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Bans on electronic cigarette sales to minors and smoking among high school students

Rahi Abouk[a], Scott Adams[b,*]

[a] Department of Economics, Finance and Global Business, William Paterson University, United States
[b] Department of Economics, University of Wisconsin-Milwaukee, United States

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ABSTRACT

Many states have banned electronic cigarette sales to minors under the rationale that using e-cigarettes leads to smoking traditional combustion cigarettes. Such sales bans would be counterproductive, however, if e-cigarettes and traditional cigarettes are substitutes, as bans might push teenagers back to smoking the more dangerous combustion cigarettes. We provide evidence that these sales bans reduce the incidence of smoking conventional cigarettes among high school seniors. Moreover, we provide evidence suggesting that sales bans reduced e-cigarette usage as well. This evidence suggests that not only are e-cigarettes and smoking regular cigarettes positively related and not substitutes for young people, banning retail sales to minors is an effective policy tool in reducing tobacco use.

1. Introduction

Electronic cigarettes (e-cigarettes) have become increasingly popular in the United States, especially among young people. Between 2012 and 2014, e-cigarette use (or vaping) increased fourfold among high school students (Arrazola et al., 2015). E-cigarettes are alluring to young people because they are perceived as harmless (Gilreath et al., 2015), and the array of flavors are more palatable (Kong et al., 2015). The pharmacological effects from e-cigarettes, which contain nicotine, could lead to dependence given the high level of susceptibility of adolescent brains (Counotte et al., 2011). This has led many public health advocates to worry about complementarities between e-cigarettes and the more dangerous conventional cigarettes, with the former perhaps serving as a gateway to the latter (Leventhal et al., 2015; Primack et al., 2015; Dutra and Glantz, 2014). Despite the worries associated with e-cigarettes being targeted to minors and the overwhelming growth in popularity among young people, there was no Federal regulation of the product until the FDA announced it would regulate e-cigarettes in mid-2016.

The link between e-cigarettes and smoking is not straightforward, however, and existing studies cannot rule out the influence of unobservable factors that might drive both experimentation with e-cigarettes and smoking. Moreover, additional studies have shown that e-cigarettes are actually a relatively safe substitute for conventional cigarettes (Cahn and Siegel (2011) and Polosa et al. (2013)). This implies that e-cigarettes could be part of a harm reduction strategy. In short, the question of whether e-cigarettes and regular cigarettes are substitutes or complements is not resolved.

In this study, we test for the effects of restricting youth access to e-cigarettes on smoking traditional combustion cigarettes in a sample of high school seniors using the 2007–2014 Monitoring the Future surveys. If e-cigarettes are a complement to regular cigarettes, we should find that prohibiting sales of e-cigarettes reduces the incidence of adolescents smoking conventional cigarettes. If there is substitution between e-cigarettes and conventional cigarettes, the bans would be counterproductive. Restricting youth access might then increase the prevalence of conventional cigarette smoking, as well as the intensity.

Our individual-level evidence suggests that e-cigarette bans do not increase smoking. In fact, the sum of the evidence suggests a decrease in the incidence of smoking. This provides the first causal evidence in population data showing e-cigarettes are likely a complement, rather than a substitute, for smoking combustion cigarettes among adolescents. In terms of smoking intensity, however, the effect of e-cigarette bans is essentially zero.

The rationale behind prohibiting sales of e-cigarettes to young people likely rests in the belief that there is some harm to using the product, even if the harm is less than that of conventional cigarettes. If the goods are complements, this would suggest bans are a good

* Corresponding author.
E-mail address: sjadams@uwm.edu (S. Adams).

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harm reduction strategy. Another justification for a sales ban would be that e-cigarettes have harmful pollutants that would potentially negatively affect bystanders. This externality justification is the primary reason that smoking is banned in indoor places. The evidence that e-cigarettes have negative externalities is limited. Certainly, the exposure from e-cigarette toxins is less dangerous than conventional cigarettes (Czogala et al., 2014; Schripp et al., 2013). There is evidence, however, of heightened exposure to several known carcinogens for those in a room where e-cigarettes are used (Grana et al., 2014; Schober et al., 2014), and multiple questions exist about the environmental impact of e-cigarette production and waste (Lerner et al., 2015). E-cigarettes also heighten one's propensity to remain at bars longer, which is potentially dangerous in terms of binge drinking and the associated dangers (Abouk et al., 2016).

We are not the first to assess the effect of youth e-cigarette sales bans on smoking using population data. Most notably, Friedman (2015) uses state-level biennial data from the National Survey on Drug Use and Health (2002–2013) to assess the effect of e-cigarette sales bans on the prevalence of smoking among adolescents, and Pesko et al. (2016) uses the Youth Risk Behavior Surveillance System for ninth-twelfth graders from 2007 to 2013, again using aggregated data. Their findings suggest e-cigarettes and conventional cigarettes are substitutes, and the bans are counterproductive. Because they use aggregate data, they also can control for aggregate trends in smoking among older young adults that can legally purchase e-cigarettes after a ban.[1] Our more granular individual-level evidence comes to a different conclusion than these two studies, and we discuss the potential reasons for the differences in the final section of the paper.

2. Data

We use data from the Monitoring the Future (MTF) surveys from 2007 to 2014. These contain information on approximately 50,000 eight, tenth, and twelfth graders from 420 public and private secondary schools in the United States, fielded annually during the spring semester. The schools are located across 46 states and the District of Columbia and are meant to be representative of the U.S. population. The MTF does not include all states every year, which is a limitation of the study.[2]

We primarily consider twelfth graders who are underage, which means either younger than 18 or 19, depending on the state of residence. Our restriction to 12th graders is for two reasons. First, past experience with restrictions on tobacco sales has suggested that those closer to the age of majority are likely to purchase cigarettes in retail establishments (Abouk and Adams, 2017). Second, smoking conventional cigarettes and e-cigarette use is more common among older students. We will, however, briefly discuss the results of our estimations for 10th and 8th graders later.

Our aim is to capture a time period where we would expect a meaningful change in retail purchases of e-cigarettes in light of a ban. Bans were passed in 2010 in California, Minnesota, New Jersey, New Hampshire, and Utah. The years 2007–2009 give us a three year pre-treatment window for these earlier bans and 2011–2014 give us a four year post treatment window. We know the month the survey questions were posed to the student and her age in months, which allows us to exploit monthly variation in the legality of sales to minors. Table 1 shows the effective dates of the ban in each state, with minimum legal ages specified in the parentheses. The distribution and timing of the bans appear to be exogenous with regard to youth smoking. States with high numbers of youth smokers per capita, like Tennessee and Arkansas, pass bans in the same years as low smoking states, like Colorado and Washington, respectively. Neighboring states, like Maryland and Virginia, pass bans years apart. Pennsylvania has no ban on sales, but every state that borders it does. We also estimated a regression of lagged smoking rates on state bans, and we found no correlation between passage of the laws and smoking rates, further suggesting policy exogeneity.

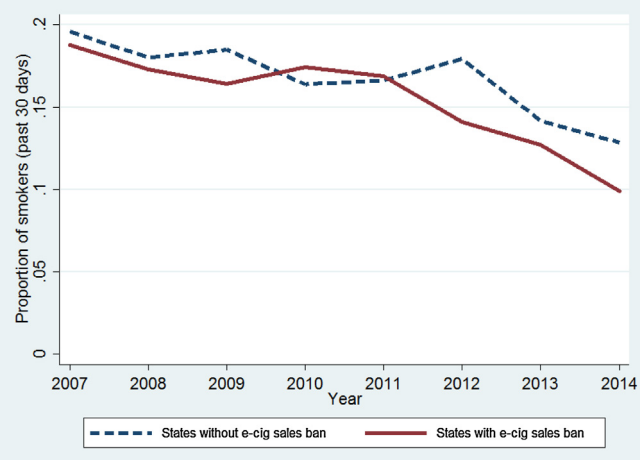

Fig. 1. Trend in smoking among underage 12th graders 2007–2014.
Notes: Data come from the Monitoring the Future.

The main variables of interest in our study are 30-day smoking prevalence and intensity. The MTF survey asks whether respondents smoked in the past 30 days and the number of cigarettes they smoke on a daily basis. Those numbers appear in Table 2. The control states, which we define as those states that never passed any restriction on e-cigarettes to minors, have an almost identical smoking rate to the states that passed a ban pre-treatment. Columns (3) and (4) illustrate the statistics in states implementing the sales bans, before and after the ban, respectively. They show that the smoking prevalence declines from 17.4% to 11.5% after the bans take effect. We note that although there were downward trends in smoking among youths nationally over this time period, the reduction implied by Table 2 is particularly large in those states with e-cigarette bans.

Fig. 1 offers visual evidence of the effects of e-cigarette sales bans. Among 12th graders, smoking rates were similar across treatment and control states through 2010. This confirms that pre-treatment smoking conditions and trends were not diverging, further suggesting policy exogeneity. We also tested statistically whether the pre-treatment trends were different in the treatment and control states. We do this by first dropping the post-treatment period for the treated states in the sample. Then, we interact year dummies with an indicator variable set to one for treated states and zero otherwise. Finally, we regress the prevalence of smoking on the interaction terms explained above, individual-level explanatory variables (listed in Table 2), state-level policy variables, and state and year-month dummies. A test of the joint significance of the estimated coefficients of the interaction terms provides information on whether the assumption of parallel pretreatment trends in the control and treated states is valid. We failed to reject the null of parallel trends at $p = 0.530$.[3] Fig. 1 also shows that the states even-

[1] Starr and Hall (2016), however, bring into question whether Friedman (2015) adequately captured pre-existing trends in smoking rates.

[2] Our main results are robust to focusing on only states included every year so we do not believe this limitation affects the interpretation of our results.

[3] We acknowledge, however, that the pre-treatment window is shorter than what is ideal for a test like this. This is a limitation of the study, but we have done our best with the data we have to show the assumption of parallel trends holds.