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E-cigarette Price Sensitivity Among Middle and High School Students: Evidence from Monitoring the Future

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Abstract:

Aims: We estimate associations between e-cigarette prices (both disposable and refill) and e-cigarette use among middle and high school students in the United States. We also estimate associations between cigarette prices and e-cigarette use.

Design: We use regression models to estimate the associations between e-cigarette and cigarette prices and e-cigarette use. In our regression models, we exploit changes in e-cigarette and cigarette prices across four periods of time and across 50 markets. We report the associations as price elasticities. In our primary model, we control for socio-demographic characteristics, cigarette prices, tobacco control policies, market fixed effects, and year-quarter fixed effects.

Setting: United States of America.

Participants: 24,370 middle and high school students participating in the Monitoring the Future Survey in years 2014 and 2015.

Measurements: Self-reported e-cigarette use over the last 30 days. Average quarterly cigarette prices, e-cigarette disposable prices, and e-cigarette refill prices were constructed from Nielsen retail data (inclusive of excise taxes) for 50 U.S. markets.

Findings: In a model with market fixed effects, we estimate that a 10% increase in e-cigarette disposable prices is associated with a reduction in the number of days vaping among e-cigarette users by approximately 9.7% (95% CI = -17.7% to 1.8%; p=0.02) and is associated with a reduction in the number of days vaping by the full sample by approximately 17.9% (95% CI=-31.5% to -4.2%; p=0.01). Refill e-cigarette prices were not statistically significant predictors of

vaping. Cigarette prices were not significantly associated with e-cigarette use regardless of the e-cigarette price used. However, in a model without market fixed effects, cigarette prices were a statistically significant positive predictor of total e-cigarette use.

Conclusions: Higher e-cigarette disposable prices appear to be associated with reduced e-cigarette use among adolescents in the US.

Introduction

In 2014 in the United States, electronic nicotine delivery systems (ENDS, and also known as e-cigarettes) overtook cigarette use among youth as the most commonly used tobacco product (1, 2). The high rate of e-cigarette use among youth has generated debate among researchers, policymakers, the media, and the general public. Some argue that e-cigarettes harm adolescent health by causing nicotine addiction, serving as a "gateway" to more dangerous tobacco products, and harming adolescent cognitive development (3). Other studies, however, suggest that current scientific evidence is insufficient to support a gateway theory (4) and suggest that e-cigarette restrictions may even increase teenage cigarette use (5, 6).

To date, state governments have responded to high e-cigarette use among youth by enacting minimum legal sale age (MLSA) laws, as well as imposing excise taxes on e-cigarettes. As of the 2nd quarter of 2017, seven states and Washington, D.C., along with a number of localities, taxed e-cigarettes (or liquid nicotine) (7). In addition, more than a dozen states have introduced bills to tax e-cigarette (8).

Despite the accelerated pace in adopting e-cigarette taxes at state and local levels, the empirical evidence on the effectiveness of these tax/price policies on reducing e-cigarette use among young people is limited. Recent studies have shown that the pattern of e-cigarette use among youth may be different from that among adults in that much of youth use reflects experimentation rather than heavy use (9). For example, imposing an e-cigarette tax may have smaller impacts among teens who are experimenting and may have larger impacts among teens

that are heavy e-cigarette users. Additionally, price elasticities may be smaller (in absolute magnitude) for youth if they are sharing devices regularly. According to the 2015 National Youth Tobacco Survey (NYTS), 11.2% of students reported currently using e-cigarettes and 90% of them received e-cigarettes from a friend at least once over the last 30 days, which suggests substantial rates of sharing (10). Finally, price elasticities may be smaller (in absolute magnitude) if teenagers are using e-cigarettes without nicotine (11, 12), which would reduce future consumption due to addiction.

Several studies have explored e-cigarette price sensitivity among a broader population than young people. One study used a discrete choice experiment to estimate an e-cigarette price elasticity among current adult smokers of -1.8, suggesting that a 10% rise in disposable e-cigarette prices reduces e-cigarette demand by 18% (13). Two studies have evaluated the relationship between market-level prices and market-level sales, finding e-cigarette own-price elasticities of demand of -1.2 for disposable e-cigarettes and -1.9 for reusable e-cigarettes in the United States (over the period of 2009 to 2012) (14) and -0.8 for disposable e-cigarettes for six European Union countries (over the period of 2011-2014). The latter study also documented evidence that cigarettes are substitute goods for e-cigarettes (15), a conclusion also reached from a study using experimental data on smokers in New Zealand (16). One discrete choice experiment has found evidence that disposable e-cigarettes and rechargeable e-cigarettes are substitute products (17).

As discussed above, previous studies have estimated e-cigarette price sensitivity separately for disposables and refillables. In the United States, one meta-analysis estimates that only 15% of youth use disposable e-cigarettes (18). The 2015 NYTS asked students about lifetime use of different e-cigarette products, and found that 4.0% of respondents had only used e-cigarette disposables, 13.3% had only used e-cigarette rechargeable/refillable tank systems, and 8.2% had used both products (10).

In addition, substantial scholarly effort has been devoted to estimating *cigarette* price sensitivity among youth. One review of 55 studies of price elasticities for young people in high income countries estimated a price elasticity range of between -0.5 and -1.2 (19). Recent estimates from the United States Community Services Task Force have found a young person price elasticity of -0.74 (using 13 studies), a young person prevalence of tobacco use price elasticity of -0.36 (using 22 studies), and a median young person initiation of tobacco use price elasticity of -0.43 (using 7 studies) (20). One review of 27 studies reached a different conclusion on the narrow outcome of youth smoking initiation, finding no strong evidence that tobacco prices or taxes affects smoking initiation (21).

The empirical evidence on the effectiveness of e-cigarette taxing and pricing policies on youth e-cigarette use (e.g. vaping) is scarce. We fill this critical gap by estimating the relationship between e-cigarette retail prices and use of e-cigarettes among American middle and high school students in 2014 and 2015 using the Monitoring the Future (MTF) data. Our study will be among the first to examine youth e-cigarette price elasticities, and will provide evidence

on the effectiveness of e-cigarette taxing and pricing policies in deterring and reducing youth vaping. In particular, we estimate associations between the prices of disposable e-cigarettes, refill e-cigarettes, and traditional cigarettes on e-cigarette use among middle and high school students in the United States.

Methods

Design

We estimate regression models to calculate the associations between e-cigarettes prices (either e-cigarette disposable or refill prices) and cigarette prices on e-cigarette use. Due to data limitations in terms of when e-cigarette use questions were added to Monitoring the Future and availability of e-cigarette prices from Nielsen, we perform our analysis using data from years 2014 and 2015.

Sample

We use e-cigarette information from the 2014 and 2015 MTF surveys, a nationally representative survey of the U.S. middle and high school students conducted by the University of Michigan between February through June of each year. University of Michigan staff members administer the questionnaires to 8^{th}, 10^{th}, and 12^{th} grade students, usually in the student classroom during a regular class period. A multistage random sampling procedure is used to secure the nationwide sample of students in each year, with geographic areas being selected in

stage 1, selection with probability proportionate to size of one or more schools in each area in stage 2, and classrooms selected from the schools in stage 3 (22). During initial school recruitment those schools refusing participation were replaced with similar schools in terms of geographic location, size, and type of school (e.g., public, private/Catholic, private/non-Catholic) (23).

MTF samples 72 first stage geographic units per year and approximately 6 schools are surveyed per geographical unit. MTF only interviews one grade per school. Typically, MTF surveys the entire grade, although a random sample is taken if the grade has more than 350 students.

377 schools were surveyed in 2014 and 382 schools were surveyed in 2015. Schools participate in the survey for two years, and about half of the schools participated for both years during the 2014-15 time period. In 2014, the 8^{th} grade student response rate (conditional on school participation) was 90%, the 10^{th} grade student response rate was 88%, and the 12^{th} grade student response rate was 82%. In 2015, the 8^{th} grade student response rate was 89%, the 10^{th} grade student response rate was 87%, and the 12^{th} grade student response rate was 83% (24).

The number of observations that we have available for each quarter/year are 3,394 (2014-Q1); 8,459 (2014-Q2), 3,571 (2015-Q1), 8,946 (2015-Q2). The higher numbers in the second quarter of each year are due to greater data collection during that quarter.

Outcomes

Starting in 2014, an e-cigarette question asking "During the LAST 30 DAYS, on how many days (if any) have you used electronic cigarettes (e-cigarettes)?" was asked to a random sample of students participating in the MTF survey. In 2014, the question was asked on 2 of 4 survey forms that were randomized among 8th and 10th grade students completing the survey, and 4 of 6 forms for 12th graders. The same question was asked on 3 of 4 forms for 8^{th} and 10^{th} graders in 2015. The survey forms were randomly assigned within MTF schools; in this way, e-cigarette responses were collected from each grade surveyed by MTF. Students had the option to answer the question with: 1) none, 2) 1-2 days, 3) 3-5 days, 4) 6-9 days, 5) 10-19 days, and 6) 20-30 days.

Price Measures

E-cigarette and cigarette price data come from the store scanner data compiled by the Nielsen Company, which includes food, drug and mass merchandise (FDM) stores in 52 US markets in a given year. A Nielsen market consists of groups of counties centered on a major city. In many cases, counties in the same Nielsen market belong to different states, as a Nielsen market can cross state borders and cover areas in two or multiple states. Nielsen participating retailers include mass stores (such as K-Mart and Target), drug stores (such as CVS, Walgreens and RiteAid) and grocery stores (such as Kroger, Food Lion, Publix, Safeway, Albertsons and Winn Dixie). The population residing in those 52 Nielsen markets represents approximately 80% of the total US population.

We used the Nielsen store scanner data to construct quarterly market-level prices for all e-cigarettes and cigarettes sold at participating retailers. Two different types of e-cigarette prices are constructed, e-cigarette disposable prices and e-cigarette refill prices. We first identified sales of e-cigarette disposables and refills. We then determined the total payments by consumers for each type of e-cigarette (inclusive of excise taxes) and total sales volume of each type of e-cigarette in a given market/quarter. Finally, we divided total revenue and total sales to obtain market-quarter prices for e-cigarette disposables and refills. We then assigned these market-quarter prices to MTF respondents depending on the year and quarter in which the students were interviewed and the location of their school.

We did not calculate prices for reusable e-cigarette devices themselves because they are usually sold in kits, which contain different numbers of batteries and e-liquid refill cartridges, and their prices cannot be easily standardized.

Cigarette prices (per pack) were also constructed by dividing total dollar sales for cigarettes by total number of packs sold in a given market/quarter.

In Figures 1, we show how Nielsen prices for cigarettes and e-cigarettes changed over time, comparing prices in the 1st quarter 2014 with prices at the same time in 2015. E-cigarette prices varied considerably across markets between 2014 and 2015, potentially reflecting rising demand for e-cigarettes and industry activity as traditional tobacco companies entered into the market, to the detriment of e-cigarette-only companies (3). Conversely, cigarette prices varied relatively little.

The market-level prices that we construct are not necessarily the prices actually paid by respondents. Respondents may pay different prices due to, among other things, price distortions caused by inability to legally purchase e-cigarette in stores and brand selection. Respondents may have also purchased the e-cigarettes that they now use at an earlier period of time than recorded by our data (e.g. stockpiling).

Covariates

We also control for a variety of individual-level demographic data and county-level tobacco policy data. These variables may have a direct effect on e-cigarette use and could also proxy anti-tobacco sentiment that may affect e-cigarette use (e.g. through social norms) and prices (e.g. through enacting taxes, for example).

The individual-level MTF data that we control for include indicators for each of the following age categories (≤13, 14, 15, 16, 17, 18, ≥19, missing), grade categories (8, 10, 12), gender categories (female, male, missing), race/ethnicity categories (White non-Hispanic, Black non-Hispanic, Hispanic, other race and multi-racial, and missing), living arrangement categories (both parents, alone, father only, mother only, other/missing), mother and father's education categories (some high school, high school, some college, college, graduate student, don't know/missing), and employment status categories (no, yes, missing). We also control for weekly money from job, other sources, or allowances (single continuous variable). Approximately 3.4% of income values were missing, and we linearly impute for these missing incomes using all

demographics (described above), market fixed effects (e.g. a fixed parameter for each market), and year-quarter fixed effects. Estimates of price sensitivity were not meaningfully affected by controlling for grade or not (which is collinear with age).

We matched on other important policy variables as well. We obtain dates of the implementation of e-cigarette minimum legal sale age (MLSA) laws at the state-level from the CDC STATE System (7) and county-level MLSA laws from a white paper (25). We used this data to control for the presence or not of a county-level e-cigarette MLSA law (1 = present, 0 = not present). We also interacted the e-cigarette MLSA law with an "underage" variable to estimate the effect of an e-cigarette MLSA for just those younger than the legal age. The "underage" variable is generally 18 except in Alabama, Alaska, New Jersey, Utah, Suffolk County, and New York City, in which it is 19 or 21. Both the interaction of MLSA with underage and both constitutive elements of the interaction are controlled for in all regressions.

We also controlled for the percent of the county population covered by county- or city-level complete bans (or only minor exemptions) on smoking in bars, restaurants and private workplaces, using data obtained from the Americans for Nonsmokers' Rights Foundation.

In our primary specification we control for market fixed effects (0/1 variable for each of the 50 markets) and year-quarter fixed effects (0/1 variable for 1st quarter of 2014, 2nd quarter of 2014, 1st quarter of 2015, and 2nd quarter of 2015). Market fixed effects removes all time-invariant, market-specific effects, and year-quarter fixed effects removes all time-varying effects across the nation as a whole.

Data Analysis

We estimate a traditional demand equation by regressing e-cigarette use onto e-cigarette prices. We evaluate three separate measures of e-cigarette use as dependent variables: 1) current e-cigarette use, defined as any e-cigarette use over the past 30 days (no = 0; yes = 1), 2) the number of days using e-cigarettes over the past 30 days among current e-cigarette users, and 3) the number of e-cigarette days over the past 30 days among all respondents (setting non-e-cigarette user days to 0). For the e-cigarette days dependent variables, the midpoints of the categories were used (e.g. 7.5 was used for individuals reporting 6-9 days of e-cigarette use over the past 30 days).

Our primary independent variable of interest is the quarterly, market-level e-cigarette price. In a regression framework, the coefficient on this variable shows the relationship that e-cigarette prices have on e-cigarette demand. We also control for cigarette prices in the same regression analysis. The estimates for cigarette prices in this equation provide evidence on if cigarettes are economic substitutes or complements for e-cigarette use by adolescents and young adults. If cigarette prices are found to be positively associated with e-cigarette use, this suggests that the products are economic substitutes; if negatively associated, then the products are economic complements.

In our primary specification we control for market fixed effects (0/1 variable for each of the 50 markets) and year-quarter fixed effects (0/1 variable for 1st quarter of 2014, 2nd quarter of

2014, 1st quarter of 2015, and 2nd quarter of 2015). In an alternative specification, we do not control for market fixed effects to explore how e-cigarette and cigarette price sensitivity is influenced by using both within- and across-market variation in prices. In this specification, we continue to control for the state- and county-level tobacco policy variables previously mentioned.

We estimate any e-cigarette use over the past 30 days (1 = any use, 0 = no use) using a logit model (extensive margin). We estimate conditional demand (i.e. number of vaping days using the sample of only people that vape) and total demand (i.e. number of vaping days using the full sample, setting to 0 people that do not vape) using a GLM model with a log link and a Poisson distribution as chosen by modified Park tests (26). The modified Park test is a diagnostic test that examines the residual structure, including how it is impacted by a large number of zeros in the dependent variable in the case of the total margin model, and suggests a distribution that models the data most efficiently. For both the conditional and total margin, the modified Park test determined that a Poisson distribution was the most efficient distribution to use. The modified Park test is frequently used for smoking intensity measures (27, 28).

Our conditional model results will be influenced by changes to the sample of e-cigarette users shown on the extensive margin. For example, if e-cigarette use declines in response to e-cigarette price increases, the conditional model will be influenced by if the remaining users are on average heavier users of e-cigarettes than prior to the decline. The total use margin removes the influence of this changed sample from affecting the results; therefore, both models have useful interpretation.

We present estimates from these logit or GLM models as price elasticities. Price elasticities show the percent change in quantity demanded for a 10% increase in the price. Standard errors were clustered at the market level in our primary analysis; however, we show that standard errors are similar if we alternatively cluster at the school level.

Results

Descriptive statistics for our data are provided in Table 1. Approximately 25% of the sample was in grade 8, 29% of the sample was in grade 10, and 46% of the sample was in grade 12. The higher rate of grade 12 students reflects the e-cigarette question being part of 4 of 6 questionnaire forms used for grade 12 compared to 2 of 4 used for grades 8 and 10. White, non-Hispanics made up about 50% of the respondents. 36% of the students had jobs, and the average student received $46 in weekly income (from jobs, allowances, and/or other sources). In part due to Nielsen prices only being available for a group of counties centered on a large city, 82% of the sample lived in urban areas. 7.5% of the students smoked cigarettes and 13.9% vaped over the past 30 days. The average student that vaped did so on 7.5 days over the past 30 days. The average price in the sample was $8.35 for a single disposable e-cigarette, $3.07 per cartridge for e-liquid refills, and $5.87 for a pack of cigarettes. 67% of the students lived in a county with a MLSA law in place, and 85% were covered by a comprehensive smoke-free air policy or a smoke-free policy with only minor exemptions. In Table 2, we show the means of our outcome variables for each quarter of our data.

In Table 3, we report e-cigarette price elasticities for vaping participation, conditional vaping demand, and total vaping demand. The results in each column were calculated from a separate model that controls for socio-demographic characteristics, tobacco control policies, market fixed effects, and year-quarter fixed effects. The first three columns use e-cigarette disposable prices and the second three columns use e-cigarette refill prices.

We estimate that a 10% increase in e-cigarette disposable prices is associated with a reduction in any e-cigarette use by 6.5%, but this was not significant at $p<0.05$. A 10% increase in e-cigarette disposable prices is associated with a reduction in conditional e-cigarette demand by approximately 9.7% (column 2, $p=0.02$) and is associated with a reduction in total e-cigarette days among e-cigarette users and non-users combined by approximately 18% (column 3, $p<0.01$). The corresponding marginal effects for these estimates (unreported) shows that a $1 increase in e-cigarette prices is associated with a reduction in conditional e-cigarette demand by 0.87 days (21.8% of the mean) and reduces total demand by 0.22 days (21.4% of the mean).

In Table 3, refill e-cigarette prices were not statistically significant predictors of e-cigarette use. Cigarette prices, meanwhile, were not significantly associated with e-cigarette use at any margin, and regardless of the e-cigarette price used. There is a consistent negative sign on cigarette prices in all six models, but this is imprecisely estimated.

In Table 4, we report e-cigarette price elasticities for a model without market fixed effects, which uses price variation both within-markets and across-markets. In this case, the estimated own-price elasticity of demand for disposable e-cigarettes is attenuated from the case

with market fixed effects controlled for, but remains negative. The total demand price elasticity was previously -1.8 and now is -0.2 (p>0.05). The cigarette price elasticity of demand was previously statistically insignificant negative, but is now statistically significant positive. A 10% increase in cigarette prices is associated with an increase in total e-cigarette demand by 3.5%, which suggests that e-cigarettes and cigarettes are economic substitutes. Similar to the model with market fixed effects controlled for, estimates of the effect of refill prices on e-cigarette use remains imprecisely estimated.

We replicate Table 3 results clustering at the level of school (Online Table 1) and without controlling for cigarette prices (Online Table 2). We show that results are substantially similar.

Discussion

Our study used nationally-representative data from the 2014 and 2015 MTF survey to assess e-cigarette price impacts on adolescent e-cigarette use. We examined price impacts of e-cigarette disposables and refill cartridges separately since these products may be used along different stages of the e-cigarette initiation trajectory. We found that prices of disposables had relatively little impact on e-cigarette use participation, but had a large, statistically-significant effect on the intensity of use. In our preferred specification with market fixed effects, a 10% increase in prices of disposable e-cigarettes was associated with an approximately 10% reduction in vaping days among current e-cigarette users, or an approximately 19% reduction in vaping days among all adolescents.

The null finding for the effect of e-cigarette prices on e-cigarette participation is not surprising, as the majority of adolescent e-cigarette use within the last 30 days reflects experimentation (29). Additionally, e-cigarettes are frequently shared, which may make experimentation easier and price sensitivity on the extensive margin harder to measure. For example, the 2015 National Youth Tobacco Survey found that while 11.2% of students currently used e-cigarettes and 90% of them received e-cigarettes from a friend at least once over the last 30 days (10).

Our estimated own-price elasticity for disposable e-cigarettes on vaping days (-1.8%) matches that found in a discrete choice experiment among adult smokers (13), and is slightly higher than those found in two other studies (-0.8 and -1.2) using market-level data (15). Our price elasticity may be higher than price elasticities estimated based on market-level data because our analysis is focused on adolescents and young adults that most recent research has concluded are more responsive than adults to changes in cigarette prices (30). It may also reflect the importance of using individual level data, as studies based on market level data are potentially subject to bias towards the null of no effect since sales may endogenously influence prices.

We did not find significant associations between prices of refill cartridges and any e-cigarette use among adolescents. On one hand, this is unexpected because teenagers are less likely to use disposable e-cigarettes (18). Our lack of precision on estimates with refillable prices

may be because these products are easier to share than disposable e-cigarettes, resulting in less ability to measure price sensitivity accurately and precisely for refillable products.

Consistent with existing studies based on e-cigarette market sales data, we did not find a consistent and statistically significant relationship between combustible cigarette prices and e-cigarette use (15). However, in a model without market fixed effects and using e-cigarette disposable prices, we did find that higher cigarette prices increases total e-cigarette use.

Our study is subject to at least three limitations. First, our price data on combustible cigarettes and e-cigarettes come from Nielsen participating retailers, and may not reflect retail prices from internet (31) or local tobacco or vape shops (32). Second, our sample using Nielsen prices under-represents youth living in rural areas. Third, our best measure of e-cigarette intensive margin use is number of days of use, which may reflect measurement error over using other more precise measures of intensive margin use such as the amount of e-cigarette liquid consumed.

Despite these limitations, our results suggest that higher e-cigarette disposable prices reduce e-cigarette use among adolescents. Consequently, policies that raise retail e-cigarette prices, such as taxes, have the potential to reduce adolescents' e-cigarette initiation and consumption. E-cigarette pricing policies may present an opportunity for states and localities to go above and beyond the FDA's 2016 deeming rule to regulate e-cigarettes (33).

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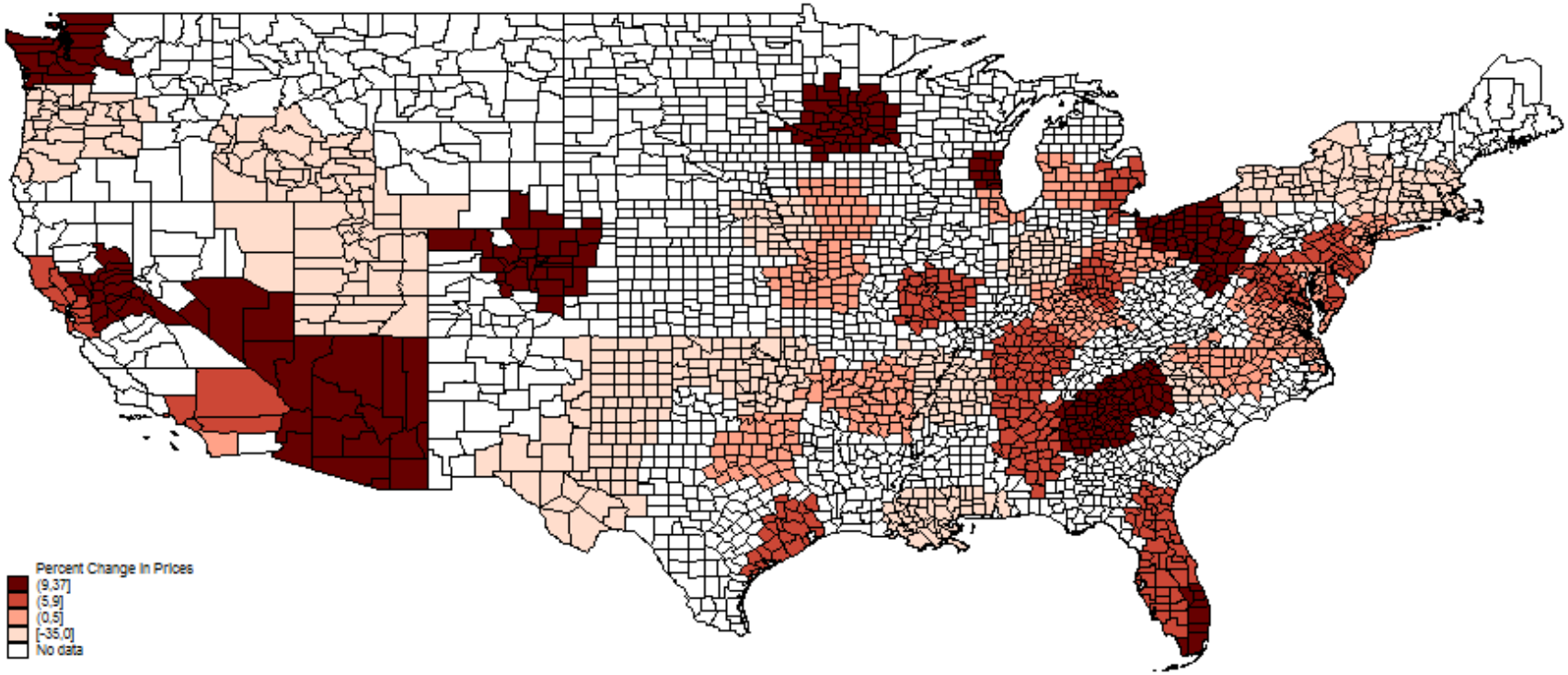
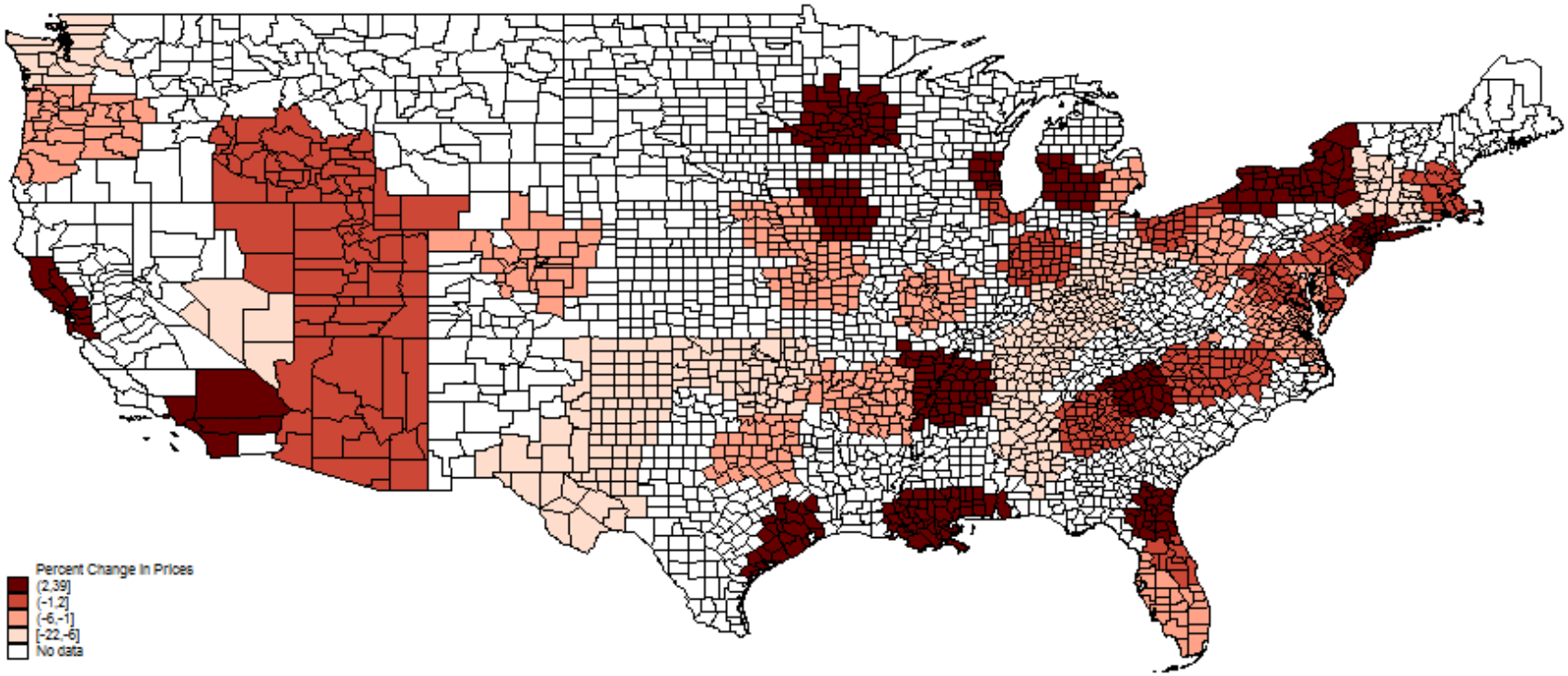
Figure 1: Maps Showing Percentage Change in Nielsen Tobacco Prices from 2014-2015

Panel A: E-cigarette Disposable Price Percentage Point Change



Panel B: E-cigarette Refill Price Percentage Point Change



Notes: The Sacramento market is excluded from this map due to incomplete price information.

Table 1: Descriptive Statistics

	N	Mean	Std. Dev.
Demographics			
Age ≤13	2,381	0.098	-
Age 14	3,318	0.136	-
Age 15	3,282	0.135	-
Age 16	3,631	0.149	-
Age 17	5,135	0.211	-
Age 18	5,465	0.224	-
Age ≥19	531	0.022	-
Age Missing	627	0.026	-
Underage	18,594	0.763	-
Grade 8	6,154	0.253	-
Grade 10	6,963	0.286	-
Grade 12	11,253	0.462	-
Gender - Female	12,031	0.494	-
Gender - Male	11,327	0.465	-
Gender - Missing	1,012	0.042	-
Race/Ethnicity - White, non-Hispanic	12,112	0.497	-
Race/Ethnicity - Black, non-Hispanic	2,929	0.120	-
Race/Ethnicity - Hispanic	4,502	0.185	-
Race/Ethnicity - Other Race, Multi-Racial	3,656	0.150	-
Race/Ethnicity - Missing	1,171	0.048	-
Employment - No	14,997	0.615	-
Employment - Yes	8,654	0.355	-
Employment - Missing	719	0.030	-
Residence - Urban	20,044	0.822	-
Residence - Rural	2,858	0.117	-
Residence - Missing Urban/Rural	1,468	0.060	-
Weekly money from job, other sources, allowance	24,370	46.143	34.507
Live With - Both Parents	16,878	0.693	-
Live With - Alone	166	0.007	-
Live With - Father Only	1,036	0.043	-
Live with Mother Only	4,855	0.199	-
Live With - Other/Missing	1,435	0.059	-
Education			
Father's Education - Some High School	1,009	0.041	-
Father's Education - High School Graduate	2,366	0.097	-
Father's Education - Some College	5,300	0.217	-
Father's Education - College Graduate	3,265	0.134	-
Father's Education - Graduate School	5,403	0.222	-
Father's Education - Don't Know	3,541	0.145	-

Father's Education - Missing	3,486	0.143	-
Mother's Education - Some High School	966	0.040	-
Mother's Education - High School Graduate	1,837	0.075	-
Mother's Education - Some College	4,409	0.181	-
Mother's Education - College Graduate	3,857	0.158	-
Mother's Education - Graduate School	6,972	0.286	-
Mother's Education - Don't Know	3,968	0.163	-
Mother's Education - Missing	2,361	0.097	-
Outcomes			
Any Cigarette Use over past 30 days	1,822	0.075	-
Any E-cigarette Use	3,383	0.139	-
Vaping Days (past 30 days, among current vapers only)	24,370	7.409	8.300
Vaping Days (past 30 days, among all)	24,370	1.029	4.015
Time			
2014, Quarter 1	3,394	0.139	-
2014, Quarter 2	8,459	0.347	-
2015, Quarter 1	3,571	0.147	-
2015, Quarter 2	8,946	0.367	-
Tobacco Environment			
E-cigarette Disposable Prices	24,370	8.348	0.897
E-cigarette Refill Prices	24,370	3.071	0.224
Cigarette Prices	24,370	5.874	1.348
E-cigarette Minimum Legal Sale Age	17,206	0.706	-
Cigarette Indoor Use Air Laws (Complete or Some Exceptions)	24,370	0.851	0.221

Note: N = 24,370.

Table 2: Tobacco Use Over Time

	2014, Q1	**2014, Q2**	**2015, Q1**	**2015, Q2**
Any Cigarette Use over past 30 days	0.084	0.081	0.070	0.067
Any E-cigarette Use	0.152	0.149	0.132	0.127
Vaping Days (past 30 days, among current vapers only)	7.306	7.015	7.666	7.789
Vaping Days (past 30 days, among all)	1.109	1.048	1.011	0.986
Number of Markets	33	48	37	45
Observations	3,394	8,459	3,571	8,946

Note: N = 24,370.

Table 3: E-Cigarette Own- and Cross-Price Elasticities

	(1)	(2)	(3)	(4)	(5)	(6)
	E-cigarette Use	Conditional E-Cigarette Days	Total E-cigarette Days	E-cigarette Use	Conditional E-Cigarette Days	Total E-cigarette Days
E-cigarette Disposable Prices	-0.649	-0.974*	-1.788*			
	[-1.431,0.133]	[-1.769,-0.178]	[-3.154,-0.421]			
	(0.104)	(0.016)	(0.01)			
E-cigarette Refill Prices				-0.426	0.711	0.549
				[-1.759,0.908]	[-0.514,1.936]	[-1.621,2.720]
				(0.532)	(0.255)	(0.62)
Cigarette Prices	-0.919	-0.02	-0.258	-1.287	-0.589	-1.232
	[-3.583,1.744]	[-2.420,2.379]	[-3.570,3.055]	[-3.808,1.235]	[-3.113,1.935]	[-4.523,2.058]
	(0.499)	(0.987)	(0.879)	(0.317)	(0.647)	(0.463)
Observations	24,370	3,383	24,370	24,370	3,383	24,370
Socio-Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Tobacco Control Policies	Yes	Yes	Yes	Yes	Yes	Yes
Market Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Estimation	Logit	GLM, Poisson	GLM, Poisson	Logit	GLM, Poisson	GLM, Poisson

Note: Each column presents price elasticities from a different regression. E-cigarette disposable prices are used in columns 1-3 and e-cigarette refill prices are used in columns 4-6. The price elasticity's 95% confidence interval is in square brackets, and the *p*-value is in round brackets. * $p<0.05$; ** $p<0.01$; *** $p<0.001$

Table 4: E-Cigarette Own- and Cross-Price Elasticities, without Market Fixed Effects

	(1)	(2)	(3)	(4)	(5)	(6)
	E-cigarette Use	Conditional E-Cigarette Days	Total E-cigarette Days	E-cigarette Use	Conditional E-Cigarette Days	Total E-cigarette Days
E-cigarette Disposable Prices	-0.113	-0.094	-0.204			
	[-0.635,0.409]	[-0.519,0.330]	[-0.957,0.549]			
	(0.672)	(0.663)	(0.596)			
E-cigarette Refill Prices				-0.12	0.234	0.19
				[-0.903,0.663]	[-0.287,0.755]	[-0.937,1.318]
				(0.763)	(0.379)	(0.741)
Cigarette Prices	0.194	0.168*	0.353*	0.186	0.12	0.287
	[-0.028,0.415]	[0.015,0.321]	[0.073,0.633]	[-0.031,0.403]	[-0.052,0.292]	[-0.049,0.623]
	(0.087)	(0.032)	(0.014)	(0.093)	(0.17)	(0.094)
Observations	24,370	3,383	24,370	24,370	3,383	24,370
Socio-Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Tobacco Control Policies	Yes	Yes	Yes	Yes	Yes	Yes
Market Fixed Effects	No	No	No	No	No	No
Year-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Estimation	Logit	GLM, Poisson	GLM, Poisson	Logit	GLM, Poisson	GLM, Poisson

Note: Each column presents price elasticities from a different regression. E-cigarette disposable prices are used in columns 1-3 and e-cigarette refill prices are used in columns 4-6. The price elasticity's 95% confidence interval is in square brackets, and the *p*-value is in round brackets. * $p<0.05$; ** $p<0.01$; *** $p<0.001$