in the United States. According to the Monitoring the Future study, the prevalence of smoking by 12th grade students decreased from 36.5% in 1997 to 5.7% in 2019 and the prevalence of smoking among 8th graders decreased from 19.4% in 1997 to 2.3% in 2019. However, in 2007, the tobacco landscape changed dramatically when electronic cigarettes (e-cigarettes) entered the marketplace. Many youth and young adults began using e-cigarettes and prevalence rates significantly escalated. By 2014, e-cigarettes overtook cigarettes as the most commonly used tobacco product by youth in the United States (USDHHS, 2016). From 2011 to 2019, current e-cigarette use, defined by use on at least one day in the past 30 days, by high school students increased 1,733 percent, from 1.5 to 27.5 percent, accounting for a whopping 4.1 million American high school students using e-cigarettes in 2019 (CDC, 2013; Wang et al. 2019). Moreover, from 2011 to 2019, current e-cigarette use by middle school students increased 1,650 percent, from 0.6 to 10.5 percent, accounting for 1.2 million American middle school students using e-cigarettes in 2019 (CDC, 2013; Wang et al. 2019).

The dramatic increase in e-cigarette use rates by adolescents is troubling since e-cigarettes have been found to be a strong predictor of future combustible tobacco product use. The National Academies of Science Engineering and Medicine found "substantial evidence that e-cigarette use increases risk of ever using combustible tobacco cigarettes among youth and young adults" (National Academies of Science (NAS, 2018). Moreover, the NAS concluded there exists "moderate evidence that e-cigarette use increases the frequency and intensity of subsequent combustible tobacco cigarette smoking" by youth and young adults (NAS, 2018).

The rise in e-cigarette use by youth is equally disconcerting given the health consequences associated with their use. According to the Surgeon General "E-cigarette use poses a significant – and avoidable – health risk to young people in the United States. Besides increasing the possibility of addiction and long-term harm to brain development and respiratory health, e-cigarette use is associated with the use of other tobacco products that can do even more damage to the body. Even breathing e-cigarette aerosol that someone else has exhaled poses potential health risks (USDHHS, 2020).

The rapid rise in e-cigarette use among adolescents in conjunction with the health risks of use and the increased likelihood of transitioning to smoking combustible products later in life has been a significant source of public policy concern for many states. In an effort to prevent tobacco initiation and promote tobacco cessation, state tobacco control programs have funded a variety of anti-tobacco activities. Numerous evaluations of state and national tobacco control programs provide compelling evidence that these programs reduce cigarette use (USDHHS, 2000; Wakefield and Chaloupka, 2000; Institute of Medicine, 2007). Unfortunately, to date, there have been no econometric studies that have examined the effects of state tobacco control programs on e-cigarette use. This paper is an attempt to fill that void by providing empirical evidence of the effects of state tobacco control spending on e-cigarette smoking prevalence and intensity among high school students in the United States.

Brief Overview of State Tobacco Control Programs

In 1988, California voters passed Proposition 99, which raised the cigarette excise tax by 25 cents per pack. A portion of the revenue generated from this excise tax increase was earmarked for tobacco control purposes. In 1989, California became the first state in the US to create a comprehensive state-wide tobacco control program. Within a few years, several other states did the same, including Massachusetts, Arizona, Oregon and Maine. In the wake of the 1997 Master Settlement Agreement that resolved state lawsuits against the tobacco industry, many other states used industry settlement payments to support comprehensive tobacco control programs.

In addition, several federally funded initiatives have supported state efforts to reduce tobacco use. The National Cancer Institute's American Stop Smoking Intervention Study (ASSIST) program provided funding for 17 states to organize community efforts for the successful delivery of tobacco control interventions from 1991 through 1998. During the same period, the Center for Disease Control and Prevention's Initiatives to Mobilize for the Prevention and Control of Tobacco Use (IMPACT) program provided funding for the 33 states not funded by ASSIST to help them build capacity for addressing tobacco use as a public health problem. In 1999, the CDC launched the National Tobacco Control Program (NTCP), which provides financial support, training, and technical support for tobacco control programs in all 50 states and the District of Columbia. Despite these investments in tobacco control, many states today are supporting tobacco control efforts at levels significantly below CDC recommendations and are diverting revenue collected from tobacco industry for other purposes despite evidence that spending on tobacco control matters.

It is estimated that the 50 states and the District of Columbia combined will collect $27.2 billion in fiscal year (FY) 2020 from tobacco tax revenues, MSA payments, and individual state settlements (Campaign for Tobacco Free Kids (CTFK, 2020). Although the Centers for Disease Control and Prevention (CDC) recommends that states spend a combined $3.3 billion, or $10.53 per capita, to maintain comprehensive tobacco control programs (CDC, 2014), states have traditionally appropriated significantly less than what CDC recommends. In FY 2020, no state reached the CDC recommended spending levels for tobacco control, and only 3 states (CA, AK, ME) reached 70 percent of the recommended CDC funding. In FY 2020, all 50 states and the District of Columbia combined appropriated $739.7 million for tobacco prevention and cessation programs (CTFK, 2020). For FY 2020, the average state-level tobacco control funding represents just 22.4% of the CDC-recommended level of funding, and reflects just 2.7% of the revenue that states received from tobacco settlements and tax revenues.

Brief Review of the Literature

Numerous studies provide resounding evidence that state-funded tobacco control programs reduce tobacco use (USDHHS, 2000; Wakefield and Chaloupka, 2000; Institute of Medicine, 2007). For example, in California following the creation of the nation’s first comprehensive state-wide tobacco control program in 1988, per capita cigarette sales were cut nearly in half from 1988 to 1999, whereas the decline was only about 20% in the rest of the Unites States. The prevalence of smoking among adults in California declined by 47.5% from 1988 to 2010, whereas adult smoking prevalence for the United States as a whole declined by 31.3% over the same period. Other states including Arizona, Florida, Massachusetts, and Oregon also observed significant reductions in smoking after implementing large comprehensive state tobacco control programs (Biener and colleagues, 2000; Massachusetts Department of Public Health, 2000; ABT, 1999; CDC, 1996; CDC, 1999; Arizona Department of Health Services, 1999; Florida Department of Health, 2001; Bauer and colleagues, 2000). However, many of these state-specific studies relied primarily on simple trend analyses that did not control for potential confounding factors. Furthermore, state-specific studies often lack generalizability to other states or to the United States as a whole.

Very few analyses have examined the impact of state tobacco control programs on cigarette smoking across states. An early study compared per capita cigarette sales in ASSIST states to sales in non-ASSIST States (Manley and colleagues, 1997). The study found sales declined 28% faster in the ASSIST states than non-ASSIST states in the first several years after the program began, whereas in the years before the program, trends in sales between the two groups were similar (Manley and colleagues, 1997). Another study investigated the effect of state-level per capita tobacco control expenditures on state-level per capita cigarette sales for the period 1981-2000 (Farrelly, Pechacek, and Chaloupka, 2003). The study concluded that if states had funded tobacco control efforts at the CDC minimum recommended levels, the rate of decline in cigarette consumption would have doubled from 1994 through 2000. Another study that used survey data on adults from 1985 to 2003 concluded that if states would have spent the minimum CDC-recommended level of expenditures on tobacco control efforts, there would have been approximately 2.2 million fewer adult smokers than observed between the years 1985 and 2003 (Farrelly et al., 2008). The most recent study examined actual tobacco control spending in each state in relation to the 5 CDC Best Practice categories for the years 2008-2012 and found associations between increased spending in the areas of cessation interventions, health communication interventions, state and community interventions, and even surveillance, evaluation and administration and declines in cigarette sales (Tauras et al., 2018). The paper concluded that cigarette sales would continue to decline if current program spending was significantly increased.

Only one econometric study has examined the effect of tobacco control spending on youth and young adult smoking across the US (Tauras et al. 2005). This study found a strong inverse relationship between state level tobacco control funding and youth smoking using survey data from the 1991-2000 Monitoring the Future project (Tauras et al. 2005). The study concluded that had states spent the minimum amount of funding recommended by the CDC, the decline in prevalence of smoking among youths would have been between 3.3% and 13.5% lower than the rate that was observed over this period.

No econometric studies to date have examined the effect of tobacco control spending on youth electronic cigarette use. This is an important omission from the literature given e-cigarettes are now the leading tobacco product used by youth in the US. The goal of this paper is to provide the first empirical evidence of the relationship between state-funded tobacco control efforts and youth e-cigarette use. Findings will be particularly informative to federal and state policymakers interested in reversing the e-cigarette epidemic among youth and young adults in the United States.

Data

The data employed in this study are extracted from the National 2015-2017 Youth Risk Behavior Surveys (YRBS) conducted by the Centers for Disease Control and Prevention. The YRBS are conducted during spring semesters and provide data representative of 9th through 12th grade students in public and private schools in the United States. The YRBS was developed in 1990 to monitor health behaviors that contribute to the leading causes of death, disability, and social problems among youth and adults in the United States. In 2015, questions regarding high school student use of electronic vaping products were added to the surveys.

Two dependent variables were created from the surveys: participation in vaping and number of days using vaping products. The first measure was a dichotomous indicator equal to one for respondents who indicated that they had used vaping products on at least one day in the past 30 days and equal to zero otherwise. The second dependent variable was a quasi-continuous measure of the number of days vapers used vaping products during the past 30 days. This variable is based on the midpoints of the categorical responses. The values and categorical responses (in parentheses) follow: 1.5 (1-2 days), 4 (3-5 days), 7.5 (6-9 days), 14.5 (10-19 days), 24.5 (20-29 days), and 30 (all 30 days).

Based on the survey data, a number of independent variables were constructed to control for factors thought likely to affect youth and young adult vaping. These factors included: the age of the respondent in years; gender (male and female—reference category); indicators of race/ethnicity (non-Hispanic Black , non-Hispanic American Indian or Alaskan Native, non-Hispanic Asian, non-Hispanic native Hawaiian or Pacific Islander, Non-Hispanic Multiple Races, Hispanic, and non-Hispanic White – reference category); and indicators of grade level (grade 10, grade 11, grade 12 and grade 9 – reference category).

We also created dichotomous indicators for each state in the survey and each year of the survey. The dichotomous state indicators capture all time-invariant state-level unobserved heterogeneity and the year indicators account for the overall trend in vaping over time. We employed a two-way fixed-effects regression technique in all the analyses. The fixed effects approach amounts to including a dichotomous indicator for each state (less one) and each year (less one) as explanatory variables in the models.

Annual inflation adjusted per-capita expenditures on tobacco control were merged with the survey data using state-level geoidentifiers. The tobacco control expenditure data are based on the American Lung Association's annual State of Tobacco Control report which included spending for each state from the following sources: tobacco excise tax revenues earmarked for tobacco control, Master Settlement Agreement and individual state settlements with the tobacco industry earmarked for tobacco control, other state appropriated funds earmarked for tobacco control programs, and Federal funding to states earmarked for tobacco control (American Lung Association, 2015, 2017). State expenditures were used to calculate per-capita measures using population estimates from the United States Census and were adjusted for inflation using the United States Bureau of Labor Statistics Consumer Price Index.

Based on the state in which each youth's school was located, we merged a dichotomous indicator equal to one if the student resided in a state that imposed a tax on vapor products at the time the student was surveyed, and was equal to zero otherwise. A dichotomous indicator was used for this tax rather than a tax rate given the variation in how vaping taxes are imposed by states. Unlike cigarettes which are taxed by all states at constant nominal rate per pack of cigarettes (i.e. a specific excise tax), the taxing strategies of states are quite different from one another as it pertains to vaping products. Some states tax on an *ad valorem* basis (i.e. a tax based on the value of a tobacco product), some tax them on a specific tax basis, and some states apply a two-tier tax that employs both an *ad valorem* and a specific excise tax component. States that apply an *ad valorem* tax differ in what constitutes a taxable vapor product with states taxing one or more of the following vapor products: vapor devices; vapor kits, components of vapor products, volume of the consumable liquid product that contains nicotine, and volume of the consumable liquid product that is not required to contain nicotine. States that apply a specific excise tax to vapor products tax the number of milliliters of consumable product (i.e. liquid) purchased. However, states differ on what constitutes a consumable product to be taxed with some states requiring consumable products to contain nicotine and other states to not require nicotine in the consumable product.

Several variables reflecting the presence of state-level smoke-free air laws were merged with the survey data using data from the Centers for Disease Control and Prevention's State Tobacco Activities Tracking and Evaluation System. We constructed separate dichotomous indicators for states that ban smoking cigarettes and vapor products in private worksites. The first dichotomous indicator was equal to one if the state banned cigarette smoking in private worksites but did not ban the use of vapor products in private worksites, and was equal to zero otherwise. The second dichotomous indicator was equal to one if the state banned both cigarette smoking and using vapor products in private worksites, and was equal to zero otherwise. The third dichotomous indicator (i.e. the omitted reference category) was equal to one if the state did not ban cigarette smoking or vapor products in private worksites, and was equal to zero otherwise. No states at the time of the surveys banned vaping products but allowed cigarette smoking.

Based on the state in which each youth's school was located, we merged cigarette prices with the survey data using data from the annual Tax Burden on Tobacco (Orzechowski and Walker, 2019). Including cigarette prices in the e-cigarette demand equations should provide evidence on whether cigarettes are economic substitutes or complements for e-cigarettes among high school students. The cigarette prices are weighted averages for a pack of 20 cigarettes and are inclusive of state-level cigarette excise taxes. Since the price data reflects data as of November 1 and the surveys were conducted between January and June of each year, we created a weighted average price for the first 6 months of each year. To account for changes in the relative price of cigarettes over time, all cigarette prices were adjusted by the Consumer Price Index published by the Bureau of Labor Statistics.

Lastly, a variable reflecting cigarette and vapor product minimum purchase age (MLPA) laws was merged with the survey data, using data from the Centers for Disease Control and Prevention's State Tobacco Activities Tracking and Evaluation System. We constructed a dichotomous indicator equal to one for states that had a MLPA law for cigarettes that was higher than the MLPA for vaping products and was equal to zero otherwise. No states during the time of the surveys had a MLPA for vapor products that was higher than those for cigarettes.

Methods

We used a modified two-part model of demand in which vaping prevalence and vaping intensity were estimated separately. In the first step, we used probit methods to estimate a vaping prevalence equation. In the second step, we used a generalized linear model with log link and gaussian distribution to model the number of days vaped in the previous 30 days among current vapers. In both parts of the model, we utilized a difference-in-difference regression technique where we included a dichotomous indicator for each state (less one) and each year (less one) as explanatory variables in the models. This assumes that the differences across states and over time not captured by the other covariates included in the model, can be captured by the state and year fixed effects. The standard errors of the estimates are corrected using a robust method of calculating the variance-covariance matrix developed by Huber (1967). Estimates from the participation in vaping equations are presented in Table 1. Estimates from the vaping intensity equations are presented in Table 2. We estimated five alternative models for both participation in vaping and the number of days in the past month using vaping products. The first model for each dependent variable contained estimates from a model specification that includes real per capita tobacco control expenditures, prevalence of a vaping tax, age, gender, grade in school, race and ethnicity, year fixed effects and state fixed effects. Models two through four add additional tobacco control measures to model one and model five includes all tobacco control measures simultaneously. In particular, model two for each dependent variable is identical to model one, but model two adds the two smoke-free air variables. Model three for each dependent variable is identical to model one, but model three adds the real average price of cigarettes. Model four for each dependent variable is identical to model one, but model four adds the minimum legal purchase age variable. Finally, model five for each dependent variable is identical to model one, but model five adds the smoke-free air variables, the real average price of cigarettes, and the minimum legal purchase age variable. Including only the real per capita tobacco control expenditures and the prevalence of a vaping tax in model one minimizes the collinearity resulting from the inclusion of a group of potentially highly correlated measures of tobacco control policy. The potential correlation stems from the fact that when states implement or enhance tobacco control programs they may enact several new tobacco control measures at the same time. Omitting some measures of tobacco control in models one through four, however, may lead to biased estimates of the effects of real per capita tobacco control expenditures and other tobacco control policies on high school vaping. The tradeoff between models one through four and model five is a tradeoff between multicollinearity and omitted variable bias.

Results

After controlling for the other potential determinants of youth vaping, we found real per capita tobacco control expenditures to have a negative and statistically significant relationship with vaping prevalence and the number of days youth vape. This relationship was found in all of the models that were estimated. These estimates indicate that higher per capita tobacco control spending is associated with lower youth vaping prevalence and fewer days vaping among high schoolers that choose to use vapor products. Because the probit models that were used to estimate the vaping prevalence equations are nonlinear in nature, the estimated parameters do not directly provide meaningful information for understanding the relationship between tobacco control spending and vaping prevalence. Therefore, the estimates were used to perform simulations that predict vaping prevalence rates under alternative assumptions about the level of tobacco control program spending. Table 3 provides predicted probabilities of vaping prevalence if states were to increase their funding for tobacco control by 25%, 50%, 75%, and 100%, holding all other independent variables at their actual values. Table 3 also provides the predicted number of days vapers use vaping products if states were to increase their funding for tobacco control by 25%, 50%, 75%, and 100%, holding all other independent variables at their actual values. The average predicted vaping prevalence across the 5 alternative models is 19.71. If states would have spent more on tobacco control during each year of the survey, vaping prevalence among high school students would have been significantly lower than what was observed. For example, using the average effects across all 5 models, if states would have spent 25% more on tobacco control efforts, the estimates imply that high school vaping prevalence would have been 2.49 percentage points lower than what was observed. Likewise, had states spent 50%, 75%, and 100% more on tobacco control efforts, the estimates imply that high school vaping prevalence would have been 4.65, 6.5, and 8.1 percentage points lower than what was observed. The average predicted number of days vaped by high school vapers in the previous 30 days across the 5 alternative models is 8.27. If states would have spent more on tobacco control during each year of the survey, vaping intensity among high school students would have been significantly lower than what was observed. For example, using the average effects across all five models, if states would have spent 25% more on tobacco control efforts, the estimates imply that the number of days vapers used vaping products would have been 1.95 days fewer than what was observed. Likewise, had states spent 50%, 75%, and 100% more on tobacco control efforts, the estimates imply that the number of days that high school students used vaping products would have been 3.24, 4.16, and 4.84 days fewer than what was observed.

We found high school students who reside in states that impose an excise tax on vaping products are less likely to vape than high school students who reside in states that do not impose a tax on vapor products. However, the relationship is not significant at conventional levels of a two tailed test in models 2 and 3 when the smoke-free air laws and the price of cigarettes are included in the model. Moreover, we found high school students who reside in states that impose an excise tax on vaping products vape on fewer days than high school students who reside in states that do not impose a tax on vapor products, however the results are not statistically significant at conventional levels.

We found a positive relationship between the prevalence of students vaping and states that only ban smoking (and not vaping) in private worksites compared to states that do not ban smoking or vaping in private worksites, however, this variable loses significance in model 5 when all measure of tobacco control are included simultaneously. We also found a positive and significant relationship between the number of days vaping and states that only ban smoking (and not vaping) in private worksites compared to states that do not ban smoking or vaping in private worksites. Moreover, we found a negative and significant relationship between the prevalence of students vaping and states that ban both smoking and vaping in private worksites compared to states that do not ban smoking or vaping in private worksites. Finally, we found a positive relationship between the number of days vaping and states that ban both smoking and vaping in private worksites compared to states that do not ban smoking or vaping in private worksites.

We found the price of cigarettes and the minimum legal purchase age variables to have a statistically insignificant effect on the prevalence of vaping and the number of days vaped by high school vapers.

Other statistically significant findings from the multivariate analyses include: age being positively related to vaping prevalence; males having significantly higher vaping prevalence rates and number of days vaping than females; Blacks, Hispanics, Asians, and individuals of multiple races having significantly lower vaping prevalence rates than whites; American Indians and Alaskan Natives having significantly higher vaping prevalence rates than Whites; Blacks and Hispanics vape significantly fewer days than do Whites.

Discussion

Since 1999, the CDC has issued its Best Practices for Comprehensive Tobacco Control Programs Report which provides guidance on key components of comprehensive state tobacco control programs and includes recommendations for funding of these programs. Its most recent release recommends that states allocate a total of $3.3 billion to their comprehensive tobacco control programs--a funding level sufficient to most effectively reduce tobacco use (CDC, 2014). In FY 2020, all 50 states and the District of Columbia combined appropriated $739.7 million for tobacco prevention and cessation programs (CTFK, 2020), which is equivalent to approximately 22.4% of the CDC recommended level of funding. Results from this study confirm the critical need for states to sufficiently fund tobacco control efforts given the significant and rapid escalation of e-cigarette use among youth. Moreover, findings indicate that had states increased their spending on tobacco control programs by 50% during the time of the surveys, high school vaping prevalence would have been 4.65 percentage points lower than what was observed.

In conclusion, the findings from this study provide strong evidence that funding for state tobacco control programs is associated with reduced vaping among youth in the US. These findings could help to inform decision making about how states should allocate scarce public resources. Indeed, in the face of dramatic increases in youth vaping, the findings from this study provide justifications for states to increase their expenditures on tobacco control efforts in an attempt to curb the epidemic.

Limitations

Unfortunately, no information was available on how the tobacco control expenditures were spent by states. Thus, the overall state tobacco control expenditure variable used in our study reflects total resources spent on tobacco control efforts in each state in each year. Future data collections separating out the amount of money states spend preventing electronic cigarette use by youth from spending on other types of tobacco control efforts is needed. A second possible limitation is despite our attempt to generate causal estimates using a difference-in-difference methodology, our study employs pooled cross-sectional data and causality cannot be established with certainty when using cross-sectional data.

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Table 1

Vaping Prevalence Among High School Students

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
Tob Control Expenditure	-0.239	-0.134	-0.233	-0.238	-0.174
	(0.058)	(0.065)	(0.065)	(0.060)	(0.071)
E-cig Tax	-0.301	-0.100	-0.265	-0.298	-0.367
	(0.074)	(0.092)	(0.159)	(0.077)	(0.182)
SFA Only Cig		0.579			0.071
		(0.166)			(0.335)
SFA Both Cig and E-cig		-0.280			-0.355
		(0.075)			(0.087)
Price of Cig			-0.000		0.002
			(0.001)		(0.001)
Cig MLPA > E-cig MLPA				-0.008	0.056
				(0.064)	(0.074)
Age	0.071	0.071	0.071	0.071	0.071
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
Male	0.162	0.162	0.162	0.162	0.162
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
10th Grade	0.033	0.034	0.033	0.033	0.034
	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
11th Grade	0.022	0.023	0.022	0.022	0.024
	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)
12th Grade	0.082	0.085	0.083	0.082	0.085
	(0.055)	(0.055)	(0.055)	(0.055)	(0.055)
Black	-0.361	-0.360	-0.361	-0.360	-0.358
	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
American Indian/ Alaskan	0.254	0.251	0.254	0.254	0.251

Native	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)
Hispanic	-0.171	-0.173	-0.172	-0.171	-0.174
	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
Asian	-0.458	-0.456	-0.458	-0.457	-0.454
	(0.052)	(0.052)	(0.052)	(0.052)	(0.052)
Native Hawaiian/ Pacific	-0.072	-0.060	-0.072	-0.072	-0.059
Islander	(0.108)	(0.109)	(0.108)	(0.108)	(0.108)
Multiple Race	-0.080	-0.078	-0.080	-0.080	-0.079
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
2017	-0.493	-0.484	-0.491	-0.495	-0.486
	(0.026)	(0.026)	(0.027)	(0.030)	(0.030)
Constant	-1.879	-1.932	-1.733	-1.879	-3.189
	(0.260)	(0.260)	(0.624)	(0.260)	(0.767)
Observations	27144	27144	27144	27144	27144

All equations include dichotomous indicators for each state in the sample minus 1. Regression coefficients are presented in the table and robust standard errors are in parentheses.

Table 2

Number of Days Vaping Among High School Vapers

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
Tob Control Expenditure	-0.383	-0.801	-0.391	-0.410	-0.965
	(0.142)	(0.330)	(0.146)	(0.147)	(0.466)
E-cig Tax	-0.177	-1.196	-0.229	-0.223	-1.205
	(0.214)	(0.714)	(0.346)	(0.222)	(0.906)
SFA Only Cig		1.228			2.555
		(0.391)			(1.036)
SFA Both Cig and E-cig		0.904			1.396
		(0.451)			(0.722)
Price of Cig			0.000		-0.005
			(0.002)		(0.003)
Cig MLPA > E-cig				0.122	0.107
MLPA				(0.121)	(0.128)
Age	0.074	0.079	0.074	0.076	0.083
	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)
Male	0.392	0.392	0.392	0.392	0.391
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)
10th Grade	-0.031	-0.045	-0.031	-0.034	-0.053
	(0.068)	(0.068)	(0.068)	(0.067)	(0.069)
11th Grade	-0.094	-0.106	-0.094	-0.098	-0.114
	(0.100)	(0.100)	(0.100)	(0.099)	(0.100)
12th Grade	-0.099	-0.120	-0.099	-0.105	-0.134
	(0.141)	(0.142)	(0.141)	(0.140)	(0.142)
Black	-0.174	-0.157	-0.173	-0.174	-0.155
	(0.068)	(0.070)	(0.069)	(0.068)	(0.071)
American Indian/ Alaskan	-0.074	-0.060	-0.074	-0.073	-0.052

Native	(0.132)	(0.130)	(0.132)	(0.131)	(0.129)
Hispanic	-0.250	-0.239	-0.250	-0.256	-0.243
	(0.060)	(0.061)	(0.060)	(0.060)	(0.062)
Asian	-0.012	-0.009	-0.012	-0.014	-0.012
	(0.108)	(0.109)	(0.108)	(0.108)	(0.109)
Native Hawaiian/ Pacific	0.103	0.117	0.105	0.100	0.110
Islander	(0.192)	(0.186)	(0.193)	(0.191)	(0.183)
Multiple Race	-0.056	-0.047	-0.056	-0.060	-0.047
	(0.045)	(0.046)	(0.045)	(0.045)	(0.047)
2017	0.207	0.204	0.205	0.231	0.255
	(0.048)	(0.046)	(0.050)	(0.055)	(0.053)
Constant	0.467	0.607	0.251	0.455	3.477
	(0.710)	(0.719)	(1.436)	(0.709)	(1.944)
Observations	5353	5353	5353	5353	5353

All equations include dichotomous indicators for each state in the sample minus 1. Regression coefficients are presented in the table and robust standard errors are in parentheses.

Table 3

Predicted Prevalence of Smoking					
	Model 1	Model 2	Model 3	Model 4	Model 5
Average Predicted Prevalence	19.71	19.71	19.71	19.71	19.71
Predicted Vaping Prevalence if States Increase Tobacco Control Spending by 25%	16.81	18.03	16.89	16.83	17.56
Predicted Vaping Prevalence if States Increase Tobacco Control Spending by 50%	14.34	16.49	14.47	14.37	15.64
Predicted Vaping Prevalence if States Increase Tobacco Control Spending by 75%	12.27	15.08	12.43	12.31	13.94
Predicted Vaping Prevalence if States Double their Tobacco Control Spending	10.54	13.8	10.72	10.58	12.44
Predicted Days Vaping by High School Student Vapers					
	Model 1	Model 2	Model 3	Model 4	Model 5
Average Predicted Number of Days Vaping	8.27	8.26	8.28	8.28	8.24
Predicted Vaping Days if States Increase Tobacco Control Spending by 25%	6.89	5.71	6.86	6.80	5.33
Predicted Vaping Days if States Increase Tobacco Control Spending by 50%	5.81	4.16	5.77	5.68	3.69
Predicted Vaping Days if States Increase Tobacco Control Spending by 75%	4.96	3.15	4.92	4.80	2.69
Predicted Vaping Days if States Double their Tobacco Control Spending	4.28	2.46	4.23	4.11	2.04