

The Effects of Tobacco Control Policies on Tobacco Products, Tar, and Nicotine Purchases among Adults: Evidence from Household Panel Data

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Abstract

We analyze the Nielsen Homescan Consumer Panel to estimate the effects of tobacco policies on tobacco-related purchases using within-household variation. We also match purchases to cigarette contents from NHANES. Higher cigarette taxes reduce cigarette purchases and increase smoking cessation product purchases, while estimates of smoking ban effects are less precisely estimated. Smokeless tobacco (SLT) taxes lead to reductions in SLT use but also lead to substitution among SLT products. We find evidence that cigarette taxes induce purchases of cigarettes with higher tar, nicotine, and carbon monoxide contents, but this compensatory behavior is overwhelmed by the reduction in cigarettes purchased.

Keywords: cigarette smoking, cigarette taxes, smokeless tobacco taxes, compensating behavior,
JEL Codes: D12, I12, I18

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The authors thank the editor and three anonymous referees, participants at the 2014 American Society of Health Economists Biannual Meeting, the 2014 Southern Economic Association Annual Meeting, the NBER Health Economics Spring 2015 Program Meeting, and an Indiana University Purdue University Indianapolis seminar for helpful comments. The authors thank the Kilts-Nielsen Data Center at The University of Chicago Booth School of Business for providing the data (<http://research.chicagobooth.edu/nielsen/>). Author order is alphabetic and lead authorship is shared amongst all of the authors. There are no conflicts of interest.

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I. Introduction

Cigarette smoking causes many adverse health outcomes including cancers of the mouth, pharynx, larynx, esophagus, stomach, pancreas, bladder, kidney, cervix, and stomach; stroke; coronary heart disease; chronic obstructive pulmonary disease; asthma; and low birth weight (U.S. Department of Health and Human Services, 2004). Additionally, smokeless tobacco (SLT) carries its own risks, including cancers of the mouth, tooth loss, and oral lesions (National Cancer Institute, 1992). The body of economic research suggests that tobacco consumption responds to policy levers such as cigarette taxes, although some important aspects of consumer responses to tobacco control policies remain relatively unexplored.

First, relatively little research examines whether cigarette smokers respond to tobacco control policies by switching to cigarette brands with higher nicotine contents. The few studies that do study this question reach differing conclusions, and relatively small sample sizes and limited time variation raise concerns that null results regarding the effects of cigarette excise taxes on nicotine consumption may reflect a Type II error. Moreover, much of the economic research examining responses to tobacco control policies is based on repeated cross-section data. In the context of measuring smokers' compensating behavior, repeated cross-section data do not allow researchers to identify whether changes in the number or strength of cigarettes consumed after cigarette tax increases result from changes in smokers' behavior or from composition changes in the pool of smokers after some smokers quit. Lastly, more detailed research examining whether cigarettes and other tobacco-related products are economic substitutes or complements is needed, e.g., for predicting whether raising cigarette taxes will have the unintended consequence of raising SLT use.

This paper aims to address these existing questions in the literature. Using the Nielsen Homescan Consumer Panel (NHCP) between the years of 2004 and 2012, we examine a panel of households to estimate the effects of tobacco control policy changes on household purchases of cigarettes, smoking-cessation products, chewing tobacco, and snuff among adults. Additionally, we use UPC codes and product names to match 90% of cigarette product purchases in the NHCP to cigarette characteristics from the National Health and Nutrition Examination Survey (NHANES). This allows us to examine whether households respond to changes in tobacco

control policies by changing the tar, nicotine, and carbon monoxide contents of the cigarettes they purchase, and moreover, whether tobacco control policies lead to changes in households' estimated intakes of these substances.

This study contributes to the literature in several ways. We present a comprehensive investigation of the impact of several principal tobacco control policies on household purchase habits across a range of tobacco-related products. This includes investigating impacts on the purchase of smoking cessation products (e.g. electronic cigarettes, nicotine patches/gum, etc.), which, due to their relatively new and expanding presence in the marketplace, have not been studied in conjunction with tobacco control policies in a comprehensive analysis. Second, by matching detailed cigarette characteristics information on tar, nicotine, and carbon monoxide content, as well as cigarette length and type, from the NHANES back to the NHCP, we are able to more precisely understand the degree to which smokers alter their smoking behavior to compensate for changes in tobacco control policies. Lastly, our analysis leverages detailed household panel data to examine changes in smoking behavior within households across time in response to changes in tobacco control policies. Using household fixed effects, we are able to determine whether estimated changes in the number of cigarettes consumed or the tar, nicotine, and carbon monoxide contents represent changes in smokers' behavior or changes in the pool of smokers from, for example, low-quantity smokers quitting and leaving a pool of higher-quantity smokers.

In a preview of our main results, we confirm that cigarette taxes meaningfully reduce cigarette purchases, even when examining within-household variation. We also observe substitution behavior between chewing tobacco and snuff following corresponding tax increases. Results do not, however, provide strong evidence that smokefree air laws lead to statistically significant changes in tobacco product purchases in the primary sample, although compensating behaviors toward chewing tobacco is observed among pack-a-day smokers. Of new interest, we find some evidence that cigarette and snuff taxes lead to substitution toward the purchase of smoking-cessation products, but cigarette taxes do not lead to statistically significant changes in SLT purchases. Lastly, and importantly, we find that cigarette taxes reduce total estimated tar, nicotine, and carbon monoxide purchases, which overwhelms estimates of compensatory behavior, in contrast to previous cross-sectional studies (Adda and Cornaglia, 2006; Evans and Farrelly, 1998; Farrelly et al., 2004). These estimates are robust to the inclusion of controls for

household-level demographic characteristics, geographic area controls expected to affect individual tobacco consumption, and time period, household, and geographic trends.

We view the findings in this paper as further demonstrating the effectiveness of tobacco taxes as a policy lever to reduce smoking levels, for a number of reasons. We find that tobacco taxes lead to statistically and economically significant reductions in tobacco purchases, even when including household-level fixed effects and state-level trends. Moreover, although previous literature utilizing cross-sectional data has suggested that substitution to other tobacco products or cigarettes with higher tar and nicotine contents may offset the impact of cigarette taxes, our results suggest that this substitution is overwhelmed by the reduction in total cigarette purchases. Lastly, we find evidence suggesting that other tobacco control policies, such as smoke-free air laws, have heterogeneous impacts on smoking outcomes.

The rest of this paper is organized as follows. Section I summarizes the previous economic literature estimating the effects of tobacco control policies, Section II describes the NHCP and other data sources, Section III overviews our empirical strategy, Section IV describes our results, and Section V concludes.

I. Literature Review and Background

a) Research on Tobacco Control Policies

Literature on the impacts of tobacco control policies is vast and covers decades of research. Beginning in the 1970s, economists began to examine the link between cigarette prices and consumption. While elasticity estimates varied depending on timeframe, dataset, age group, etc., a general consensus about the effectiveness of cigarette taxes on reducing cigarette consumption has formed, with own-price elasticity estimates of between -0.2 and -0.6 for adults and -1.0 to -1.3 for youth (see Chaloupka & Warner (2000) for an extensive summary of the literature). Nevertheless, these conclusions spurred even more research into the effects of other tobacco control policies, such as smoking bans and SLT taxes, and investigation into potential substitution across tobacco-related products.

For example, Ohsfeldt and Boyle (1994) conduct the first such study on SLT taxes and cigarette taxes using the Current Population Survey from 1985. They find a large own-price elasticity of approximately -0.5, as well as a strong positive cross-price elasticity with cigarettes of just under 0.5. Ohsfeldt et al. (1997) follow up with a look at individual-level data from the

1995 Current Population Survey data and conclude that the own-price elasticity and cross-price elasticity are much smaller in magnitude (about -0.15 and 0.10, respectively). Similarly, using the 1995, 1997, 1999, and 2001 National School-Based Youth Risk Behavior Surveys, Tauras et al. (2007) find price elasticity estimates in the range of -0.1 to -0.2. However, Chaloupka et al. (1997) find a larger SLT own-price elasticity. Adams et al. (2013) utilize several waves of the Behavioral Risk Factor Surveillance System data to test for compensatory behavior across tobacco products in response to bar smoking bans. They find a meaningful increase in SLT use among smokers, particularly those who drink and are of typical bar-going age.¹

While very impactful, these studies have important shortcomings. They typically do not study tobacco control policies concurrently, nor are they able to leverage panel data, which presents identification challenges. In particular, much of the economic research examining responses to tobacco control policies is based on repeated cross-section data, raising concerns about endogeneity between tobacco control policies and unobserved determinants of smoking levels.

b) Within-product Substitution and Compensation

In addition to reductions in consumption and substitution to other related products in response to tobacco control policies, there is also great interest in understanding the compensating behaviors among tobacco users in terms of within-product substitution. Economic theory suggests that if cigarette taxes are levied on each cigarette regardless of nicotine content, smokers may switch to brands with higher nicotine content or change the way which they smoke each cigarette (Adda and Cornaglia, 2006; Harris, 1980). From a policy perspective, if smokers reduce the number of cigarettes they smoke but do not change their intake of carcinogens in response to tobacco control policies, then the policies may not be effective at combating smoking-related disease. Evans and Farrelly (1998) and Farrelly et al. (2004) examine whether cigarette tax or price increases lead smokers to purchase cigarettes with higher tar and nicotine contents. Both studies find that smokers facing higher cigarette taxes decrease the self-reported number of cigarettes smoked but that these taxes are associated with increased tar and nicotine

¹ The contemporary and related literature of the impacts of smoking restrictions (smoking bans) is also prominent, with a number of recent studies showing a substantial reduction in cigarette sales and smoking prevalence following the implementation of smoking bans (Gallus et al., 2006; Levy et al., 2004) and other studies finding smoking bans to be less effective (Adda and Cornaglia 2010, MaClean et al. 2014, Nesson 2015).

contents of the cigarettes smoked. This increase in tar and nicotine content offsets the reduced number of cigarettes smoked, leaving daily estimated nicotine intake unchanged.

Some more recent studies measure smoking behavior through biomarkers of recent nicotine intake, although these papers arrive at differing conclusions. Adda and Cornaglia (2006) find that while increased cigarette taxes decrease the number of cigarettes smoked, cigarette taxes do not change the average levels of serum cotinine, a biomarker of recent nicotine exposure, found in smokers. However, Abrevaya and Puzzello (2012), a comment, find that Adda and Cornaglia's results are unstable when the sample is increased to all respondents in the NHANES III data. In a reply Adda and Cornaglia (2013) extend the NHANES III data set through 2006 and find that their initial results largely hold. Most recently, Nesson (2015) extends the NHANES dataset further to include data through 2012 and finds that cigarette taxes lead to statistically significant reductions in serum cotinine levels.

In addition to sharing problems associated with utilizing cross-sectional data discussed above, these studies leave other issues unresolved as well. First, the use of cross-section data is additionally problematic in measuring within-product substitution because it is difficult to attribute changes in across-wave smoker behavior to changes *within* smokers. When cigarette taxes increase, some smokers choose to quit smoking, leaving a different pool of smokers. While models can naturally incorporate this into an estimation of cigarette demand, it is more difficult to address changes in cigarette tar, nicotine, or carbon monoxide contents. Thus, if cigarette taxes induce light smokers to quit at a higher rate than heavy smokers, then a finding that average tar, nicotine, and carbon monoxide contents have risen among remaining smokers may simply reflect a change in the pool of remaining smokers rather than a change in smokers' behavior.

Second, small sample sizes and limited time variation cause these papers to arrive at differing conclusions regarding whether compensating behavior exists and, if so, how much it offsets reductions in cigarette consumption. Evans and Farrelly (1998) use the 1979 Smoking Supplement and 1987 Cancer Control Supplements to the National Health Interview Survey, a repeated cross section dataset. While they find statistically significant increases in tar and nicotine contents in response to cigarette tax changes in pooled-OLS models, including state fixed effects renders very large standard errors and statistically insignificant coefficients. Farrelly et al. (2004) use two waves of the Community Intervention Trial for Smoking Cessation

(COMMIT) project, which follows smokers through a randomly-assigned smoking cessation program.² Limitations in the time period variation contribute to the authors choosing a random-effects, rather than a fixed effects, framework. Relatedly, many of the standard errors in the papers estimating compensating behavior using data from NHANES are very large.

Third, measuring changes in smokers' behavior using the self-reported retrospective survey data may introduce measurement error. Relatedly, previous studies which examine changes in smokers' cigarette brand purchases such as Evans and Farrelly (1998) and Farrelly et al. (2004), determine cigarette characteristics by asking survey respondents to provide a pack of cigarettes that they usually smoke.³ This may omit information if smokers purchase more than one brand of cigarette, and if multi-product purchases are correlated with tobacco control policies, this may lead to biased estimates of smokers' responses to tobacco control policies. Using biomarkers of smoking intake to measure smokers' behavior offers an advantage over using the self-reported number of cigarettes smoked in that there is less measurement error introduced by misreports. However, the use of biomarkers introduces its own concerns. First, the collection of biomarkers is a time and money-intensive process, so surveys containing biomarkers such as NHANES contain much smaller sample sizes than other health surveys such as the Behavioral Risk Factor Surveillance System or National Health Interview Survey. Second, as biomarkers of nicotine are metabolized and removed from the body, smokers consuming the same amount of nicotine on average may have very different levels of these biomarkers, depending on the time of day or day of the week they were interviewed.

II. Data

To study the comprehensive impact of state-level policies on household purchases of tobacco and anti-tobacco products, we use data from the NHCP between 2004 and 2012. The Nielsen Corporation recruits a sample of American households that continually provide information on their purchasing behavior, including when and where they shop, what food and non-food items they purchase, and how much they pay for each item. Specifically, Nielsen provides each NHCP household with a device to scan the UPC of each item they purchase on a shopping trip and

² Please see Farrelly et al. (2004) for more information regarding the COMMIT project.

³ For example, in NHANES survey respondents are asked, "May I please see the pack for the brand of cigarettes you usually smoke?" See the NHANES documentation for the smoking module for the 2011/2012 waves, available at http://wwwn.cdc.gov/nchs/nhanes/2011-2012/SMQ_G.htm (accessed February 2015).

report where they bought the item. If the store participates in Nielsen's point-of-sale (POS) data collection program, the item is assigned the average weekly price of that good at that store. If the store is not a POS participant, the Homescan panelist is asked to provide the price. Each unique UPC code is treated as a separate item. The sample includes respondents from all states and major metropolitan areas, and allows for calculations of national, regional, and market area projections. The dataset contains approximately 40,000 households between 2004 and 2006, and 60,000 households between 2007 and 2012. Respondents are provided incentives in the form of "points" which may be redeemed for products to encourage continued participation, but these are designed to not influence purchasing habits. Approximately 80% of households each year continue participation in the following year.

We collect data on four categories of tobacco-related products: cigarettes, smoking-cessation products (e.g. electronic cigarettes, nicotine patches/gum, etc.), chewing tobacco and snuff. For each product category, we first create an indicator variable for whether a household purchased that product in a given month. We also create variables for the number of products in each category a household purchased. Cigarettes are measured in the number cigarettes, smoking cessation products are measured in the number of products, and chewing tobacco and snuff are measured in ounces.

A potential concern with the NHCP is that the sample is not nationally representative. However, previous studies using the NHCP found very similar cigarette price elasticity estimates to previous studies using nationally-representative survey data, and our estimated elasticities are very similar to those previously estimated elasticities as well (Harding, Leibtag, & Lovenheim, 2012). Additionally, we control for many demographic characteristics in our regressions which are typically used to generate survey weights in nationally-representative surveys and used to account for variation in the demographic effects.

Another potential concern with the NHCP is internet purchases. The NHCP tracks whether purchases are made with an online retailer, and only 0.5 percent of cigarettes purchased are from an online retailer. We compared this result against another source of identifying the prevalence of internet purchases, the Current Population Survey's Tobacco Use Supplement, which asks whether respondents bought their last pack or carton of cigarettes "By mail-order, phone, or internet" in the 2010-2011 survey wave. Only 11 out of over 12,000 respondents report buying their last pack or carton of cigarettes in this manner. Thus it seems that internet

purchases are likely captured sufficiently in the NHCP data and, in addition, are not of sufficient magnitude to be of large concern. Nevertheless, to further account for internet purchases, we include an indicator of household internet use in all models.

While the NHCP is a rich data source of all retail purchases, it does not provide details about the characteristics of cigarettes purchased. To complement the data on household purchases, we merge in cigarette characteristics collected from the National Health and Nutrition Examination Survey (NHANES). NHANES is a cross-sectional survey of health and nutritional information conducted by the CDC which combines surveys, physical examinations, and laboratory measurements. NHANES releases waves biennially, and each wave is nationally representative and contains about 10,000 individuals. Since the 2001-2002 wave, NHANES has collected cigarette UPCs and characteristics including tar, nicotine, and carbon monoxide contents as measured by the Federal Trade Commission. We created a database of all unique UPCs with cigarette characteristics and NHANES survey wave combinations. We then merged the cigarette characteristics using the survey wave and UPCs. Using our match algorithm, we match 91% of cigarette brands and 90% of cigarette purchases.⁴ We use this information to construct two types of measures of cigarette characteristics. First, we examine the average characteristic levels that households purchase per month, aggregating characteristics for each cigarette pack to the household-month level. For example, here we construct a measure of the average nicotine content of the cigarettes a household purchases using the average nicotine content of each unique brand purchased by each household-month cell weighted by the number of cigarettes purchased of each brand. We also construct measures of the total estimated tar, nicotine, and carbon monoxide purchased by multiplying the tar, nicotine, and carbon monoxide contents of each cigarette brand by the number of purchases of that brand and then summing across all brands purchased by each household-month cell.

⁴ When merging based on complete survey year and UPC matches, approximately 35% of cigarette purchases were for a brand that was successfully assigned NHANES characteristics. In order to increase the match rate we successively stepped backward through NHANES years until a purchase matched a UPC (or until the NHANES years were exhausted). This additional step increased the cigarette purchase match rate to approximately 43% of recorded cigarette purchases. Finally, since unique UPC codes are generated for each packaging variation of a cigarette brand (i.e. single packs vs. 3-packs vs. cartons), we standardized cigarette product names in the NHCP to match cigarette products for which a package variety was matched to NHANES. This additional step increased our match rate to 91%. This additional step assumes that cigarette brand characteristics are identical across packaging, i.e. 84mm Marlboro Light Non-Menthol cigarettes have identical nicotine, tar, and carbon monoxide characteristics whether sold in single packs or cartons.

Data on cigarette tax rates are available in the Tax Burden on Tobacco (TBOT) historical compilation, produced by Orzechowski and Walker (2012). The TBOT is an annual compendium of tobacco revenues and industry statistics that provides information on cigarette taxes for all 50 states and the District of Columbia, as well as information on the month and year in which tax changes occurred. We use this information to assign real (denominated in Q4 2012 dollars) cigarette tax rates for every household in the NHCP. There is substantial variation in cigarette taxes during our time period. Overall, there are 70 tax changes in 39 different states with between two and 15 changes in each year.

We collect data on state *ad valorem* smokeless tobacco tax rates from the Centers for Disease Control and Prevention and the Office on Smoking and Health.⁵ As not all states implement *ad valorem* tax rates on smokeless tobacco, we restrict our sample to states which do not levy a *specific* excise tax, which comprises 77% of our sample, similar to Dave and Saffer (2013).⁶ We will demonstrate, however, that our results are robust to this restriction.

Lastly, we include a measure of the percent of each household's county that lives under a smoking ban in bars derived from the Americans for Nonsmokers' Rights Foundation (ANR) Tobacco Control Laws Database. The ANR Tobacco Control Laws Database is a repository of nearly 8,500 state, county, and municipal laws, with detailed information about the day, month, and year of implementation by legislative type (e.g. clean indoor air laws/smoking bans, youth access, advertising, conditional use permits). Using the ANR database, we calculate the percent of each county living under a smoking ban in bars in each quarter.

Table 1 describes yearly within-state changes for all tobacco control policies investigated during our study period. As can be seen, there is substantial variation spread across all nine years and many states.

III. Methods

We utilize a quasi-natural experiment design, connecting policy changes within counties and states, over time, to within-household variation in tobacco-related purchases. We first estimate the effects of tobacco control policies on monthly quantities purchased of a comprehensive set of tobacco products, specifically, the count of cigarettes, ounces of SLT products, and the count of

⁵ Ad valorem taxes are based on wholesale price, which are not available in the NHCP data.

⁶ The 23% of observations are households living in Alabama, Arizona, Connecticut, Maine, North Dakota, Texas, Virginia, and Washington, DC.

smoking-cessation products. Thus, we are able to study potential substitution responses when the scope of a policy is limited to only specific tobacco products. We utilize household fixed effects regression models to estimate the total effect of tobacco control policies on each tobacco product. We first estimate a linear probability model to estimate the probability that a household buys a specific tobacco product as follows:

$$(1) P(T_{hsym} > 0) = \beta_0 + Z_{sym}\beta_Z + X_{hsym}\beta_X + \delta_h + \tau_y + \mu_m + \gamma_{sym} + \varepsilon_{hsym},$$

where $P(T_{hsym} > 0)$ is the probability that household h at year y and month m purchases the tobacco product of interest, Z_{sym} is a vector of tobacco control policies (cigarette taxes expressed in dollars, *ad valorem* chewing tobacco and snuff taxes, and the percent of the household's county living under a bar smoking ban), and X_{hsym} contains household-level demographic characteristics. We also include household and time period (year and month), fixed effects, given by δ_h , τ_y and μ_m , respectively, and state-specific linear time trends, given by γ_{sym} . As we include household fixed effects, in our main models we only include households that purchase the product in question at least once.. We will demonstrate, however, that our results are robust to this restriction by separately estimating models that include all households. In these instances, a dichotomous measure at the household level can be a reasonable proxy for cessation, although in multi-person households it is only an indirect measure. We will also vary our model specification to include different geographic fixed effects and exclude geographic time trends to demonstrate the robust of the results to these alternative approaches.

Next, we estimate the effects of tobacco control policies on the quantity of tobacco products purchased using a similar fixed effects model:

$$(2) T_{hsym} = \alpha_0 + Z_{stm}\alpha_Z + X_{hsym}\alpha_X + \delta_h + \tau_y + \mu_m + \gamma_{sym} + \varepsilon_{hsym},$$

where T_{hsym} represents the amount of the tobacco product purchased each month and all other variables are defined as above. By estimating the effects of each policy on each tobacco product category within this framework we identify the comprehensive, causal policy effects across all tobacco product sub-categories. We also use the merged cigarette characteristics from the NHANES to explore whether tobacco control policies induce smokers to substitute to cigarettes that have higher tar, nicotine, and carbon monoxide contents. To estimate these effects, we examine all purchases that can be matched to cigarette characteristics and examine household-month observations where at least one purchase is matched to cigarette characteristics. We also

ran models where we restrict our sample to households where all purchases can be matched to cigarette purchases, and the results from these regressions are very similar. We modify Equation (2) to estimate two additional models. First, we replace the dependent variable with cigarette characteristics. Specifically, we look at the tar, nicotine, and carbon monoxide contents of each cigarette, measured in milligrams.⁷ If a household purchases more than one cigarette brand per month, we weight the different product characteristics by the amount of each specific cigarette brand purchased. Second, we multiply the tar, nicotine, and carbon monoxide contents of each cigarette by the number of cigarettes purchased to arrive at an estimated monthly proxy of consumption for these different compounds. Lastly, in all models we cluster standard errors at the state level (Bertrand et al., 2004).⁸

IV. Results

a) Analysis of Extensive and Intensive Purchase Habits and Tobacco Product Substitution

Table 2 shows summary statistics. Our total sample includes just over 5.6 million observations, although in our primary analysis we only include households which use the relevant tobacco product at least once. Thus our analysis sample is 1,307,350 observations from 30,476 households for cigarettes, 244,291 observations from 4,964 households for smoking-cessation products, and 69,383 observations from 1,232 households for chewing tobacco products, and 244,389 observations from 4,922 households for snuff products. In a month, the probability that a household purchases cigarettes is about 9%, and the average number of cigarettes purchased among ever-purchase households is 144 cigarettes per month, or about 5 cigarettes per day per household.

⁷ We also examined whether the cigarettes purchased were filtered and cigarette length as measured by an ordinal variable: 1 (68-72mm), 2 (79-88mm), 3 (94-101mm), and 4 (110-121mm). We do not report these results in our main tables. With respect to filtered cigarettes, this variable did not have meaningful variation, as 99 percent of cigarettes in our sample are filtered. As cigarette length is only measured on an ordinal scale, we do not have as much variation in this variable either. Additionally, longer cigarettes would be most relevant for policy makers as all else equal they contain more tar, nicotine, and carbon monoxide. However, we already have direct measures of these substances. We did run regressions using filtered cigarette purchases or cigarette length as dependent variables and not find that tobacco control policies had statistically or economically significant effects on either.

⁸ Clustering standard errors at the state level while including household fixed effects requires us to drop households who move between states during the sample period. These households comprise roughly 3 percent of our sample. We also cluster our standard errors at the household level, including these households, and find very similar results in terms of coefficient size and statistical significance.

Table 3 shows results estimating the effects of tobacco control policies on tobacco-related purchases using the models outlined in Equations (1) and (2). We find that a \$1.00 increase in cigarette taxes reduces the probability that a household will purchase cigarettes in a month by 2.6 percentage points, statistically significant at the one percent level. This coefficient suggests a reduction of roughly 9 percent off the mean of 0.30 and translates to a participation tax elasticity of around -0.15, similar to most participation elasticities in the literature (Evans and Farrelly, 1998; Nesson, 2015; Tauras, 2006, 2004).⁹ When turning to an examination of the total quantities of tobacco products purchased, we find that a \$1.00 increase in cigarette taxes reduces the quantity of cigarettes that ever-purchase households purchase by about 24 cigarettes a month, corresponding to about a 17 percent decrease off the mean of 144 cigarettes a month and a tax elasticity of about -0.30. These results are also comparable to those in the literature (Adda and Cornaglia, 2013; Evans and Farrelly, 1998; Farrelly et al., 2004; Harding et al., 2012; Nesson, 2015; Tauras, 2006). We also find evidence that increases in cigarette taxes also increase the probability that households will purchase smoking-cessation products. Specifically, results suggest that a \$1.00 increase in cigarette taxes leads households to purchase 1.4 additional smoking cessation products per month, an increase of roughly 12 percent of the mean. We do not find statistically significant changes in consumers' likelihood to make cigarette, smoking cessation product or snuff purchases in response to bar smokefree air laws when looking at this sample, however large standard errors inhibit our ability to draw strong conclusions from these results. We do find that bar smokefree air laws increase chewing tobacco purchases.

Additionally, we find that if a state raises a snuff tax by one percent, households will purchase about 0.1 fewer cigarettes per month. This translates to a tax elasticity of about -0.22. We also find that snuff taxes and chewing tobacco taxes affect smoking cessation purchases, although in the opposite direction; an increase in chewing tobacco taxes decreases smoking cessation product purchases while an increase in snuff taxes increases smoking cessation product purchases. We also provide some evidence that households purchasing SLT will strategically

⁹ We do not include federal cigarette excise taxes because changes in the federal tax would be largely accounted for by our year fixed effects. However, we do include the federal excise tax when calculating our elasticity estimates, as excluding the federal tax would lead to smaller elasticity estimates. Including the federal excise tax increases the average tax rate for the cigarette sample from \$1.07 to \$1.75. In results available upon request, we show models including the federal excise tax, which produce coefficients, standard errors, and statistical significance levels very similar to our main results here.

respond to changes in SLT taxes. While we find that snuff taxes reduce snuff purchases, we also find some evidence that snuff taxes increase chewing tobacco use on the extensive margin.

In order to verify that the results are not sensitive to specification choices, we next engage in an extensive series of robustness checks. First, one possible concern may be that restricting our sample to households who purchased cigarettes at least once may affect our cigarette participation elasticity. To check this we re-run our results in Table 3, but include all households, resulting in a sample of over 4 million observations. Relatedly, we test the robustness of our results to estimating our sample over all households that ever purchased any tobacco product, which gives us a sample of just under 1.5 million. Results from these two sets of regressions, shown in Table 4, yield very similar elasticity estimates. We next test the robustness of our results to including the states excluded for not levying an *ad valorem* smokeless tobacco tax. These estimates are shown in Appendix A1, again prove similar to our main results.

Next, we test the sensitivity of our results to excluding state specific time trends, replacing household fixed effects with state fixed effects, and estimating our models using NCHP survey weights to render a nationally-representative sample. Appendix B shows results from these regressions, and these results are very similar in terms of coefficient size and statistical significance, with the exception of the smoking cessation product results, which are not robust to excluding state-specific time trends. We note that smoking cessation products represent a count of all products classified as smoking cessation products, including a variety of tobacco-related products. Thus, our results are less easily interpreted than in other categories.

There is also the potential concern that the passing of cigarette taxes may reflect policy endogeneity. To examine whether political endogeneity affects our results, we re-estimate our models including four quarterly lags and four quarterly leads of the cigarette excise tax. Results from these regressions are shown in Appendix C, and our main conclusions are unchanged. For cigarette purchases, the leaded coefficients are much smaller than the contemporaneous coefficient and not statistically significant at the 10 percent level. It is worth noting that many standard addiction models, e.g. Becker and Murphy (1988), would predict a correlation between lagged taxes and current consumption. In fact, we find a positive lagged coefficient in Appendix Table C1, perhaps consistent with a “rebound effect” as smokers reduce consumption in the

weeks after a tax increase but increase consumption from this lower level after finding lower prices during the next quarter.

Lastly, we want to evaluate the possibility that the variability in cigarette tax levels across tests is creating a meaningful amount of cross-border purchases or “bootlegging” between states and, hence, impacting our baseline estimates. To confirm that bootlegging is not affecting our results, we re-estimate our baseline model including three additional variables in a fashion similar to Harding, Leibtag, and Lovenheim (2012). First, using a household’s county of residence, we calculate the difference between a household’s cigarette tax and the nearest lower cigarette tax. Second, we calculated the natural log of the distance between a household’s county and the nearest county with a lower tax. Finally, we include an interaction between the tax difference and the log distance. Results from these regressions are shown in Appendix D. The cigarette tax coefficients rise slightly in magnitude, but our conclusions are unchanged.

b) Analysis of Compensatory Behavior; Cigarette Characteristics

In addition to reductions in consumption and substitution to other related products in responses to tobacco control policies, there is also great interest in understanding the compensating behaviors among tobacco users in terms of within-product substitution. In this regard, we leverage the product-code level detail provided in the NHCP data to match our sample of NHCP tobacco purchases to cigarette characteristics in the NHANES in order to estimate whether tobacco control policies induce smokers to switch to cigarettes with different characteristics and whether tobacco control policies lead to reductions in estimated tar, nicotine, and carbon monoxide intake. Table 5 shows summary statistics from the matched sample of cigarette purchases, which contains all households where at least one product could be matched to NHANES. Nearly all cigarettes purchased in this sample are filtered. The average tar, nicotine, and carbon monoxide contents are just under 12mg, 1mg, and 12mg, respectively. As a basis for comparison, Winston Filtered 100mm cigarettes have 16mg of tar, 1.3mg of nicotine, and 15mg of carbon monoxide. On the lower end of tar, nicotine, and carbon monoxide contents, Marlboro Ultra-Light 83mm cigarettes have 6mg of tar, 0.5mg of nicotine, and 8mg of carbon monoxide.

Table 6 and Figure 1 show estimates from the models estimating the effects of tobacco control policies on cigarette characteristics and estimated tar, nicotine, and carbon monoxide

purchases. The left panel of Table 6 displays results estimating whether tobacco control policies affect the average tar, nicotine and carbon monoxide contents of the cigarettes consumers purchase, all measured in milligrams. We find evidence that cigarette taxes lead to statistically significant changes in tar, nicotine, and carbon monoxide contents. For example, in our preferred specifications, a \$1.00 increase in cigarette taxes leads to statistically significant increases of 0.109mg, 0.008mg and 0.067mg in the average tar, nicotine, and carbon monoxide contents of cigarettes smoked. However, these point estimates translate to very small tax elasticities. The small magnitudes of these elasticities are visually apparent in Figure 1. However, these results for average tar, nicotine, and carbon monoxide contents are not robust to changing the sample or to the inclusion of additional geographic controls, suggesting weaker statistical evidence for these small compensating effects.

The right panel of Table 6 displays results estimating whether tobacco control policies affect estimated household monthly tar, nicotine, and carbon monoxide purchases. For comparison, we also include results for monthly cigarette purchases among this subsample. Here, our cigarette tax coefficients are all negative and statistically significant at the one percent level. We find that cigarette taxes lead to a reduction in cigarette purchases of about 42 cigarettes a month, a tax elasticity of about -0.15.¹⁰ We find very similar and negative elasticities with respect to tar, nicotine, and carbon monoxide purchases, all around -0.14, and statistically significant at the one percent level. Figure 1 visually shows the similarity in tax elasticities between cigarette purchases and estimated tar, nicotine, and carbon monoxide purchases. These outcomes indicate that, while some compensatory behavior may exist with regard to tax increases, any effects are overwhelmed by households purchasing fewer cigarettes.

We also test whether our results are robust to only examining households where *all* purchases, rather than *at least one purchase*, can be matched to cigarette characteristics, and these results are shown in Appendix Table E1. These households are less likely to change brands, given that all of their purchases can be matched to NHANES and are thus less likely to ever purchase off-brand cigarettes. Thus, we not surprisingly find that the coefficients on the average tar, nicotine, and carbon monoxide contents are not statistically significant at conventional levels and are roughly half the size of the coefficients in our preferred specification. However, the coefficients on the reductions in cigarette purchases and total estimated tar,

¹⁰ For the sample of purchases matched to NHANES, the average federal and state cigarette excise tax is \$1.69.

nicotine, and carbon monoxide consumption are very similar to those in Table 6. Lastly, we further control for a changing pool of smokers by including the zero purchase months into our sample of households where all cigarette purchases can be matched to NHANES. These results, contained in Appendix E2, show statistically significant reductions in overall cigarette, tar, nicotine, and carbon monoxide purchases. Transforming the coefficients into tax elasticities yields elasticities of roughly -0.27 to -0.32, very similar to the overall tax elasticities in Table 6.¹¹ We also run the same robustness checks as described in section IV.a, with results displayed in Appendices B, C, and D, and our main conclusions are essentially unchanged. The statistical significance of the small effects of cigarette excise taxes on the tar, nicotine and carbon monoxide contents is not robust to the substitution of state fixed effects for the household fixed effects, or the exclusion of state-specific time trends, however, both the magnitude and statistical significance of the negative effects of cigarette taxes on overall purchases of cigarette, tar, nicotine and carbon monoxide are robust to these different specifications.

c) Analysis of Heterogeneity in Responses

In this section we investigate whether there is heterogeneity in household responses to policy changes. We first investigate heterogeneity depending on smokers' cigarette consumption levels, as previous research suggests that heavy and light smokers respond differently to tobacco control policies (Maclean et al., 2014; Nesson, 2015). We estimate separate models for households who purchase an average of 300 cigarettes per month or less (occasional smoker households) versus an average of 600 cigarettes per month or more (pack-a-day smoker households).¹² Next, we examine heterogeneity based on income levels, age, region of residence, state smoking prevalence, and change in smoking prevalence between 1993 and 2013.

Appendix F displays results from these additional models. Heavier smokers respond more strongly to cigarette taxes in terms of the number of cigarettes smoked. However, in terms of tax elasticities, lighter smoking households are much more responsive with an estimated conditional

¹¹ These elasticities are larger than the elasticities in Table 6 since they include zero purchases, and are thus overall tax elasticities rather than conditional on positive purchase tax elasticities. The average federal and state cigarette excise tax for this sample is \$1.76.

¹² We also estimated models defining the sample of occasional and pack-a-day smokers based on the first year we observe a household's purchases, rather than across all observed years. The corresponding results are very similar.

tax elasticity of around -0.54 compared to -0.15.¹³ Moreover, in this specification, we no longer find evidence that cigarette taxes impact the likelihood of purchasing smoking cessation products among either type of smoker. In terms of point estimates, households with higher income respond more strongly to cigarette excise taxes, both in terms of reducing the quantity of cigarettes purchased, but also in terms of substituting to smoking cessation products and cigarettes with higher tar, nicotine and carbon monoxide contents. However, most of these differences are not statistically significant. Although in terms of point estimates, older households reduce cigarette purchases and increase smoking cessation purchases more in response to cigarette tax increases, younger households are more likely to purchase cigarettes with higher tar, nicotine and carbon monoxide contents. Again, most of these differences are not statistically significant. Geographic location does statistically significantly affect responses to cigarette taxes. Households living in the South and Midwest reduce cigarette consumption much more than households in the Northeast or West. Additionally, we use data from the Centers for Disease Control's State Tobacco Activities Tracking System (<http://www.cdc.gov/statesystem/>) to examine households living in states with low versus high smoking prevalence (less than 20 percent versus at least 20 percent in 2013) or states with smaller versus larger declines in smoking prevalence (less than three percentage points versus at least three percentage points between 1993 and 2013). We find that households in low smoking prevalence states or states with larger declines in smoking are more likely to increase smoking cessation product purchases or purchase cigarettes with higher tar, nicotine and carbon monoxide contents, but these differences are not statistically significant. Of note, we find that the effects of snuff and chewing tobacco taxes are more apparent among occasional smoking households, lower income households, and younger households.

d) Comparison to Previous Research

Finally, we compare our results to previous studies by transforming our coefficients into tax elasticities and comparing them to tax elasticities from previous literature. A summary of the tax elasticities in this literature estimating smokers' compensatory behavior, and how our results

¹³ The average federal and state cigarette excise taxes for occasional smoker households and pack-a-day smoker households are \$1.76 and \$1.67, respectively.

compare, is provided in Table 7.¹⁴ Notably, our results (presented in row 1) intersect the confidence intervals of nearly all of the other papers presented. However, the precision of the estimates presented in this paper is much higher in all cases but one.¹⁵ This suggests that a strong degree of confidence can be attributed to our estimates, as they build on the previous literature but are able to improve on identification and precision with the use of household panel data from the NHCP and merged cigarette characteristics from the NHANES. In many ways these results tie together conflicting estimates of smokers' compensatory responses to cigarette taxes. Like Evans and Farrelly (1998) and Farrelly et al. (2004), which use self-reported cigarette consumption and cigarette characteristics, we find evidence that smokers increase the tar and nicotine contents of the cigarettes they smoke in response to cigarette taxes. However, given our more extensive data source, we are able to identify these effects even when accounting for household fixed effects. Similar to more recent estimates of smokers' compensatory behavior using biomarkers of nicotine intake, we find that smokers' compensatory responses are not large enough to meaningfully offset reductions in the number of cigarettes smoked (Nesson, 2015).

V. Conclusion

This paper utilizes household panel data to estimate the effects of tobacco control policies on a range of tobacco-related outcomes among adults, including purchases of cigarettes, SLT, and smoking-cessation products. Using panel data on the monthly purchases of a large number of households, we are able to control for household-level fixed effects, which provides much clearer evidence of detailed changes in purchasing habits in response to different tobacco control policies. Moreover, we are able to circumvent the many potential issues arising from the use of self-reported smoking data. Lastly, we are able to look at within-household changes in cigarette characteristics, including the tar, nicotine, and carbon monoxide contents of the cigarettes smoked, and estimate the total household intake of these substances.

¹⁴ Appendix G summarizes our calculation of tax elasticity estimates in the previous literature. An important concern is whether our sample is similar to the samples in previous papers. The other studies in Table 7 use a sample of individuals who smoked at least one cigarette in the past 30 days. Thus, although our sample is households purchasing cigarettes in the past month, we feel our sample is similar to those in our comparison studies. The average number of cigarettes purchased per month in Table 5 translates to about 16 cigarettes per day per household. These numbers are in line with the sample statistics from our comparison studies, for example, 20 cigarettes per day in Evans and Farrelly (1998), 19 cigarettes per day in Adda and Cornaglia (2006), 16 cigarettes per day in Adda and Cornaglia (2013) and 15.5 cigarettes per day in Nesson (2015).

¹⁵ In Farrelly et al. (2004) the confidence interval for their estimates of tax elasticity of cigarettes is comparable, but their estimates are not statistically significant, except for the youngest age group of 25-34.

Our results provide convincing evidence that cigarette taxes are an effective policy lever with which to reduce cigarette smoking. We find that, even when examining cigarette purchases within households over time, cigarette taxes both induce households to stop purchasing cigarettes and reduce the number of cigarettes that they purchase. Additionally, we find some evidence that increased cigarette taxes increase the probability that households purchase smoking cessation products, and that smokeless tobacco taxes lead to notable substitution effects. When we stratify our sample into light vs. heavy smoking households, we find that cigarette taxes reduce cigarette smoking in all subgroups, but light smokers respond most strongly in terms of tax elasticities. Lastly, we find some, albeit weak, evidence that households respond to cigarette taxes by switching to cigarettes with higher tar, nicotine, and carbon monoxide contents. However, these changes are too small to be economically significant, and we find that the reduction in the number of cigarettes smoked per day overwhelms these small increases in the tar, nicotine, and carbon monoxide contents of cigarettes. When we run models estimating how households' total estimated tar, nicotine, and carbon monoxide purchases are affected by tobacco control policies, we find tax elasticities of total tar, nicotine, and carbon monoxide purchases that are very close to the tax elasticity of cigarettes purchased. Although our estimates fall within the confidence intervals reported by previous studies, our larger sample size allows a much more precise estimation of these effects.

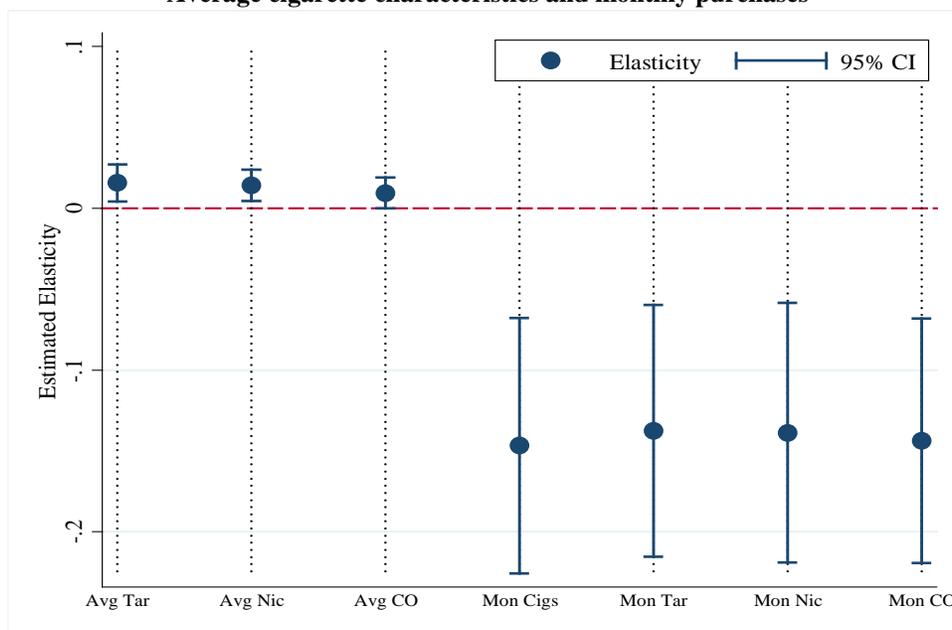
Our methodology and dataset lend themselves to a number of extensions. First, although our results are in line with previous estimates of smokers' responses to tobacco control policies, little research has addressed the relationship between self-reported measures of consumption and scanner-data measures of purchases. In particular, future research could estimate whether taxes and other policies affect purchase venues and thus the probability that households scan certain items. Additionally, the literature on consumers' responses to taxes and prices has also recently examined the effect of salience on purchasing behavior, and our data are well positioned to add to the literature examining whether smokers respond differently to more salient taxes, included in the price of the cigarettes, or less-visible sales taxes, incorporated only at the register.

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Figure 1. Estimated tax elasticities
Average cigarette characteristics and monthly purchases



Notes: Each dot and bar show estimated tax elasticities and corresponding 95% confidence intervals for the effects of cigarette taxes on cigarette characteristics and monthly consumption of cigarettes, tar, nicotine, and carbon monoxide. These elasticities are calculated from regression coefficients in Table 5. The samples are restricted to household-month observations with a positive purchase for households who purchased cigarettes such that at least one purchase could be matched to cigarette characteristics. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects, as well as state-specific time trends. The confidence intervals are calculated from robust standard errors clustered by state are in parentheses.

Table 1: Summary of Within-State Tobacco Control Policy Changes

Year	Mean	States with Changes from Previous Year
<i>Cigarette Excise Taxes (\$)</i>		
2004	\$0.91	AL, MI, NJ, RI
2005	\$1.01	CO, KY, ME, MN, MT, NC, NH, OH, OK, VA, WA
2006	\$0.99	AZ, NC, NJ, VT
2007	\$1.06	CT, DE, IA, IN, NH, SD, TN, TX
2008	\$1.11	DC, MA, MD, NH, NY, VT, WI
2009	\$1.15	AR, CT, DC, DE, FL, KY, MS, NC, NH, NJ, PA, RI, VT, WI
2010	\$1.20	NM, NY, SC, UT, WA
2011	\$1.20	CT, DC, MN, NH, VT
2012	\$1.17	IL, RI
<i>Chewing Tobacco Ad Valorem Taxes (%)</i>		
2004	28.1	
2005	29.5	CA, CO, KY, ME, MT, OK, RI, VA
2006	31.5	KY, MN, NC, TX
2007	29.5	CA, IA, IN, NC, SD
2008	30.3	VT, WI
2009	35.3	AR, FL, NH, NY, TX, WI
2010	33.5	CT, NC, NH, RI, UT, VA, WA, WI
2011	34.2	CA, CT, ME, NH, NY
2012	35.2	CA, IL, MD
<i>Snuff Ad Valorem Taxes (%)</i>		
2004	28.1	
2005	29.5	CA, CO, CT, ME, MT, OK, RI, VA
2006	31.5	MN, MT, NC, NJ, TX, VT
2007	29.5	CA, DE, IA, IN, NC, NY, SD, UT
2008	32.5	WI
2009	36.1	AR, FL, ME, NE, NH, OR, RI, TX, WI, WY
2010	34.3	CT, NC, NH, VA, WA
2011	35.4	CA, CT, NH
2012	36.4	CA, IL, IN, MD
<i>Population Under Bar Ban (%)</i>		
2004	29.0%	-
2005	30.3%	AL, AZ, CO, CT, GA, IL, IN, KS, KY, MD, MA, MN, MS, NE, NM, OH, RI, TX, VT, WA, WV, WI, WY
2006	37.5%	AL, AZ, CO, CT, GA, IL, IN, KS, KY, MD, MN, MS, MO, NJ, NM, OH, RI, SC, TX, VT, WA, WV, WI, WY
2007	41.6%	AL, AZ, CO, DC, GA, IL, IN, KS, KY, MD, MN, MS, MO, NV, NH, NJ, NM, OH, SC, TX, WV, WY
2008	51.5%	AL, AZ, IL, IN, IA, KS, KY, MD, MN, MS, MO, NE, NH, NM, ND, SC, TX, VA, WV, WI, WY
2009	55.5%	AL, ID, IN, IA, KS, KY, MD, MS, MO, MT, NE, ND, OR, SC, TX, UT, VA, WV, WI, WY
2010	65.2%	AL, ID, IN, KS, KY, MI, MS, MO, MT, NE, NC, ND, SC, SD, TX, WV, WI
2011	72.0%	AL, GA, IN, KS, KY, MI, MS, MO, ND, SC, SD, TX, WV, WI, WY
2012	72.0%	AL, GA, ID, IN, KY, LA, MS, MO, ND, SC, TX, WV

Notes: Tobacco policy data are from the Tax Burden on Tobacco and the American Non-Smokers Rights Foundation. Annual means are levels, calculated across households in the full estimation sample, which includes data from all states and Washington, D.C. in the contiguous United States. Only changes in nominal taxes between years are counted in the states with changes, but annual means are calculated in real (2012) dollars. Only changes in the population of a state living under a bar smoking ban are counted in the bottom panel.

Table 2: Summary Statistics

	Ever Purchased:									
	Entire Sample (N=4,173,033)		Cigarettes (N=1,307,350)		Smoking Cessation Products (N=244,291)		Chewing Tobacco (N=69,383)		Snuff (N=244,389)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
<u>Dependent Variables</u>										
Any Cigarettes	0.093	0.291	0.297	0.457	0.319	0.465	0.148	0.355	0.184	0.388
Any Smoking Cessation Products	0.004	0.066	0.010	0.098	0.076	0.265	0.008	0.091	0.007	0.085
Any Chewing Tobacco	0.002	0.042	0.002	0.050	0.003	0.051	0.104	0.305	0.008	0.088
Any Snuff	0.006	0.077	0.011	0.105	0.011	0.105	0.048	0.213	0.104	0.305
Number of Cigarettes	45.198	217.641	144.272	370.005	164.822	383.130	74.388	292.612	94.953	311.112
Number Smoking Cessation Products	0.701	17.490	1.105	18.419	11.973	71.348	1.094	19.139	1.259	22.003
Chewing Tobacco (Oz.)	0.068	2.567	0.100	3.192	0.090	2.930	4.115	19.483	0.319	5.328
Snuff (Oz.)	0.074	1.460	0.144	2.057	0.145	2.023	0.783	5.308	1.271	5.907
<u>Policy Variables</u>										
Cigarette Excise Taxes	1.095	0.640	1.068	0.640	1.088	0.648	0.894	0.620	1.002	0.624
Chewing Tobacco Tax (Ad Velorem)	31.842	24.270	30.811	24.010	31.805	24.287	26.562	22.318	28.237	22.904
Snuff Tax (Ad Velorem)	32.592	25.953	31.494	25.578	32.691	26.242	26.950	23.361	28.858	24.466
% Pop Under Bar Ban	0.506	0.503	0.478	0.512	0.484	0.492	0.408	0.538	0.408	0.500

Notes: Individual data from the Nielsen Homescan Consumer Panel Dataset spanning 2006 to 2012. Tobacco policy data are from the Tax Burden on Tobacco and the American Non-Smokers Rights Foundation.

Table 3: Analysis of tobacco control policies and products

	Cigarettes (count)		Smoking Cessation Products (count)		Chewing Tobacco (oz)		Snuff (oz)	
	Any Purchase	Quantity	Any Purchase	Quantity	Any Purchase	Quantity	Any Purchase	Quantity
		Purchased		Purchased		Purchased		Purchased
Cigarette Excise Tax (\$)	-0.0259*** (0.0056)	-24.3445*** (6.0729)	0.0054 (0.0060)	1.3850** (0.5806)	-0.0110 (0.0096)	-0.1814 (0.5176)	-0.0047 (0.0036)	-0.0850 (0.0628)
Chewing Tobacco Tax (Ad Velorem)	0.0003** (0.0001)	0.1479 (0.1110)	0.0002 (0.0001)	-0.0945*** (0.0209)	-0.0008** (0.0003)	-0.0276 (0.0227)	0.0001 (0.0002)	0.0042 (0.0026)
Snuff Tax (Ad Velorem)	-0.0003*** (0.0000)	-0.0992** (0.0398)	0.0000 (0.0000)	0.0421*** (0.0086)	0.0004*** (0.0001)	0.0047 (0.0059)	-0.0001*** (0.0001)	-0.0021*** (0.0007)
% Pop Under Bar Smoking Ban	-0.0003 (0.0024)	-2.0779 (2.5701)	-0.0034 (0.0040)	-1.5070 (1.0353)	-0.0011 (0.0064)	0.3004** (0.1484)	0.0008 (0.0035)	0.0059 (0.0634)
Observations	1,307,350	1,307,350	244,291	244,291	69,383	69,383	244,389	244,389
Households	30,476	30,476	4,964	4,964	1,232	1,232	4,922	4,922
Mean Value: Dep Variable	0.297	144.272	0.076	11.973	0.104	4.115	0.104	1.271

Notes: Samples are restricted to households who purchased the product at least once throughout the sample period. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Table 4: Analysis of tobacco control policies and products; variations on sample inclusion

	<u>Cigarettes (count)</u>		<u>Smoking Cessation Products (count)</u>		<u>Chewing Tobacco (oz)</u>		<u>Snuff (oz)</u>	
	<u>Any Purchase</u>	<u>Quantity Purchased</u>	<u>Any Purchase</u>	<u>Quantity Purchased</u>	<u>Any Purchase</u>	<u>Quantity Purchased</u>	<u>Any Purchase</u>	<u>Quantity Purchased</u>
Sample doesn't restrict to ever purchased								
Cigarette Excise Tax (\$)	-0.00828*** (0.00201)	-7.80645*** (2.14151)	0.00033 (0.00038)	0.08330** (0.03642)	-0.00013 (0.00015)	-0.00306 (0.00775)	-0.00022 (0.00022)	0.00169 (0.00473)
Chewing Tobacco Tax (Ad Velorem)	0.00008** (0.00004)	0.04631 (0.04077)	0.00001* (0.00001)	-0.00614*** (0.00132)	-0.00001* (0.00000)	-0.00042 (0.00033)	0.00001 (0.00001)	0.00019 (0.00016)
Snuff Tax (Ad Velorem)	-0.00008*** (0.00001)	-0.03424** (0.01417)	0.00000 (0.00000)	0.00323*** (0.00047)	0.00001*** (0.00000)	0.00016* (0.00009)	-0.00001*** (0.00000)	-0.00012** (0.00005)
% Pop Under Bar Smoking Ban	0.00008 (0.00097)	-0.72137 (0.95694)	-0.00019 (0.00019)	-0.07250 (0.04970)	0.00006 (0.00023)	0.01403*** (0.00487)	0.00013 (0.00025)	0.00056 (0.00301)
Observations	4,173,033	4,173,033	4,173,033	4,173,033	4,173,033	4,173,033	4,173,033	4,173,033
Households	106,507	106,507	106,507	106,507	106,507	106,507	106,507	106,507
Mean Value: Dep Variable	0.093	45.198	0.004	0.701	0.002	0.068	0.006	0.074
Sample includes households that purchased any tobacco product								
Cigarette Excise Tax (\$)	-0.02307*** (0.00512)	-21.70208*** (5.47147)	0.00090 (0.00106)	0.23139** (0.10118)	-0.00034 (0.00041)	-0.00641 (0.02067)	-0.00061 (0.00059)	0.00500 (0.01275)
Chewing Tobacco Tax (Ad Velorem)	0.00023** (0.00009)	0.11826 (0.09773)	0.00004 (0.00002)	-0.01798*** (0.00364)	-0.00003* (0.00001)	-0.00112 (0.00091)	0.00002 (0.00003)	0.00051 (0.00045)
Snuff Tax (Ad Velorem)	-0.00023*** (0.00003)	-0.08064** (0.03552)	0.00000 (0.00001)	0.00986*** (0.00132)	0.00001*** (0.00001)	0.00036 (0.00022)	-0.00003*** (0.00001)	-0.00034** (0.00013)
% Pop Under Bar Smoking Ban	-0.00037 (0.00218)	-1.83480 (2.26215)	-0.00040 (0.00043)	-0.15565 (0.11729)	0.00010 (0.00052)	0.02997*** (0.01052)	0.00024 (0.00055)	0.00045 (0.00668)
Observations	1,487,204	1,487,204	1,487,204	1,487,204	1,487,204	1,487,204	1,487,204	1,487,204
Households	34,331	34,331	34,331	34,331	34,331	34,331	34,331	34,331
Mean Value: Dep Variable	0.262	126.824	0.012	1.967	0.005	0.192	0.017	0.209

Notes: All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Table 5: Summary statistics: NHANES cigarette contents

	Mean	Std. Dev.	1st Quart.	3rd Quart.	N
Average Cigarette Tar Content	11.738	3.798	9.665	15.000	349,779
Average Cigarette Nicotine Content	0.949	0.279	0.798	1.138	349,779
Average Cigarette Carbon Monoxide Content	11.959	3.163	10.000	14.000	349,779
Average Monthly Cigarette Purchases	488.2	544.1	120.0	660.0	349,779
Total Monthly Cigarette Tar Content	5369.2	6501.4	1080.0	7200.0	349,779
Total Monthly Cigarette Nicotine Content	433.1	512.8	96.0	597.9	349,779
Total Monthly Cigarette Carbon Monoxide Content	5499.7	6539.8	1180.0	7511.4	349,779

Notes: The sample is restricted to household-month observations with a positive cigarette purchase which could be matched to cigarette characteristics from NHANES.

Table 6: NHANES Cigarette characteristics among households purchasing matched cigarettes

	Cigarette Characteristics			Total Estimated Monthly Consumption of:			
	Average Tar Content	Average Nicotine Content	Average CO Content	Cigarettes	Tar	Nicotine	Carbon Monoxide
Cigarette Excise Tax (\$)	0.1093*** (0.0405)	0.0080*** (0.0028)	0.0669* (0.0344)	-42.4959*** (11.6539)	-438.0464*** (126.4967)	-35.6638*** (10.5144)	-469.0745*** (125.6585)
Chewing Tobacco Tax (Ad Velorem)	-0.0004 (0.0016)	-0.0000 (0.0002)	-0.0015* (0.0009)	0.4211* (0.2120)	-0.5817 (2.5389)	0.0334 (0.1962)	-0.4889 (2.4901)
Snuff Tax (Ad Velorem)	0.0011* (0.0005)	0.0001** (0.0000)	0.0010*** (0.0003)	-0.2102** (0.0871)	2.4268** (1.0986)	0.1147 (0.0877)	2.1404** (1.0551)
% Pop Under Bar Smoking Ban	0.0209 (0.0561)	0.0030 (0.0050)	-0.0345 (0.0330)	-6.9646* (3.5087)	-35.9731 (52.3014)	-2.6386 (4.5128)	-61.4898 (45.3961)
Observations	349,779	349,779	349,779	349,779	349,779	349,779	349,779
Households	25,826	25,826	25,826	25,826	25,826	25,826	25,826
Mean Value: Dep Variable	11.738	0.949	11.959	488.2	5369.2	433.1	5499.7

Notes: The sample is restricted to household-month observations with a positive purchase for households who purchased cigarettes such that at least one purchase could be matched to cigarette characteristics. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Table 7: Estimated tax elasticities for cigarette, nicotine per cigarette, and nicotine demand among studies estimating smokers' compensatory behavior

Paper	Cigarettes			Nicotine			Total Nicotine		
	Tax Elasticity	Lower Bound	Upper Bound	Tax Elasticity	Lower Bound	Upper Bound	Tax Elasticity	Lower Bound	Upper Bound
Cotti, Nesson, Tefft (2015)	-0.147	-0.226	-0.068	0.014	0.005	0.024	-0.139	-0.220	-0.059
Evans & Farrelly (1998)	0.031	-0.105	0.167	0.061	-0.038	0.159	0.054	-0.122	0.230
Farrelly et al. (2004): Age 25-34	-0.035	-0.063	-0.008	0.046	0.024	0.068	na	na	na
Farrelly et al. (2004): Age 35-44	-0.017	-0.045	0.011	0.005	-0.017	0.028	na	na	na
Farrelly et al. (2004): Age 45-64	-0.017	-0.043	0.010	0.037	0.013	0.061	na	na	na
Adda and Cornaglia (2006)	-0.190	-1.152	0.772	0.461	0.136	0.786	0.270	-0.397	0.937
Abrevaya and Puzzello (2012)	0.009	-0.358	0.377	0.078	-0.161	0.317	0.087	-0.192	0.366
Adda and Cornaglia (2013)	-0.089	-0.175	-0.003	0.069	0.012	0.126	-0.020	-0.094	0.054
Nesson (2015)	-0.149	-0.210	-0.088	0.022	-0.115	0.158	-0.095	-0.172	-0.017

Notes: Each dot and bar show estimated tax elasticities and corresponding 95% confidence intervals for the effects of cigarette taxes on cigarette consumption from various studies. From left to right, these studies are the current study, Evans and Farrelly (1998), Farrelly et al. (2004) including three age break downs, Abrevaya and Puzzello (2012), Adda and Cornaglia (2013), and Nesson (2015). Nicotine content per cigarette is measured by cigarette nicotine contents in the current study, Evans and Farrelly (1998), and Farrelly et al. (2004). Nicotine demand is estimated from the logged ratio of serum cotinine levels and cigarette consumption in Abrevaya and Puzzello (2012), Adda and Cornaglia (2013), and Nesson (2015).

APPENDIX A:

MAIN SPECIFICATION; MORE ALTERNATE SAMPLES

Appendix Table A1: Analysis of tobacco control policies and products (without restriction due to SLT taxes)

	Cigarettes (count)		Smoking Cessation Products (count)		Chewing Tobacco (oz)		Snuff (oz)	
	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased
Cigarette Excise Tax (\$)	-0.02160***	-15.30213*	0.00533*	0.03718	-0.00518	0.04760	-0.00396	-0.00131
	-0.00571	(7.77695)	-0.0031	(0.46791)	-0.00641	(0.33688)	-0.00254	(0.05358)
Smokeless Tobacco Tax	0.01137	4.73720	0.02094	3.19893	-0.03332**	-0.98133*	0.01209	-0.39017
	-0.01548	(22.93563)	-0.02863	(5.48676)	-0.01655	(0.57427)	-0.00889	(0.31170)
% Pop Under Bar Smoking Ban	-0.00118	-2.25695	-0.00383	-1.26785	-0.001	0.36291**	0.00365	0.01173
	-0.00232	(2.54087)	-0.00326	(0.92430)	-0.00677	(0.17990)	-0.004	(0.04426)
Observations	1,685,045	1,685,045	321,078	321,078	86,698	86,698	317,669	317,669
Households	36,026	36,026	5,870	5,870	1,398	1,398	5,787	5,787
Mean Value: Dep Variable	0.291	138.661	0.074	11.896	0.104	4.080	0.104	1.277

Notes: All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

**APPENDIX B:
RESULTS INCLUDING SAMPLE WEIGHTS, EXCLUDING
STATE-SPECIFIC TIME TRENDS, OR INCLUDING STATE
FIXED EFFECTS INSTEAD OF HOUSEHOLD FIXED
EFFECTS**

Appendix Table B1: Analysis of tobacco control policies and products (excluding state-specific time trends)

	Cigarettes (count)		Smoking Cessation Products (count)		Chewing Tobacco (oz)		Snuff (oz)	
	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased
	Cigarette Excise Tax (\$)	-0.0263*** (0.0055)	-23.2967*** (6.9921)	0.0040 (0.0049)	-0.0597 (0.9245)	-0.0176 (0.0116)	-0.2670 (0.5942)	-0.0077*** (0.0028)
Chewing Tobacco Tax (Ad Velorem)	0.0001 (0.0002)	0.0162 (0.1692)	0.0005*** (0.0001)	0.0332 (0.0362)	-0.0010 (0.0010)	-0.0260 (0.0519)	0.0002 (0.0002)	0.0042 (0.0026)
Snuff Tax (Ad Velorem)	-0.0003*** (0.0001)	-0.1046* (0.0588)	-0.0001 (0.0001)	0.0238 (0.0143)	0.0005** (0.0002)	0.0121 (0.0123)	-0.0002*** (0.0001)	-0.0021*** (0.0007)
% Pop Under Bar Smoking Ban	-0.0004 (0.0041)	-1.1629 (3.8181)	-0.0002 (0.0041)	-0.1427 (1.2635)	-0.0055 (0.0132)	0.0001 (0.4753)	-0.0009 (0.0039)	0.0059 (0.0634)
Observations	1,307,350	1,307,350	244,291	244,291	69,383	69,383	244,389	244,389
Households	30,476	30,476	4,964	4,964	1,232	1,232	4,922	4,922
Mean Value: Dep Variable	0.297	144.272	0.076	11.973	0.104	4.115	0.104	1.271

Notes: Samples are restricted to households who purchased the product at least once throughout the sample period. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table B2: NHANES Cigarette characteristics among households purchasing matched cigarettes (excluding state-specific time trends)

	Cigarette Characteristics			Total Estimated Monthly Consumption of:			
	Average Tar Content	Average Nicotine Content	Average CO Content	Cigarettes	Tar	Nicotine	Carbon Monoxide
Cigarette Excise Tax (\$)	0.0603 (0.0436)	0.0052* (0.0029)	0.0026 (0.0313)	-37.8182*** (13.7942)	-392.7213*** (142.7114)	-29.5686** (11.5857)	-441.7066*** (149.5439)
Chewing Tobacco Tax (Ad Velorem)	-0.0018 (0.0025)	-0.0000 (0.0002)	-0.0035** (0.0014)	0.1887 (0.2371)	-3.9245* (2.2404)	-0.2032 (0.1764)	-4.3374 (2.6680)
Snuff Tax (Ad Velorem)	0.0019*** (0.0006)	0.0001*** (0.0000)	0.0016*** (0.0004)	-0.1900* (0.1117)	2.5938* (1.3023)	0.1291 (0.1027)	2.2621* (1.3116)
% Pop Under Bar Smoking Ban	0.0705 (0.0591)	0.0051 (0.0050)	0.0233 (0.0396)	-1.3160 (5.8579)	17.2253 (62.1232)	0.5067 (4.9862)	-4.0781 (66.4613)
Observations	349,779	349,779	349,779	349,779	349,779	349,779	349,779
Households	25,826	25,826	25,826	25,826	25,826	25,826	25,826
Mean Value: Dep Variable	11.738	0.949	11.959	488.2	5369.2	433.1	5499.7

Notes: The sample is restricted to household-month observations with a positive purchase for households who purchased cigarettes such that at least one purchase could be matched to cigarette characteristics. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table B3: Analysis of tobacco control policies and products (without household fixed effects and including state fixed effects)

	Cigarettes (count)		Smoking Cessation Products (count)		Chewing Tobacco (oz)		Snuff (oz)	
	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased
Cigarette Excise Tax (\$)	-0.03135*** (0.00754)	-27.54651*** (7.20450)	0.00572 (0.00573)	3.09031*** (0.96079)	-0.00745 (0.01495)	0.17320 (0.63749)	-0.00943 (0.00713)	-0.04497 (0.08745)
Chewing Tobacco Tax (Ad Velorem)	0.00011 (0.00015)	-0.09776 (0.14596)	0.00024* (0.00014)	-0.08021** (0.03846)	-0.00043 (0.00049)	-0.00803 (0.01372)	-0.00020 (0.00021)	-0.00107 (0.00364)
Snuff Tax (Ad Velorem)	0.00002 (0.00005)	0.21585*** (0.05206)	-0.00006 (0.00004)	0.01070 (0.01886)	0.00043*** (0.00015)	-0.00342 (0.00751)	0.00029*** (0.00009)	0.00158 (0.00138)
% Pop Under Bar Smoking Ban	-0.00478 (0.00477)	-4.12210 (4.18819)	-0.00396 (0.00585)	-1.55792 (2.53768)	-0.01486 (0.01103)	-0.44492 (0.44764)	-0.01587** (0.00713)	-0.30032** (0.12816)
Observations	1,307,350	1,307,350	244,291	244,291	69,383	69,383	244,389	244,389
Households	30,476	30,476	4,964	4,964	1,232	1,232	4,922	4,922
Mean Value: Dep Variable	0.297	144.272	0.076	11.973	0.104	4.115	0.104	1.271

Notes: Samples are restricted to households who purchased the product at least once throughout the sample period. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include state, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table B4: NHANES Cigarette characteristics among households purchasing matched cigarettes (without household fixed effects and including state fixed effects)

	Cigarette Characteristics			Total Estimated Monthly Consumption of:			
	Average Tar Content	Average Nicotine Content	Average CO Content	Cigarettes	Tar	Nicotine	Carbon Monoxide
Cigarette Excise Tax (\$)	0.09406 (0.09557)	0.00644 (0.00694)	0.03844 (0.06539)	-37.06831*** (11.67321)	-337.09235** (131.21446)	-28.38799** (10.58043)	-384.58495*** (131.90394)
Chewing Tobacco Tax (Ad Velorem)	0.00382** (0.00161)	0.00029** (0.00012)	0.00169 (0.00180)	-0.20613 (0.26601)	-3.02190 (3.44155)	-0.16511 (0.26672)	-5.03928 (3.32933)
Snuff Tax (Ad Velorem)	0.00146* (0.00084)	0.00010 (0.00006)	0.00115 (0.00075)	0.49141*** (0.10170)	8.36524*** (1.34658)	0.60072*** (0.10291)	8.84248*** (1.30514)
% Pop Under Bar Smoking Ban	-0.06091 (0.09333)	-0.00192 (0.00694)	-0.09122 (0.07079)	-1.21748 (11.34341)	-22.46718 (115.18349)	0.35432 (9.70756)	-37.06532 (122.85267)
Observations	349,779	349,779	349,779	349,779	349,779	349,779	349,779
Households	25,826	25,826	25,826	25,826	25,826	25,826	25,826
Mean Value: Dep Variable	11.738	0.949	11.959	488.2	5369.2	433.1	5499.7

Notes: The sample is restricted to household-month observations with a positive purchase for households who purchased cigarettes such that at least one purchase could be matched to cigarette characteristics. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include state, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table B5: Analysis of tobacco control policies and products (including NHCP sample weights)

	Cigarettes (count)		Smoking Cessation Products (count)		Chewing Tobacco (oz)		Snuff (oz)	
	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased
Cigarette Excise Tax (\$)	-0.02162*** (0.00589)	-20.15105*** (6.02630)	0.00952 (0.00571)	1.28426 (1.02271)	-0.01608 (0.01403)	-0.77943 (0.66034)	-0.00588 (0.00574)	0.00964 (0.10162)
Chewing Tobacco Tax (Ad Velorem)	0.00061*** (0.00014)	0.21703 (0.12952)	0.00013 (0.00024)	-0.06019* (0.03427)	0.00035 (0.00038)	-0.04259*** (0.01104)	0.00035 (0.00026)	0.00220 (0.00642)
Snuff Tax (Ad Velorem)	-0.00049*** (0.00005)	-0.20992*** (0.03459)	0.00011* (0.00006)	0.04044*** (0.01313)	-0.00020 (0.00014)	0.00783 (0.00742)	-0.00020** (0.00009)	0.00106 (0.00133)
% Pop Under Bar Smoking Ban	0.00755** (0.00369)	-1.89145 (3.40891)	0.00187 (0.00423)	-1.47687 (1.11495)	0.01680 (0.01497)	1.26398*** (0.41440)	-0.00277 (0.00701)	-0.01912 (0.11063)
Observations	1,307,350	1,307,350	244,291	244,291	69,383	69,383	244,389	244,389
Households	30,476	30,476	4,964	4,964	1,232	1,232	4,922	4,922
Mean Value: Dep Variable	0.297	144.272	0.076	11.973	0.104	4.115	0.104	1.271

Notes: Samples are restricted to households who purchased the product at least once throughout the sample period. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include state, year and month fixed-effects, as well as state-specific time trends. All models include NHCP sample weights, and robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table B6: NHANES Cigarette characteristics among households purchasing matched cigarettes (including NHCP sample weights)

	Cigarette Characteristics			Total Estimated Monthly Consumption of:			
	Average Tar Content	Average Nicotine Content	Average CO Content	Cigarettes	Tar	Nicotine	Carbon Monoxide
Cigarette Excise Tax (\$)	0.08306 (0.08267)	0.00512 (0.00598)	0.03052 (0.05052)	-41.16514*** (12.85267)	-457.83253*** (140.68508)	-37.04725*** (11.26930)	-481.33276*** (140.30423)
Chewing Tobacco Tax (Ad Velorem)	-0.00371* (0.00200)	-0.00029* (0.00015)	-0.00510*** (0.00151)	0.40972 (0.30551)	-4.75882 (4.40748)	-0.26321 (0.36572)	-4.11989 (4.63681)
Snuff Tax (Ad Velorem)	0.00140 (0.00101)	0.00010 (0.00008)	0.00270*** (0.00056)	-0.43219*** (0.10239)	1.81231 (1.47228)	0.01379 (0.11612)	1.85694 (1.37258)
% Pop Under Bar Smoking Ban	0.06422 (0.12342)	0.00600 (0.00959)	0.05173 (0.07067)	-13.89166 (8.60785)	-40.00405 (166.92129)	-3.02701 (13.65921)	-45.55885 (137.10402)
Observations	349,779	349,779	349,779	349,779	349,779	349,779	349,779
Households	25,826	25,826	25,826	25,826	25,826	25,826	25,826
Mean Value: Dep Variable	11.738	0.949	11.959	488.2	5369.2	433.1	5499.7

Notes: The sample is restricted to household-month observations with a positive purchase for households who purchased cigarettes such that at least one purchase could be matched to cigarette characteristics. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include state, year and month fixed-effects, as well as state-specific time trends. All models include NHCP sample weights, and robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

**APPENDIX C:
RESULTS - QUARTERLY LEADS AND LAGS**

Appendix Table C1: Analysis of tobacco control policies and products; quarterly leads and lags analysis

	Cigarettes (count)		Smoking Cessation Products (count)		Chewing Tobacco (oz)		Snuff (oz)	
	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased
	Cigarette Excise Tax (\$) (4Q-Lead)	0.00066 (0.00248)	-3.02069 (2.83297)	-0.00402 (0.00599)	-0.90413 (0.61707)	0.01629* (0.00834)	-0.21035 (0.47239)	0.00789 (0.00491)
Cigarette Excise Tax (\$) (3Q-Lead)	-0.00032 (0.00286)	-1.57504 (3.40378)	-0.00029 (0.00373)	1.01977 (0.81626)	-0.00885 (0.00848)	0.59109 (0.39693)	-0.00540 (0.00405)	-0.01209 (0.05418)
Cigarette Excise Tax (\$) (2Q-Lead)	-0.00375 (0.00445)	5.13736 (3.87423)	0.00127 (0.00495)	2.40511** (1.03128)	0.00248 (0.00787)	0.54912 (0.39078)	-0.00930* (0.00480)	-0.14410 (0.13142)
Cigarette Excise Tax (\$) (1Q-Lead)	-0.00612 (0.00489)	-1.52757 (4.35775)	-0.00427 (0.00552)	0.26482 (0.76381)	0.00365 (0.00661)	0.37656 (0.40819)	0.00524 (0.00462)	0.11923** (0.05202)
Cigarette Excise Tax (\$)	-0.02467*** (0.00571)	-32.62002*** (5.51011)	0.01981*** (0.00471)	0.89214 (1.19828)	-0.00448 (0.01041)	-0.87628 (0.55353)	0.00078 (0.00637)	0.01105 (0.09596)
Cigarette Excise Tax (\$) (1Q-Lag)	0.00171 (0.00237)	5.95613** (2.40002)	-0.01274** (0.00629)	-1.88731* (1.02721)	0.01120 (0.00934)	0.41165** (0.18046)	-0.00653 (0.00429)	0.05015 (0.07447)
Cigarette Excise Tax (\$) (2Q-Lag)	0.00246 (0.00176)	2.32770* (1.36892)	0.00035 (0.00590)	3.13585** (1.38901)	-0.02265*** (0.00662)	-0.08491 (0.25045)	0.00570 (0.00406)	-0.09069 (0.05881)
Cigarette Excise Tax (\$) (3Q-Lag)	-0.00086 (0.00250)	1.69662 (2.00771)	-0.00992** (0.00447)	-1.89577 (1.15423)	0.00953 (0.00681)	0.33523 (0.25057)	-0.00506 (0.00436)	-0.04766 (0.07600)
Cigarette Excise Tax (\$) (4Q-Lag)	-0.00444 (0.00300)	-2.54051 (3.56518)	0.01054** (0.00495)	1.77778* (0.97398)	-0.00082 (0.00681)	-0.10414 (0.38913)	-0.00229 (0.00300)	0.04739 (0.05761)
Chewing Tobacco Tax (Ad Velorem)	0.00040*** (0.00010)	0.12123 (0.08602)	0.00027 (0.00020)	-0.16800*** (0.03724)	-0.00036 (0.00037)	-0.03108 (0.02930)	0.00052*** (0.00012)	0.00662* (0.00337)
Snuff Tax (Ad Velorem)	-0.00031*** (0.00004)	-0.09467** (0.03841)	-0.00001 (0.00005)	0.06014*** (0.01303)	0.00027*** (0.00008)	0.00485 (0.00716)	-0.00023*** (0.00005)	-0.00271** (0.00103)
% Pop Under Bar Smoking Ban	-0.00363 (0.00325)	-5.58620 (3.39444)	-0.00550 (0.00377)	-1.08783 (1.18332)	-0.00553 (0.01667)	0.58833 (0.38945)	-0.00157 (0.00596)	0.00541 (0.04194)
Observations	1,063,627	1,063,627	199,992	199,992	55,905	55,905	199,355	199,355
Households	28,021	28,021	4,690	4,690	1,161	1,161	4,633	4,633
Mean Value: Dep Variable	0.296	143.447	0.075	12.163	0.102	4.095	0.104	1.245

Notes: Samples are restricted to households who purchased any tobacco product at least once throughout the sample period. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table C2: NHANES Cigarette characteristics among households purchasing matched cigarettes; quarterly leads and lags analysis

	Cigarette Characteristics			Total Estimated Monthly Consumption of:			
	Average Tar Content	Average Nicotine Content	Average CO Content	Cigarettes	Tar	Nicotine	Carbon Monoxide
Cigarette Excise Tax (\$) (4Q-Lead)	0.01101 (0.02932)	-0.00018 (0.00242)	0.01944 (0.01941)	-15.60150* (7.82592)	-221.82340*** (75.80300)	-17.44239*** (6.36329)	-237.51782*** (85.67939)
Cigarette Excise Tax (\$) (3Q-Lead)	0.03446 (0.03447)	0.00203 (0.00195)	0.03799 (0.03235)	-2.96150 (8.31201)	16.49904 (106.78994)	0.34427 (8.76720)	31.71963 (104.92927)
Cigarette Excise Tax (\$) (2Q-Lead)	-0.02132 (0.02990)	-0.00082 (0.00190)	-0.02348 (0.02823)	10.76942 (10.26126)	51.12103 (136.21527)	4.71778 (10.66926)	52.88813 (134.46077)
Cigarette Excise Tax (\$) (1Q-Lead)	-0.01283 (0.02487)	-0.00002 (0.00197)	-0.00138 (0.02052)	3.54213 (9.09094)	53.29202 (84.35242)	5.36969 (7.19385)	29.94382 (85.50114)
Cigarette Excise Tax (\$)	0.07506** (0.03644)	0.00446 (0.00306)	0.05057** (0.02206)	-67.50575*** (10.22320)	-718.07687*** (116.53709)	-60.09233*** (9.44205)	-726.82115*** (118.23026)
Cigarette Excise Tax (\$) (1Q-Lag)	0.01399 (0.01994)	0.00183 (0.00150)	0.02398 (0.01603)	15.12427** (6.32940)	162.92752** (69.08952)	14.44427** (5.70134)	162.14870** (77.00827)
Cigarette Excise Tax (\$) (2Q-Lag)	-0.00353 (0.02853)	0.00011 (0.00157)	-0.03132 (0.01950)	1.95479 (5.55755)	3.43946 (55.49572)	0.50165 (4.47272)	-11.93735 (63.95597)
Cigarette Excise Tax (\$) (3Q-Lag)	0.01599 (0.02474)	0.00003 (0.00212)	-0.00567 (0.02481)	6.45911 (7.26122)	69.06111 (72.02544)	4.86952 (5.80387)	55.96558 (72.65535)
Cigarette Excise Tax (\$) (4Q-Lag)	0.06798** (0.02986)	0.00702** (0.00266)	0.00900 (0.03089)	2.23662 (11.51456)	78.51074 (118.52341)	5.84091 (9.15126)	59.44711 (128.67903)
Chewing Tobacco Tax (Ad Velorem)	-0.00183 (0.00179)	-0.00019 (0.00015)	-0.00150 (0.00144)	0.19976 (0.23322)	-2.27729 (2.96922)	-0.12848 (0.22936)	-1.74435 (3.16638)
Snuff Tax (Ad Velorem)	0.00252*** (0.00056)	0.00022*** (0.00005)	0.00153*** (0.00035)	-0.06283 (0.10325)	4.54435*** (1.34080)	0.27618** (0.10535)	3.95833*** (1.41777)
% Pop Under Bar Smoking Ban	0.02723 (0.07399)	0.00415 (0.00672)	-0.03796 (0.04344)	-12.76603** (5.52062)	-71.46525 (90.89505)	-5.34852 (7.63259)	-103.74346 (80.41743)
Observations	284,670	284,670	284,670	284,670	284,670	284,670	284,670
Households	22,471	22,471	22,471	22,471	22,471	22,471	22,471
Mean Value: Dep Variable	11.708	0.947	11.944	487.6	5356.0	432.2	5491.3

Notes: The sample is restricted to household-month observations with a positive purchase for households who purchased cigarettes such that at least one purchase could be matched to cigarette characteristics. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

**APPENDIX D:
RESULTS - BOOTLEGGING ANALYSIS**

Appendix Table D1: Analysis of tobacco control policies and products; bootlegging analysis

	Cigarettes (count)		Smoking Cessation Products (count)		Chewing Tobacco (oz)		Snuff (oz)	
	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased
Cigarette Excise Tax (\$)	-0.03308*** (0.00633)	-31.41303*** (7.08404)	0.00437 (0.00600)	2.34537* (1.26457)	-0.03124* (0.01563)	-0.58999 (0.59257)	-0.00374 (0.00515)	-0.13367 (0.09632)
Chewing Tobacco Tax (Ad Velorem)	0.00025** (0.00011)	0.14001 (0.10829)	0.00016 (0.00014)	-0.09550*** (0.02185)	-0.00085*** (0.00028)	-0.03283 (0.02130)	0.00010 (0.00018)	0.00233 (0.00277)
Snuff Tax (Ad Velorem)	-0.00024*** (0.00004)	-0.08100* (0.04737)	0.00005 (0.00005)	0.04067*** (0.00864)	0.00056*** (0.00011)	0.00923 (0.00699)	-0.00013** (0.00006)	-0.00108 (0.00082)
% Pop Under Bar Smoking Ban	-0.00042 (0.00237)	-2.09107 (2.51096)	-0.00336 (0.00384)	-1.50068 (1.05022)	-0.00065 (0.00550)	0.30326* (0.15886)	0.00066 (0.00354)	0.00291 (0.03865)
Tax Difference	0.00088 (0.02014)	20.60534 (19.25355)	-0.02514 (0.01719)	-4.50251 (8.09458)	0.01252 (0.05764)	-4.55758* (2.38147)	-0.04702* (0.02554)	-0.28759 (0.40019)
Ln (Distance)	-0.00092 (0.00116)	-0.35638 (1.44366)	-0.00177 (0.00141)	-0.12134 (0.47737)	-0.00312 (0.00450)	-0.13181 (0.15877)	-0.00141 (0.00133)	-0.10533*** (0.02976)
Interaction (Tax Diff * lnDist)	0.00276 (0.00431)	-1.84250 (4.08855)	0.00594 (0.00394)	0.59242 (1.54594)	0.00463 (0.01236)	1.23913** (0.57807)	0.01042* (0.00526)	0.09983 (0.07770)
Observations	1,307,350	1,307,350	244,291	244,291	69,383	69,383	244,389	244,389
Households	30,476	30,476	4,964	4,964	1,232	1,232	4,922	4,922
Mean Value: Dep Variable	0.297	144.272	0.076	11.973	0.104	4.115	0.104	1.271

Notes: Samples are restricted to households who purchased any tobacco product at least once throughout the sample period. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table D2: NHANES Cigarette characteristics among households purchasing matched cigarettes; bootlegging analysis

	Cigarette Characteristics			Total Estimated Monthly Consumption of:			
	Average Tar Content	Average Nicotine Content	Average CO Content	Cigarettes	Tar	Nicotine	Carbon Monoxide
Cigarette Excise Tax (\$)	0.16648*** (0.05817)	0.01084** (0.00447)	0.11862*** (0.04142)	-49.51722*** (15.14479)	-485.63575*** (159.45201)	-41.26710*** (12.99403)	-557.31460*** (167.18974)
Chewing Tobacco Tax (Ad Velorem)	-0.00011 (0.00158)	-0.00001 (0.00015)	-0.00146 (0.00087)	0.46871** (0.20569)	0.35023 (2.41500)	0.11408 (0.18335)	0.30937 (2.47073)
Snuff Tax (Ad Velorem)	0.00075 (0.00056)	0.00008* (0.00005)	0.00090** (0.00037)	-0.23230** (0.09816)	1.74825 (1.20673)	0.05881 (0.09591)	1.63670 (1.19637)
% Pop Under Bar Smoking Ban	0.02105 (0.05201)	0.00302 (0.00470)	-0.03515 (0.03038)	-6.63350* (3.44616)	-25.35139 (50.94855)	-1.70931 (4.49624)	-51.25894 (43.06556)
Tax Difference	0.12534 (0.28924)	0.01204 (0.01792)	-0.08494 (0.22747)	68.84154* (35.61039)	892.19109* (517.26279)	82.17083** (39.32353)	896.87596 (571.89452)
Ln (Distance)	0.01770 (0.03793)	0.00096 (0.00292)	0.01027 (0.03484)	0.26546 (4.03775)	-18.27734 (71.82553)	-1.70661 (5.71753)	-24.92030 (70.50302)
Interaction (Tax Diff * LnDist)	-0.04942 (0.05870)	-0.00385 (0.00357)	0.00122 (0.04657)	-13.42984* (7.55371)	-202.64419* (111.32262)	-18.11596** (8.56090)	-187.91462 (120.95595)
Observations	349,779	349,779	349,779	349,779	349,779	349,779	349,779
Households	25,826	25,826	25,826	25,826	25,826	25,826	25,826
Mean Value: Dep Variable	11.738	0.949	11.959	488.2	5369.2	433.1	5499.7

Notes: The sample is restricted to household-month observations with a positive purchase for households who purchased cigarettes such that at least one purchase could be matched to cigarette characteristics. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

**APPENDIX E:
NHANES RESULTS AMONG HOUSEHOLDS ONLY
PURCHASING MATCHED CIGARETTES**

Appendix Table E1: NHANES Cigarette characteristics among households only purchasing matched cigarettes (excluding zero purchases)

	Cigarette Characteristics			Total Estimated Monthly Consumption of:			
	Average Tar Content	Average Nicotine Content	Average CO Content	Cigarettes	Tar	Nicotine	Carbon Monoxide
Cigarette Excise Tax (\$)	0.0681 (0.0412)	0.0042 (0.0036)	0.0569* (0.0333)	-37.4715*** (10.9160)	-409.8395*** (136.2838)	-34.6425*** (10.6007)	-422.4547*** (139.1670)
Chewing Tobacco Tax (Ad Velorem)	0.0018 (0.0015)	0.0000 (0.0001)	0.0031*** (0.0009)	0.5756* (0.3092)	5.5849 (3.7719)	0.3589 (0.2809)	8.1454* (4.2448)
Snuff Tax (Ad Velorem)	-0.0024*** (0.0005)	-0.0001 (0.0000)	-0.0029*** (0.0003)	-0.3624*** (0.1067)	-2.5072* (1.3592)	-0.1443 (0.1051)	-4.1504*** (1.4119)
% Pop Under Bar Smoking Ban	0.0276 (0.0520)	0.0021 (0.0043)	-0.0123 (0.0303)	-4.9794 (3.4720)	-44.2674 (49.4364)	-3.7664 (3.8436)	-51.2376 (47.8041)
Observations	207,335	207,335	207,335	207,335	207,335	207,335	207,335
Households	18,761	18,761	18,761	18,761	18,761	18,761	18,761
Mean Value: Dep Variable	11.699	0.949	11.917	427.3	4891.1	396.5	5005.5

Notes: The sample is restricted to household-month observations with a positive purchase for households who purchased cigarettes such that all purchases could be matched to cigarette characteristics. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table E2: NHANES Cigarette characteristics among households only purchasing matched cigarettes (including zero purchases)

	Total Estimated Monthly Consumption of:			
	Cigarettes	Tar	Nicotine	Carbon Monoxide
Cigarette Excise Tax (\$)	-21.39289*** (4.66837)	-204.04976*** (52.49740)	-17.17530*** (4.12619)	-213.58819*** (53.57026)
Chewing Tobacco Tax (Ad Velorem)	0.11468 (0.12835)	0.83654 (1.47723)	0.04034 (0.11251)	1.18484 (1.54293)
Snuff Tax (Ad Velorem)	-0.06420 (0.04094)	-0.37845 (0.50800)	-0.01469 (0.03928)	-0.68416 (0.53035)
% Pop Under Bar Smoking Ban	2.01062 (2.15453)	17.44431 (20.42088)	1.38345 (1.58948)	18.48871 (22.56039)
Observations	767,663	767,663	767,663	767,663
Households	19,920	19,920	19,920	19,920
Mean Value: Dep Variable	117.9	1321.0	107.1	1351.9

Notes: The sample is restricted to household-month observations for households who purchased cigarettes such that all purchases could be matched to cigarette characteristics. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

**APPENDIX F:
ANALYSIS OF HETEROGENEITY IN RESPONSES**

Appendix Table F1: Analysis of tobacco control policies and products: Occasional and pack-a-day smokers

	Cigarettes (count)		Smoking Cessation Products (count)		Chewing Tobacco (oz)		Snuff (oz)	
	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased
Occasional Smokers								
Cigarette Excise Tax (\$)	-0.0215*** (0.0045)	-13.6571*** (2.7560)	0.0006 (0.0011)	0.1852 (0.1438)	-0.0005* (0.0003)	-0.0053 (0.0163)	-0.0006 (0.0009)	0.0069 (0.0111)
Chewing Tobacco Tax (Ad Velorem)	0.0003*** (0.0001)	0.1079 (0.0711)	0.0001* (0.0000)	-0.0067 (0.0069)	-0.0000** (0.0000)	-0.0018 (0.0012)	0.0000 (0.0000)	0.0007* (0.0003)
Snuff Tax (Ad Velorem)	-0.0004*** (0.0000)	-0.0860*** (0.0169)	-0.0000*** (0.0000)	0.0016 (0.0016)	0.0000*** (0.0000)	0.0005** (0.0002)	-0.0000*** (0.0000)	-0.0003*** (0.0001)
% Pop Under Bar Smoking Ban	0.0010 (0.0021)	0.7661 (1.1094)	-0.0005 (0.0005)	-0.2642 (0.1649)	0.0001 (0.0002)	0.0216* (0.0111)	0.0004 (0.0006)	0.0019 (0.0098)
Observations	1,101,482	1,101,482	1,101,482	1,101,482	1,101,482	1,101,482	1,101,482	1,101,482
Households	25,115	25,115	25,115	25,115	25,115	25,115	25,115	25,115
Mean Value: Dep Variable	0.196	43.864	0.010	1.151	0.002	0.076	0.010	0.126
Pack-a-Day Smokers								
Cigarette Excise Tax (\$)	-0.0325** (0.0152)	-84.0007* (42.0881)	0.0019 (0.0021)	0.0378 (0.1318)	0.0007 (0.0011)	0.0282 (0.0806)	0.0004 (0.0028)	0.0265 (0.0279)
Chewing Tobacco Tax (Ad Velorem)	0.0004 (0.0003)	0.5846 (0.8831)	-0.0000 (0.0001)	-0.0077 (0.0048)	-0.0000 (0.0000)	-0.0026* (0.0014)	0.0001 (0.0001)	0.0013 (0.0012)
Snuff Tax (Ad Velorem)	0.0001 (0.0001)	0.2609 (0.2778)	0.0001** (0.0000)	0.0087*** (0.0014)	0.0000* (0.0000)	0.0012*** (0.0004)	-0.0000 (0.0000)	-0.0001 (0.0005)
% Pop Under Bar Smoking Ban	-0.0006 (0.0151)	-37.4973 (30.9613)	-0.0016 (0.0031)	-0.2287 (0.1890)	0.0018* (0.0010)	0.2034** (0.0962)	0.0002 (0.0031)	-0.0597 (0.0421)
Observations	87,529	87,529	87,529	87,529	87,529	87,529	87,529	87,529
Households	2,297	2,297	2,297	2,297	2,297	2,297	2,297	2,297
Mean Value: Dep Variable	0.914	1011.621	0.010	0.760	0.004	0.308	0.014	0.200

Notes: Samples are restricted to households meeting the criteria of occasional smokers (300 cigarettes or fewer purchased per month) or pack-a-day smokers (600 or more cigarettes purchased per month). All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table F2: Analysis of tobacco control policies and products by income

	Cigarettes (count)		Smoking Cessation Products (count)		Chewing Tobacco (oz)		Snuff (oz)	
	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased
Income < \$30,000								
Cigarette Excise Tax (\$)	-0.03253*** (0.00836)	-13.6571*** (2.7560)	-0.00715 (0.00756)	0.1852 (0.1438)	-0.02608 (0.01688)	-0.0053 (0.0163)	0.00419 (0.00665)	0.0069 (0.0111)
Chewing Tobacco Tax (Ad Velorem)	0.00067*** (0.00014)	0.1079 (0.0711)	-0.00035 (0.00024)	-0.0067 (0.0069)	-0.00009 (0.00065)	-0.0018 (0.0012)	0.00041 (0.00030)	0.0007* (0.0003)
Snuff Tax (Ad Velorem)	-0.00040*** (0.00006)	-0.0860*** (0.0169)	0.00059*** (0.00009)	0.0016 (0.0016)	0.00066** (0.00025)	0.0005** (0.0002)	-0.00072*** (0.00011)	-0.0003*** (0.0001)
% Pop Under Bar Smoking Ban	0.00219 (0.00572)	0.7661 (1.1094)	-0.00479 (0.00866)	-0.2642 (0.1649)	-0.01061 (0.03228)	0.0216* (0.0111)	0.01444 (0.00959)	0.0019 (0.0098)
Observations	378,566	378,566	59,635	59,635	17,246	17,246	66,127	66,127
Households	11,245	11,245	1,640	1,640	436	436	1,712	1,712
Mean Value: Dep Variable	0.341	163.986	0.059	7.675	0.124	5.418	0.066	1.126
Income > \$30,000								
Cigarette Excise Tax (\$)	-0.02358*** (0.00520)	-22.37773*** (5.91013)	0.00859 (0.00731)	1.37612** (0.67093)	-0.00339 (0.01020)	-0.60835 (0.58112)	-0.00638 (0.00401)	-0.00614 (0.07658)
Chewing Tobacco Tax (Ad Velorem)	0.00017 (0.00012)	0.20523 (0.12343)	0.00045*** (0.00013)	-0.03752 (0.02273)	-0.00070* (0.00036)	-0.03003 (0.02092)	0.00019 (0.00018)	0.00243 (0.00340)
Snuff Tax (Ad Velorem)	-0.00018*** (0.00005)	-0.15400*** (0.04328)	-0.00015*** (0.00006)	0.00332 (0.01062)	0.00030*** (0.00010)	0.01056 (0.00651)	-0.00014*** (0.00004)	-0.00117 (0.00080)
% Pop Under Bar Smoking Ban	-0.00041 (0.00216)	-0.25242 (2.14646)	-0.00069 (0.00534)	-0.79783 (1.57100)	-0.00136 (0.00495)	0.32406 (0.23807)	-0.00126 (0.00316)	-0.05881 (0.06062)
Observations	933,870	933,870	186,311	186,311	52,439	52,439	179,052	179,052
Households	23,521	23,521	4,119	4,119	1,011	1,011	3,985	3,985
Mean Value: Dep Variable	0.280	136.559	0.081	13.295	0.097	3.680	0.104	1.285

Notes: Samples are restricted to households meeting the stated income criteria. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table F3: Analysis of tobacco control policies and products by age group

	Cigarettes (count)		Smoking Cessation Products (count)		Chewing Tobacco (oz)		Snuff (oz)	
	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased
Age 25 - 54								
Cigarette Excise Tax (\$)	-0.02518*** (0.00719)	-20.46212*** (7.05335)	0.00417 (0.00394)	0.21108 (1.01425)	-0.00740 (0.00943)	-0.81820 (0.77871)	-0.00707 (0.00738)	0.04765 (0.13490)
Chewing Tobacco Tax (Ad Velorem)	0.00048*** (0.00014)	0.34693** (0.15406)	0.00041** (0.00019)	-0.05657** (0.02519)	-0.00140*** (0.00048)	-0.05051*** (0.01199)	0.00016 (0.00021)	0.00613 (0.00421)
Snuff Tax (Ad Velorem)	-0.00034*** (0.00005)	-0.15780*** (0.04936)	-0.00028*** (0.00007)	-0.01762 (0.01338)	0.00152*** (0.00013)	0.02941*** (0.00696)	-0.00010 (0.00007)	-0.00100 (0.00107)
% Pop Under Bar Smoking Ban	0.00320 (0.00305)	-2.37852 (3.34789)	-0.00070 (0.00491)	-0.26924 (1.45535)	-0.00382 (0.00720)	0.11839* (0.06578)	0.00354 (0.00343)	-0.00717 (0.06656)
Observations	727,712	727,712	134,609	134,609	32,728	32,728	137,272	137,272
Households	11,245	11,245	3,399	3,399	755	755	3,512	3,512
Mean Value: Dep Variable	0.321	146.181	0.072	10.735	0.092	3.276	0.065	1.210
Age 55+								
Cigarette Excise Tax (\$)	-0.02618*** (0.00633)	-28.74083*** (6.77124)	0.00669 (0.00885)	2.47014** (1.00031)	-0.01480 (0.01193)	-0.18718 (0.70731)	-0.00498 (0.00603)	0.05600 (0.07852)
Chewing Tobacco Tax (Ad Velorem)	0.00019* (0.00012)	0.16427 (0.12425)	-0.00014 (0.00016)	-0.13438*** (0.02139)	-0.00056 (0.00038)	-0.02398 (0.03501)	0.00016 (0.00024)	0.00444 (0.00330)
Snuff Tax (Ad Velorem)	-0.00033*** (0.00005)	-0.23764*** (0.05430)	0.00033*** (0.00008)	0.09669*** (0.01010)	-0.00008 (0.00015)	-0.00663 (0.00950)	-0.00014* (0.00007)	-0.00255** (0.00119)
% Pop Under Bar Smoking Ban	-0.00389 (0.00373)	-1.56815 (2.82759)	-0.00547 (0.00699)	-2.15468** (0.90460)	0.00929 (0.01685)	0.94526 (0.59881)	-0.00572 (0.00611)	-0.09124 (0.09604)
Observations	718,191	718,191	138,545	138,545	43,225	43,225	132,469	132,469
Households	15,699	15,699	2,805	2,805	804	804	2,520	2,520
Mean Value: Dep Variable	0.278	148.448	0.080	13.581	0.118	5.086	0.079	0.970

Notes: Samples are restricted to households meeting the criteria of age 25-54. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table F4: Analysis of tobacco control policies and products by region

	Cigarettes (count)		Smoking Cessation Products (count)		Chewing Tobacco (oz)		Snuff (oz)	
	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased
Northeast								
Cigarette Excise Tax (\$)	-0.00642 (0.00427)	-0.79465 (2.00051)	-0.00798 (0.00499)	1.25403 (1.51907)	-0.03146*** (0.00836)	-1.01789*** (0.18571)	0.00083 (0.00694)	-0.21330** (0.07041)
Chewing Tobacco Tax (Ad Velorem)	0.00099*** (0.00025)	1.07051*** (0.19067)	-0.00071** (0.00021)	-0.12562 (0.07155)	-0.00030 (0.00020)	-0.01923 (0.01076)	0.00041 (0.00070)	0.01754*** (0.00420)
Snuff Tax (Ad Velorem)	-	-	-	-	-	-	-	-
% Pop Under Bar Smoking Ban	0.00196 (0.00824)	10.15242* (4.95386)	-0.00210 (0.00994)	-3.22515 (3.09873)	0.01127 (0.02961)	-1.35591*** (0.36026)	0.00188 (0.00792)	-0.10081 (0.08119)
Observations	160,579	160,579	28,763	28,763	5,430	5,430	26,679	26,679
Households	4,144	4,144	678	678	114	114	582	582
Mean Value: Dep Variable	0.297	135.896	0.064	7.596	0.090	2.522	0.099	1.128
South								
Cigarette Excise Tax (\$)	-0.03554*** (0.00528)	-33.34270*** (6.68731)	0.01386** (0.00628)	0.85195 (0.67873)	-0.00495 (0.01704)	-0.20874 (0.85248)	-0.00875* (0.00488)	0.06089 (0.08093)
Chewing Tobacco Tax (Ad Velorem)	0.00004 (0.00012)	0.12917 (0.13125)	0.00017 (0.00011)	-0.02841 (0.02190)	0.00005 (0.00031)	-0.03557 (0.02835)	-0.00011 (0.00021)	0.00119 (0.00311)
Snuff Tax (Ad Velorem)	-	-	-	-	-	-	-	-
% Pop Under Bar Smoking Ban	0.00348 (0.00200)	1.75495 (1.63986)	-0.02012** (0.00855)	-0.91894 (1.14810)	0.00144 (0.00557)	0.18023 (0.10699)	-0.00059 (0.00191)	-0.09406 (0.07233)
Observations	531,963	531,963	95,703	95,703	37,301	37,301	112,658	112,658
Households	12,916	12,916	2,049	2,049	701	701	2,370	2,370
Mean Value: Dep Variable	0.312	160.729	0.076	11.950	0.139	6.029	0.118	1.561
Midwest								
Cigarette Excise Tax (\$)	-0.02611*** (0.00425)	-26.35404*** (5.11481)	0.00012 (0.00711)	-0.43265 (1.13126)	-0.00462 (0.01140)	0.00674 (0.33796)	0.00439 (0.00661)	-0.02224 (0.14633)
Chewing Tobacco Tax (Ad Velorem)	0.00048 (0.00030)	0.46852 (0.35480)	0.00057** (0.00024)	-0.00143 (0.04555)	-0.00204** (0.00074)	-0.02093** (0.00911)	0.00005 (0.00020)	-0.00115 (0.00365)
Snuff Tax (Ad Velorem)	-0.00031*** (0.00004)	-0.15560** (0.05782)	0.00002 (0.00007)	0.02992*** (0.00905)	0.00056** (0.00018)	0.00741 (0.00657)	-0.00025** (0.00010)	-0.00170 (0.00122)
% Pop Under Bar Smoking Ban	-0.00639 (0.00373)	-7.32277** (2.71308)	0.00300 (0.00302)	-1.51002 (1.18183)	-0.00515 (0.01059)	0.66108 (0.64177)	-0.00204 (0.00924)	0.00571 (0.04363)
Observations	407,142	407,142	79,575	79,575	16,094	16,094	71,780	71,780
Households	9,053	9,053	1,513	1,513	263	263	1,378	1,378
Mean Value: Dep Variable	0.285	132.631	0.070	10.810	0.073	2.832	0.096	1.075
West								
Cigarette Excise Tax (\$)	0.02475** (0.01038)	12.23534 (16.52014)	0.01324 (0.00850)	3.70369* (1.78496)	0.02128 (0.03483)	-0.39680 (0.68148)	-0.02768** (0.00922)	-0.05311 (0.14048)
Chewing Tobacco Tax (Ad Velorem)	-0.00071 (0.00045)	-1.19300* (0.54689)	-0.00056 (0.00034)	-0.11062** (0.04284)	-0.00144 (0.00157)	0.02931** (0.00985)	0.00092*** (0.00024)	-0.00738 (0.00909)
Snuff Tax (Ad Velorem)	-	-	-	-	-	-	-	-
% Pop Under Bar Smoking Ban	0.00042 (0.01731)	-3.17301 (17.26585)	-0.00518 (0.00639)	-3.57798*** (0.95392)	0.02380 (0.01708)	0.62459 (0.43107)	0.00736 (0.01440)	0.18726 (0.17145)
Observations	237,126	237,126	46,154	46,154	12,163	12,163	37,927	37,927
Households	5,279	5,279	907	907	197	197	731	731
Mean Value: Dep Variable	0.283	130.809	0.093	16.374	0.040	0.507	0.080	0.868

Notes: Samples are restricted to households meeting the criteria by region of household location. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table F5: Analysis of tobacco control policies and products by state smoking prevalence

	Cigarettes (count)		Smoking Cessation Products (count)		Chewing Tobacco (oz)		Snuff (oz)	
	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased
	Smoking Prevalence >= 20% (2013)							
Cigarette Excise Tax (\$)	-0.02888*** (0.00557)	-26.72059*** (6.00159)	-0.00230 (0.00684)	0.42029 (1.64969)	-0.02934* (0.01527)	-0.04524 (1.64578)	0.00578 (0.00655)	0.04079 (0.21725)
Chewing Tobacco Tax (Ad Velorem)	0.00028* (0.00016)	0.19561 (0.23479)	0.00024 (0.00044)	-0.13118* (0.07334)	0.00091 (0.00054)	-0.15737*** (0.02635)	-0.00148** (0.00053)	-0.00355 (0.01021)
Snuff Tax (Ad Velorem)	-	-	-	-	-	-	-	-
% Pop Under Bar Smoking Ban	-0.00172 (0.00280)	-2.65492 (3.07373)	-0.00887 (0.00671)	-1.66534 (1.68578)	-0.00123 (0.00632)	0.34433* (0.18757)	-0.00129 (0.00392)	-0.03226 (0.05414)
Observations	561,468	561,468	103,261	103,261	34,309	34,309	117,351	117,351
Households	12,971	12,971	2,046	2,046	610	610	2,321	2,321
Mean Value: Dep Variable	0.308	149.888	0.313	164.225	0.139	5.693	0.119	1.510
Smoking Prevalence < 20% (2013)								
Cigarette Excise Tax (\$)	-0.02537*** (0.00755)	-23.77614*** (8.03250)	0.00599 (0.00664)	1.22384** (0.48417)	-0.00504 (0.00998)	-0.22580 (0.27502)	-0.00766* (0.00377)	0.00785 (0.08626)
Chewing Tobacco Tax (Ad Velorem)	0.00014 (0.00016)	0.00516 (0.14545)	0.00021 (0.00016)	-0.06627** (0.02818)	-0.00138*** (0.00031)	-0.01847** (0.00787)	0.00026 (0.00016)	0.00143 (0.00228)
Snuff Tax (Ad Velorem)	-0.00024*** (0.00007)	-0.06605 (0.06533)	0.00003 (0.00006)	0.04729*** (0.01464)	0.00062*** (0.00011)	0.00479 (0.00502)	-0.00007 (0.00005)	-0.00017 (0.00094)
% Pop Under Bar Smoking Ban	0.00330 (0.00631)	-0.01942 (5.31366)	0.00206 (0.00357)	-0.60473 (1.31486)	0.00885 (0.01444)	-0.01909 (0.52965)	0.00562 (0.00571)	0.05892 (0.05233)
Observations	769,725	769,725	146,878	146,878	36,161	36,161	131,267	131,267
Households	18,247	18,247	3,102	3,102	652	652	2,729	2,729
Mean Value: Dep Variable	0.290	140.350	0.077	12.573	0.070	2.653	0.088	1.032

Notes: Samples are restricted to households residing in a state with the stated smoking prevalence. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table F6: Analysis of tobacco control policies and products by change in state smoking prevalence

	Cigarettes (count)		Smoking Cessation Products (count)		Chewing Tobacco (oz)		Snuff (oz)	
	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased	Any Purchase	Quantity Purchased
	Smoking Prevalence Change < 3 Percentage Points (1993- 2013)							
Cigarette Excise Tax (\$)	-0.02268*** (0.00688)	-23.45361*** (6.69049)	-0.00386 (0.00859)	0.69713 (2.11580)	-0.03844** (0.01778)	-0.71322 (2.00525)	0.00720 (0.00874)	0.09232 (0.25501)
Chewing Tobacco Tax (Ad Velorem)	-0.00005 (0.00015)	-0.14724 (0.18002)	0.00009 (0.00049)	-0.14347** (0.06628)	0.00086 (0.00063)	-0.15315*** (0.04076)	-0.00142*** (0.00046)	-0.00969 (0.00859)
Snuff Tax (Ad Velorem)	-	-	-	-	-	-	-	-
% Pop Under Bar Smoking Ban	-0.00148 (0.00286)	-1.43756 (2.69623)	-0.00234 (0.01316)	-1.49805 (1.96759)	0.00265 (0.00347)	0.27684* (0.13176)	0.00324 (0.00336)	0.05122 (0.06915)
Observations	373,116	373,116	67,394	67,394	20,161	20,161	80,346	80,346
Households	8,649	8,649	1,346	1,346	350	350	1,630	1,630
Mean Value: Dep Variable	0.315	152.742	0.076	12.269	0.128	5.378	0.131	1.663
Smoking Prevalence Change >= 3 Percentage Points (1993- 2013)								
Cigarette Excise Tax (\$)	-0.02657*** (0.00616)	-24.57077*** (6.93981)	0.00701 (0.00670)	1.45796*** (0.45502)	-0.00178 (0.01201)	-0.11442 (0.35344)	-0.00474 (0.00288)	0.01753 (0.06758)
Chewing Tobacco Tax (Ad Velorem)	0.00021 (0.00013)	0.10041 (0.12835)	0.00021 (0.00015)	-0.09046*** (0.02422)	-0.00096** (0.00038)	-0.01886** (0.00786)	0.00031*** (0.00011)	0.00302 (0.00255)
Snuff Tax (Ad Velorem)	-0.00026*** (0.00005)	-0.09236* (0.05221)	-0.00000 (0.00005)	0.04195*** (0.01031)	0.00042*** (0.00013)	0.00527 (0.00367)	-0.00015** (0.00006)	-0.00106 (0.00071)
% Pop Under Bar Smoking Ban	0.00220 (0.00437)	-1.65716 (3.72755)	-0.00261 (0.00354)	-1.29733 (1.23777)	-0.01512 (0.01700)	0.24412 (0.38780)	-0.00231 (0.00668)	-0.07807 (0.06722)
Observations	953,694	953,694	181,606	181,606	49,951	49,951	168,307	168,307
Households	22,450	22,450	3,767	3,767	903	903	3,411	3,411
Mean Value: Dep Variable	0.291	141.009	0.075	11.655	0.094	3.681	0.090	1.085

Notes: Samples are restricted to households residing in a state with the stated change in smoking prevalence. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include household, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table F7: NHANES Cigarette characteristics among households purchasing matched cigarettes by income

	Cigarette Characteristics			Total Estimated Monthly Consumption of:			
	Average Tar Content	Average Nicotine Content	Average CO Content	Cigarettes	Tar	Nicotine	Carbon Monoxide
Income < \$30,000							
Cigarette Excise Tax (\$)	0.01407 (0.05187)	0.00219 (0.00391)	-0.01406 (0.05126)	-43.65473*** (11.44748)	-510.71688*** (159.40708)	-39.56587*** (13.17200)	-530.40346*** (170.76954)
Chewing Tobacco Tax (Ad Velorem)	-0.00029 (0.00238)	-0.00000 (0.00030)	-0.00387** (0.00163)	0.36366 (0.33980)	-2.93800 (4.18010)	0.06729 (0.33581)	-5.39615 (3.80888)
Snuff Tax (Ad Velorem)	0.00267*** (0.00074)	0.00018** (0.00007)	0.00373*** (0.00056)	-0.20427 (0.12548)	5.29617*** (1.50823)	0.15970 (0.11862)	5.65578*** (1.60103)
% Pop Under Bar Smoking Ban	-0.02531 (0.03603)	-0.00072 (0.00338)	-0.04367 (0.03983)	-17.28147 (10.37114)	-202.22397 (124.39343)	-16.11148 (9.69964)	-197.87208 (128.06222)
Observations	114,171	114,171	114,171	114,171	114,171	114,171	114,171
Households	8,882	8,882	8,882	8,882	8,882	8,882	8,882
Mean Value: Dep Variable	12.271	0.985	12.377	481.6	5417.2	433.5	5502.1
Income > \$30,000							
Cigarette Excise Tax (\$)	0.11626** (0.04508)	0.00903*** (0.00316)	0.08266* (0.04365)	-40.01284** (15.33357)	-399.58310** (162.94498)	-32.71372** (13.55282)	-418.66226** (161.38723)
Chewing Tobacco Tax (Ad Velorem)	-0.00001 (0.00125)	-0.00001 (0.00010)	0.00103 (0.00095)	0.59085** (0.27038)	2.09483 (2.89320)	0.14849 (0.21650)	4.30306 (2.94034)
Snuff Tax (Ad Velorem)	0.00024 (0.00058)	0.00003 (0.00004)	-0.00115** (0.00046)	-0.41037*** (0.09913)	-1.08418 (1.28235)	-0.09580 (0.10187)	-2.52381** (1.24747)
% Pop Under Bar Smoking Ban	0.06105 (0.10153)	0.00653 (0.00776)	-0.02127 (0.06245)	2.70479 (9.22277)	103.06710 (125.37794)	8.43178 (10.18009)	61.16773 (111.65279)
Observations	237,096	237,096	237,096	237,096	237,096	237,096	237,096
Households	19,057	19,057	19,057	19,057	19,057	19,057	19,057
Mean Value: Dep Variable	11.480	0.931	11.757	492.1	5353.0	433.6	5505.4

Notes: The sample is restricted to household-month observations with income in the stated range by panel. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include state, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table F8: NHANES Cigarette characteristics among households purchasing matched cigarettes by age group

	Cigarette Characteristics			Total Estimated Monthly Consumption of:			
	Average Tar Content	Average Nicotine Content	Average CO Content	Cigarettes	Tar	Nicotine	Carbon Monoxide
Age 25-54							
Cigarette Excise Tax (\$)	0.12504*** (0.04571)	0.00921*** (0.00290)	0.07275* (0.03936)	-28.49669** (13.58845)	-320.65750** (157.40423)	-25.33767* (12.79419)	-335.82265** (158.31782)
Chewing Tobacco Tax (Ad Velorem)	-0.00051 (0.00205)	-0.00007 (0.00016)	0.00122 (0.00106)	0.78351*** (0.23637)	1.15750 (3.16427)	0.17153 (0.23455)	3.99005 (3.31673)
Snuff Tax (Ad Velorem)	0.00016 (0.00059)	0.00006 (0.00004)	-0.00153*** (0.00041)	-0.32004*** (0.10767)	1.79973 (1.33078)	0.07997 (0.10218)	-0.26794 (1.41370)
% Pop Under Bar Smoking Ban	0.03722 (0.05272)	0.00293 (0.00404)	0.00420 (0.03414)	-5.74441 (4.93941)	-45.59043 (71.18897)	-4.24184 (5.44524)	-58.28219 (67.69277)
Observations	212,704	212,704	212,704	212,704	212,704	212,704	212,704
Households	18,070	18,070	18,070	18,070	18,070	18,070	18,070
Mean Value: Dep Variable	11.824	0.953	12.113	457.8	5060.8	407.4	5211.7
Age 55+							
Cigarette Excise Tax (\$)	0.08274 (0.06197)	0.00654 (0.00448)	0.05923 (0.05277)	-55.73587*** (11.87612)	-543.54456*** (125.53644)	-45.01466*** (10.55242)	-575.60995*** (125.25154)
Chewing Tobacco Tax (Ad Velorem)	-0.00170 (0.00164)	-0.00007 (0.00017)	-0.00369*** (0.00102)	0.67554** (0.33359)	1.85610 (4.04783)	0.30537 (0.28799)	0.21319 (4.46906)
Snuff Tax (Ad Velorem)	0.00286*** (0.00065)	0.00020*** (0.00006)	0.00279*** (0.00037)	-0.62064*** (0.13051)	-0.41687 (1.65515)	-0.18052 (0.13153)	0.18927 (1.61048)
% Pop Under Bar Smoking Ban	-0.01704 (0.06910)	0.00196 (0.00692)	-0.12782* (0.06423)	-9.86971 (8.77682)	-13.40240 (112.33889)	0.76526 (9.81033)	-67.02882 (115.06282)
Observations	176,790	176,790	176,790	176,790	176,790	176,790	176,790
Households	12,089	12,089	12,089	12,089	12,089	12,089	12,089
Mean Value: Dep Variable	11.632	0.944	11.772	539.8	5877.9	475.0	5991.1

Notes: The sample is restricted to household-month observations with income in the stated range by panel. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include state, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table F9: NHANES Cigarette characteristics among households purchasing matched cigarettes by region

	Cigarette Characteristics			Total Estimated Monthly Consumption of:			
	Average Tar Content	Average Nicotine Content	Average CO Content	Cigarettes	Tar	Nicotine	Carbon Monoxide
Northeast							
Cigarette Excise Tax (\$)	-0.12848* (0.06567)	-0.00323 (0.00690)	-0.07006*** (0.01336)	1.93995 (8.55167)	-87.52972 (119.88147)	-4.06293 (10.98895)	-109.84430 (112.76001)
Chewing Tobacco Tax (Ad Velorem)	0.01464*** (0.00183)	0.00112*** (0.00014)	0.00440 (0.00261)	3.05947*** (0.59628)	46.33401*** (6.52937)	3.55059*** (0.61701)	42.36313*** (6.11312)
Snuff Tax (Ad Velorem)	-	-	-	-	-	-	-
% Pop Under Bar Smoking Ban	0.13784 (0.16424)	0.01355 (0.01184)	0.02196 (0.12995)	-3.77676 (12.83777)	56.78388 (222.99356)	6.93677 (20.37444)	21.25464 (260.64553)
Observations	43,711	43,711	43,711	43,711	43,711	43,711	43,711
Households	3,376	3,376	3,376	3,376	3,376	3,376	3,376
Mean Value: Dep Variable	12.252	0.985	12.363	457.3	5309.3	426.1	5378.4
South							
Cigarette Excise Tax (\$)	0.12191* (0.06448)	0.00886 (0.00511)	0.11233* (0.06009)	-58.65922*** (14.89426)	-589.74752*** (199.96152)	-48.42295*** (16.17320)	-601.62174*** (190.40176)
Chewing Tobacco Tax (Ad Velorem)	-0.00225** (0.00089)	-0.00023*** (0.00007)	-0.00185** (0.00069)	0.15017 (0.27023)	-1.24508 (3.29293)	-0.09075 (0.24501)	-0.48367 (3.67052)
Snuff Tax (Ad Velorem)	-	-	-	-	-	-	-
% Pop Under Bar Smoking Ban	0.00036 (0.06334)	0.00240 (0.00535)	-0.01563 (0.04191)	-2.21525 (2.02326)	2.17598 (43.49703)	1.58777 (4.44534)	-10.80145 (25.40399)
Observations	147,519	147,519	147,519	147,519	147,519	147,519	147,519
Households	10,917	10,917	10,917	10,917	10,917	10,917	10,917
Mean Value: Dep Variable	11.524	0.932	11.825	521.2	5604.7	451.3	5790.5
Midwest							
Cigarette Excise Tax (\$)	0.10055* (0.04878)	0.00369 (0.00333)	0.07628*** (0.02287)	-41.76626*** (8.59756)	-459.57014** (156.86378)	-37.68925** (12.76527)	-477.10361*** (144.61175)
Chewing Tobacco Tax (Ad Velorem)	0.00184 (0.00397)	0.00035* (0.00019)	-0.00176 (0.00364)	1.32982*** (0.36270)	11.53105*** (2.05032)	1.02395*** (0.16218)	9.42940*** (2.65344)
Snuff Tax (Ad Velorem)	0.00032 (0.00054)	0.00004 (0.00005)	0.00056* (0.00030)	-0.38577*** (0.10210)	-0.59619 (1.24677)	-0.12425 (0.09932)	-0.59913 (1.20200)
% Pop Under Bar Smoking Ban	-0.00444 (0.04649)	-0.00349 (0.00327)	-0.01369 (0.04641)	-16.77058*** (2.23598)	-223.65823** (76.51564)	-20.16004*** (5.87656)	-209.55597*** (63.08259)
Observations	104,906	104,906	104,906	104,906	104,906	104,906	104,906
Households	7,727	7,727	7,727	7,727	7,727	7,727	7,727
Mean Value: Dep Variable	11.708	0.947	11.930	469.0	5185.0	419.6	5285.8
West							
Cigarette Excise Tax (\$)	-0.00619 (0.07842)	0.00004 (0.00537)	-0.04075 (0.06095)	-2.89207 (32.50411)	-64.00450 (319.06963)	-5.53761 (26.41031)	-51.14661 (330.39605)
Chewing Tobacco Tax (Ad Velorem)	0.00644 (0.00377)	0.00026 (0.00023)	0.00296 (0.00228)	-2.03655* (1.04818)	-21.01351* (11.35974)	-1.69897* (0.90305)	-24.84502* (12.53391)
Snuff Tax (Ad Velorem)	-	-	-	-	-	-	-
% Pop Under Bar Smoking Ban	-0.06733 (0.23942)	0.00051 (0.01411)	-0.22491* (0.11431)	7.18332 (25.58094)	161.46972 (205.61673)	13.74106 (17.64553)	80.07817 (289.36171)
Observations	60,342	60,342	60,342	60,342	60,342	60,342	60,342
Households	4,379	4,379	4,379	4,379	4,379	4,379	4,379
Mean Value: Dep Variable	11.953	0.968	12.040	464.9	5175.4	418.9	5256.9

Notes: The sample is restricted to household-month observations which reside in the stated region by panel. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include state, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table F10: NHANES Cigarette characteristics among households purchasing matched cigarettes by state smoking prevalence

	Cigarette Characteristics			Total Estimated Monthly Consumption of:			
	Average Tar Content	Average Nicotine Content	Average CO Content	Cigarettes	Tar	Nicotine	Carbon Monoxide
Smoking Prevalence >= 20% (2013)							
Cigarette Excise Tax (\$)	0.12023 (0.10622)	0.00700 (0.00830)	0.09243 (0.08010)	-55.24805*** (15.96637)	-536.79042** (215.85018)	-45.15249** (17.25583)	-552.13071** (200.95328)
Chewing Tobacco Tax (Ad Velorem)	0.00418 (0.00399)	0.00026 (0.00026)	-0.00007 (0.00376)	-0.28955 (0.52655)	-4.16047 (6.13287)	-0.19424 (0.41241)	-6.41530 (4.98032)
Snuff Tax (Ad Velorem)	-	-	-	-	-	-	-
% Pop Under Bar Smoking Ban	0.08006 (0.07890)	0.00563 (0.00667)	0.03294 (0.04498)	-6.98418* (3.68492)	18.95490 (46.75959)	1.12105 (4.02840)	-16.61595 (27.74875)
Observations	155,595	155,595	155,595	155,595	155,595	155,595	155,595
Households	11,217	11,217	11,217	11,217	11,217	11,217	11,217
Mean Value: Dep Variable	11.748	0.944	11.982	489.3	5343.0	428.5	5482.8
Smoking Prevalence < 20% (2013)							
Cigarette Excise Tax (\$)	0.09519** (0.03839)	0.00878*** (0.00264)	0.03806 (0.03105)	-38.07736** (15.79629)	-391.74890** (164.57276)	-31.33514** (13.62992)	-438.52137** (167.32064)
Chewing Tobacco Tax (Ad Velorem)	-0.00025 (0.00150)	0.00004 (0.00012)	-0.00202*** (0.00068)	0.23881 (0.23201)	-1.41604 (2.44005)	-0.02230 (0.19468)	-1.74892 (2.37408)
Snuff Tax (Ad Velorem)	0.00071 (0.00063)	0.00003 (0.00005)	0.00129*** (0.00041)	-0.17386* (0.10101)	2.50244** (1.08721)	0.09954 (0.08894)	2.69123** (1.05899)
% Pop Under Bar Smoking Ban	-0.05346 (0.09100)	-0.00254 (0.00637)	-0.10101** (0.04892)	-6.03209 (7.64383)	-102.43582 (102.19279)	-8.50180 (8.84991)	-91.92045 (101.29361)
Observations	200,230	200,230	200,230	200,230	200,230	200,230	200,230
Households	15,101	15,101	15,101	15,101	15,101	15,101	15,101
Mean Value: Dep Variable	11.734	0.952	11.942	488.7	5410.7	438.4	5531.3

Notes: Samples are restricted to households residing in a state with the stated smoking prevalence. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include state, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table F11: NHANES Cigarette characteristics among households purchasing matched cigarettes by change in state smoking prevalence

	Cigarette Characteristics			Total Estimated Monthly Consumption of:			
	Average Tar Content	Average Nicotine Content	Average CO Content	Cigarettes	Tar	Nicotine	Carbon Monoxide
Smoking Prevalence Change < 3 Percentage Points (1993- 2013)							
Cigarette Excise Tax (\$)	0.15877 (0.10704)	0.00979 (0.00829)	0.11636 (0.09808)	-54.79785*** (17.71954)	-477.52040* (247.09235)	-39.63976* (20.24979)	-480.84010* (236.65611)
Chewing Tobacco Tax (Ad Velorem)	0.00534 (0.00416)	0.00046* (0.00025)	0.00008 (0.00399)	-0.62070* (0.34914)	-5.88663 (5.60529)	-0.25143 (0.45226)	-10.68542** (4.72307)
Snuff Tax (Ad Velorem)	-	-	-	-	-	-	-
% Pop Under Bar Smoking Ban	0.00112 (0.01627)	0.00044 (0.00151)	-0.01142 (0.02357)	-4.29270 (4.09429)	0.82434 (51.74133)	-0.06114 (4.34415)	-2.32079 (42.62963)
Observations	105,572	105,572	105,572	105,572	105,572	105,572	105,572
Households	7,515	7,515	7,515	7,515	7,515	7,515	7,515
Mean Value: Dep Variable	11.896	0.953	12.118	488.3	5387.6	430.1	5517.6
Smoking Prevalence Change >= 3 Percentage Points (1993- 2013)							
Cigarette Excise Tax (\$)	0.08019** (0.03883)	0.00654** (0.00280)	0.04145 (0.03200)	-38.76006** (14.50313)	-421.07271*** (150.60871)	-34.35212*** (12.41299)	-456.15570*** (150.97932)
Chewing Tobacco Tax (Ad Velorem)	-0.00070 (0.00159)	-0.00005 (0.00015)	-0.00167** (0.00078)	0.42950* (0.22864)	0.12931 (2.65898)	0.06257 (0.20630)	0.72542 (2.48890)
Snuff Tax (Ad Velorem)	0.00128* (0.00073)	0.00010 (0.00007)	0.00128*** (0.00042)	-0.23337** (0.09364)	2.29836** (1.06791)	0.10536 (0.08675)	1.95856* (0.99702)
% Pop Under Bar Smoking Ban	0.02845 (0.09813)	0.00511 (0.00850)	-0.05944 (0.05214)	-7.53437 (5.02520)	-53.40717 (89.66258)	-3.41861 (7.89172)	-96.46388 (71.20286)
Observations	249,198	249,198	249,198	249,198	249,198	249,198	249,198
Households	18,744	18,744	18,744	18,744	18,744	18,744	18,744
Mean Value: Dep Variable	11.679	0.948	11.897	488.7	5372.2	435.3	5501.2

Notes: Samples are restricted to households residing in a state with the stated change in smoking prevalence. All models include controls for the gender, race, ethnicity and marital status of the head of household, household size, indicator variables for income categories, and interactions between head of household gender and indicators for age categories, education categories, employment, and household access to the internet. Additionally, all models include state, year and month fixed-effects, as well as state-specific time trends. Robust standard errors clustered by state are in parentheses. Stars denote statistical significance: *** p<0.01, ** p<0.05, * p<0.10.

Appendix G: Calculation of Tax Elasticity Estimates in Previous Literature

1. Evans and Farrelly (1998).

We base our tax elasticity estimates off of the coefficients in the Fixed Effects specifications in the left panel of Table 2. The paper presents marginal effect coefficients, and we combine these with tax and cigarettes per day sample means to estimate tax elasticities. We calculate sample means from Table 1, weighting the values in 1979 and 1987 by the numbers of observations in each year.

Our tax elasticity estimate is $\varepsilon_t = \beta \left(\frac{\bar{t}}{\bar{x}} \right)$, where β is the marginal effect coefficient of interest from Table 2, \bar{t} is the sample mean tax, and \bar{x} is the sample mean of the dependent variable of interest. To build a 95% confidence interval, we use the t-statistics contained in Table 2 as follows: $LB_{\varepsilon_t} = \varepsilon_t(1 - 1.96/t_\beta)$ and $UB_{\varepsilon_t} = \varepsilon_t(1 + 1.96/t_\beta)$.

2. Farrelly et al. (2004)

We base our tax elasticity estimates off of the price elasticities in Tables 3 and 4. Although the paper reports marginal effect coefficients, we do not have estimates of average tax rates and thus cannot estimate tax elasticities as with Evans and Farrelly (1998). Therefore, we combine the price elasticities with information regarding the relationship between taxes and prices to transform the price elasticity into a tax elasticity. Adda and Cornaglia (2006) use data over a similar time period and estimate that a one percent increase in cigarette taxes leads to a 0.15 percent increase in cigarette prices, i.e., $\frac{\partial p}{\partial t} * \frac{t}{p} = 0.15$.

Thus, we estimate the tax elasticity as $\varepsilon_t = \varepsilon_p * 0.15$. To build a 95% confidence interval, we use the standard errors and coefficients to calculate t-statistics, then use the t-statistics as follows: $LB_{\varepsilon_t} = \varepsilon_t(1 - 1.96/t_\beta)$ and $UB_{\varepsilon_t} = \varepsilon_t(1 + 1.96/t_\beta)$.

3. Adda and Cornaglia (2006)

Adda and Cornaglia (2006) report tax elasticities and their respective standard errors, so we can directly compute confidence intervals using the elasticities and standard errors contained in Model (3) in Table 2. To measure nicotine consumption per cigarette, we use Adda and Cornaglia's measure of smoking intensity, or the logged ratio of cotinine concentration to the number of cigarettes smoked. To measure total nicotine consumption, we use serum cotinine concentrations.

4. Abrevaya and Puzzello (2012)

Abrevaya and Puzzello (2012) report tax elasticities and their respective standard errors, so we can directly compute confidence intervals using the elasticities and standard errors in Table 1 Specification 3, top panel. These results contain unweighted regressions, similar to Adda and Cornaglia (2006). The authors also report weighted regressions in the bottom panel, and these results are qualitatively similar in that no coefficients are statistically significant at conventional levels. To measure nicotine consumption per cigarette, we use Adda and Cornaglia's measure of smoking intensity, or the logged ratio of cotinine concentration to the number of cigarettes smoked. To measure total nicotine consumption, we use serum cotinine concentrations.

5. Adda and Cornaglia (2013)

Adda and Cornaglia (2013) report tax elasticities and their respective standard errors, so we can directly compute confidence intervals using the elasticities and standard errors. We use the estimates in Table 3 in the right-most column, reporting results using lagged cigarette taxes. To measure nicotine consumption per cigarette, we use Adda and Cornaglia's measure of smoking intensity, or the logged ratio of cotinine concentration to the number of cigarettes smoked. To measure total nicotine consumption, we use serum cotinine concentrations.

6. Nesson (2015)

We base our tax elasticity estimates off of the coefficients in the OLS specifications in Tables 2 and 3. The paper presents marginal effect coefficients, and we combine these with tax and cigarettes per day sample means from Table 1.

Thus our tax elasticity estimate is $\varepsilon_t = \beta \left(\frac{\bar{t}}{\bar{x}} \right)$, where these values are as defined above. To build a 95% confidence interval, we use the standard errors and coefficients contained in Tables 2 and 3 to calculate t-statistics, then use the t-statistics as follows:

$$LB_{\varepsilon_t} = \varepsilon_t \left(1 - 1.96/t_\beta \right) \text{ and } UB_{\varepsilon_t} = \varepsilon_t \left(1 + 1.96/t_\beta \right).$$

To measure nicotine consumption per cigarette, we use Adda and Cornaglia's measure of smoking intensity, or the logged ratio of cotinine concentration to the number of cigarettes smoked. To measure total nicotine consumption, we use serum cotinine concentrations.