The Heterogeneous Geographic and Socioeconomic Incidence of Cigarette and Beer Taxes: Evidence from Nielsen Homescan Data*

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Abstract

This paper uses Nielsen Homescan data at the Universal Product Code-transaction level to identify how cigarette and beer taxes are passed through to consumer prices in order to determine how the supply and demand-side split the excess burden of taxation. We find that both cigarette and excise taxes are less than fully passed through to consumer prices, though the pass-through rate is much higher for cigarettes than for beer. Using information on consumer location and the location of purchases, we show that the availability of lower-tax goods across uncontrolled borders creates significant differences in how consumer prices are affected by excise taxes. Close to lower-tax borders, beer taxes decline and less than half of cigarette taxes are passed on to consumers through higher prices. Far from these borders, however, consumer prices are highly responsive to excise taxes. With the household demographic information contained in our data, we show that the incidence of these taxes and the border effect varies across household income groups and race. These findings have important consequences for the distribution of the excess burden of both cigarette and alcohol taxes and thus for the social welfare costs and benefits of these taxes.

KEYWORDS: Cigarettes, Alcohol, Taxes, Incidence, Tax Evasion
JEL CLASSIFICATION:

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1 Introduction

Sin taxes, and in particular taxes on cigarettes and alcohol, are increasingly popular in the United States due to their revenue-generating potential and their potential benefits for public health. In 2008, the average state-level cigarette tax was $1.10 per pack and ranged from $0.07 in South Carolina to $2.58 in New Jersey. State excise taxes on beer were lower on average, at $0.27 per gallon, but also exhibited substantial cross-state heterogeneity, ranging from $0.02 in Wyoming to $1.07 in Alaska. Gross state cigarette excise tax receipts topped $15.6 billion in 2008 and beer excise tax collections were $1.6 billion.

Given the pervasive nature of these taxes and states' increasing reliance on them to close rising budget deficits, a question of central policy importance is who bears the economic burden of cigarette and alcohol taxes. The incidence of a tax is a critical component to assessing its social welfare implications; the distribution of the tax burden across different agents in the economy can change the net welfare gain or loss from taxation significantly.[1] Is the burden of these taxes "passed forward" to consumers or is it "passed backward" to suppliers (and thus onto the factors of production)? The incidence of state alcohol and cigarette taxes is of particular interest because of the evasion opportunities supplied by large cross-state tax differences.[2] The ability to subvert local laws by driving to another state to purchase alcohol or cigarettes may change how the burden of taxation is split between the supply and demand side of the market. Furthermore, the incidence of these taxes may differ depending on the socioeconomic status of households.

Our research examines the incidence of cigarette and beer taxes by estimating the degree to which excise taxes are passed through to consumer prices. We make several contributions to the literature. First, we employ a unique and detailed data set, the

[1] See Fullerton and Metcalf (2002) for a detailed discussion of tax incidence.

[2] Lovenheim (2008), Stehr (2005), Goolsbee, Lovenheim and Slemrod (Forthcoming) and Merriman (Forthcoming) show evidence of large-scale cross-state tax evasion among cigarette consumers. Stehr (2007) and Beard, Gant and Saba (1995) show similar tax evasion activity exists for alcohol. Lovenheim and Slemrod (2010) and Baughman et al. (2001) further demonstrate the existence of cross-state evasion of alcohol access restrictions.

Nielsen Homescan data. These data contain every purchase made by a household at the Universal Product Code (UPC) level from 2006 through 2007. They are linked to the store at which the purchase was made, and each consumer's Census tract is know along with her demographic characteristics. These data offer a level of detail in the types of products purchased, the location of purchase, and information on purchasers that has not been used in the small cigarette and alcohol incidence literature to date. Most of the previous literature has used aggregate data or has studied micro-data on a small subset of individual products in a small number of states (see Section 2 for an overview of the literature). This is the first analysis to use a nationally-representative panel of consumers with complete product-level data to analyze the response of consumer prices to taxes.

Second, because we observe the zip code of the purchasing store and the Census tract of the purchasing consumer, we are able to analyze how tax shifting behavior changes relative to the distance of the consumer to lower-tax borders and the distance of the stores in which they shop to lower-tax borders. The difference between these estimates will allow us to disentangle how actual store-level prices are affected by excise taxes and how equilibrium prices consumers pay that take into account endogenous search behavior are affected by excise taxes. Finally, we assess whether prices paid by consumers respond differently to taxes across the socioeconomic spectrum.

Contrary to much of the literature on cigarette and alcohol tax incidence, we find taxes are less than fully passed through to consumer prices on average. For cigarettes, a 1 cent increase in taxes leads to a 0.83 cent increase in prices. This result suggests the economic burden of state cigarette excise taxes is somewhat split between the consumption and production sides of the market, though consumers bear more of the burden. Our estimates for beer suggest consumers bear little burden of these taxes: a 1 cent increase in excise taxes is associated with a 0.13 cent increase in consumer prices.

These average effects mask considerable heterogeneity across the geographic and socioeconomic spectrum. On the border with a lower-tax state, a 1 cent increase in cigarette taxes leads to a price increase of only 0.49 cents and is 0.08 cents larger for every 1 percent increase in distance from that state. For beer, a 1 cent increase in taxes leads to a 1.27 cent *decline* in prices, but for every 1 percent increase in distance the pass-through increases by 0.35 cents. Overall, these estimates are suggestive of a large amount of geographic heterogeneity in how consumer prices respond to taxation, which ostensibly is driven by the opportunities for cross-state evasion. We also find that measuring distance from stores rather than from consumers' home Census tracts has little effect on the results, which is suggestive of a limited role for expanded consumer search activity surrounding tax changes.

We further find differences in the tax pass-through by consumer family income and race. The effect of consumer prices on taxes is non-linear across the income distribution for cigarettes, with middle income families making between $35,000 and $100,000 experiencing full pass-through and families with higher and lower income experiencing less than full pass-through. Cigarette prices paid by Hispanic consumers increase one-for-one with taxes, while African American consumers' prices increase by 0.65 cents for every 1 cent increase in taxes. For beer taxes, the pass-through increases across the income distribution, at $0.07 for households with under $35,000 of income and at $0.27 for households with over $100,000 of income. White consumers are the only ones who experience a positive price increase from a tax increase, as prices for black and Hispanic consumers decline when taxes increase. Examining differences with respect to lower-price borders, it is only among white and middle income consumers that there is evidence of a larger increase in consumer prices due to taxes farther from lower-price borders for cigarettes. The effect of taxes on beer prices when one moves farther from the border increases across the income distribution and is largest for black consumers.

These results differ substantially from most of the literature in this area that

suggests large over-shifting of taxes onto consumer prices. We argue this different result is due to our use of a detailed data set on consumers and prices that allows us to employ UPC fixed effects and control for consumer heterogeneity. Our finding of large amounts of geographic and socioeconomic heterogeneity in the price response to cigarette and excise taxes suggests it is not simple to characterize who bears the economic burden of these taxes. Though we find clear evidence it is split between consumers and the factors of production, the size of this split varies significantly by consumer tax evasion opportunities as well as by the socioeconomic background of the consumer. The specific mechanisms driving these differences deserve more attention in future work.

The rest of this paper is organized as follows: Section 2 presents background on tax incidence, Section 3 describes the previous literature on prices responses to excise taxes, and Section 4 contains a detailed description of our data and empirical methodology. Empirical results are shown in Section 5, and Section 6 concludes.

2 Tax Incidence

The modern study of tax incidence[3] dates back to Harberger (1962), who shows that the incidence of a given tax is a function of the relative supply and demand elasticities. These elasticities yield the slopes of the supply and demand curves, which describe how much of the deadweight loss from a tax can be attributed to reduced consumer surplus and reduced producer surplus.

An illustrative example is given in Figure 1. In Panel A, neither supply nor demand are perfectly elastic or perfectly inelastic. Without a tax, the intersection of the supply and demand curves determine the equilibrium market prices p^* and q^*. When the government imposes a per-unit tax of τ on the good, the net consumer price shifts up to P_2 and the net producer price shifts down to $P_3 = P_2 - \tau$. As the figure illustrates, the deadweight loss (i.e., the "Harberger Triangle") is split between the

[3] A more detailed and current discussion of tax incidence is given in Fullerton and Metcalf (2002).

consumer-side of the market and the producer-side of the market. When the economic burden of the tax is split such as in Panel A, the increase in consumer prices is less than the tax increase because it is shared between consumers and producers.

Taxes will be fully passed on to consumers in the case of perfectly elastic supply, such as when there is constant marginal cost of production. Note that perfectly elastic supply is a common framework in economics because it is associated with perfect competition. Although the assumption of perfect competition is unlikely for our analysis, especially for the cigarette market that is dominated by a few producers and wholesalers, it is a useful benchmark case. Perfectly elastic supply also is relevant due to the pervasive finding in the literature that both cigarette and alcohol taxes are passed fully (or more than fully) on to consumer prices, which one most commonly finds in perfectly competitive markets.[4] Panel B shows that when supply is infinitely responsive to price changes, all of the burden of the tax must be borne by consumers in the form of higher prices. Thus, $P_2 = P^* + \tau$ and all of the deadweight loss falls on consumers.

In Panel C, we show the implications for tax incidence when demand is perfectly elastic; all of the burden of the tax increase falls on the producers. The price faced by consumers is unchanged, but the net price experienced by producers drops by τ, such that $P^* - P_3 = \tau$.

Figure 1 demonstrates the relationship between tax incidence and the pass-through of taxes to prices. The degree to which consumer prices are affected by excise taxes is related directly to how producers and consumers split the excess burden of taxation. The remainder of this paper estimates the extent of such pass-through empirically.

[4]Full pass-through of taxes to consumer prices also will occur with perfectly inelastic demand. The available evidence on the effect of cigarette and beer prices on consumption is inconsistent with perfectly inelastic demand, however, but demand appears to be less than unit elastic for both goods. See Chaloupka and Warner (2002) and Lovenheim (2008) for an overview of the cigarette demand literature and Young and Bielinska-Kwapisz (2006) and Stehr (2007) for an overview of the relationship between beer prices and consumption.

3 Previous Literature

While there is a large literature examining the public health benefits of cigarette and alcohol taxation, there is a much smaller literature that attempts to estimate the responsiveness of consumer prices to these excise taxes.[5] This lack of literature is somewhat surprising, because not only is the relationship between prices and taxes important in the assessment of tax incidence, but it also has direct public health implications; if consumer prices do not respond to taxes, one should not expect consumer behavior to be affected by these taxes either.

Two studies have estimated the relationship between state beer excise taxes and prices in the United States. Young and Bielinska-Kwapisz (2002) use beer prices from the American Chamber of Commerce Research Association (ACCRA) between 1982 and 1997. The ACCRA data come from unpaid volunteers who sample prices of a given product in stores in a given city and report them to ACCRA. Although these data cover a long time period, they have several drawbacks. First, the product sampled changes over time, so it is difficult to generate a consistent price series. Second, the sampling is inconsistent in the sense that many cities and states are not sampled each year. Furthermore, the averages in each state likely are coming from different stores and different cities in each year. Despite the potentially large amount of measurement error contained in these data, Young and Bielinska-Kwapisz (2002) estimate a large amount of over-shifting of taxes onto prices: a 1 cent increase in taxes is estimated to increase prices by about 1.7 cents.

Kenkel (2005) corroborates this finding using a single alcohol excise tax change in Alaska in 2002. Alaska increased its tax from $0.35 to $1.07 per gallon, making it the highest beer-tax state in the United States. He conducts a telephone survey of alcohol retailers throughout Alaska before and after the October 1 change to collect data on six-pack beer prices of Budweiser, Bud Light, Coors, Miller, Corona

[5] In addition to the previous literature examining the incidence of beer and cigarette excise taxes, Poterba (1996) finds that clothing prices rise approximately one-for-one with state and local retail sales taxes. Besley and Rosen (1999) examine the effect of sales taxes on several goods and find overshifting for over half the goods and full shifting of taxes onto consumer prices for the other goods.

and Heineken. Kenkel (2005) finds pass-through rates of between 0.87 and 2.14, though only one of the six brands exhibits less than a one-for-one pass-through. These findings are again suggestive that beer taxes are more than fully passed on to consumers. However, although this study examines a consistent set of products and prices, it only includes one tax change at one point in time that leaves the potential for spurious time shocks to influence the result. Furthermore, it only examines six products rather than a representative bundle of beer purchases made by consumers.

Three previous studies have examined the relationship between cigarette taxes and prices in the United States. Keeler et. al. (1996) use a state-level panel of cigarette taxes and prices from 1960 to 1990 and estimate state-level taxes are more than passed on to consumers by between 3% and 26%. Their use of aggregate state-average prices in this context is potentially problematic, however, since consumers may respond to a per-unit tax by purchasing higher quality items.[6] Our data will allow us to estimate this possibility directly to assess whether such a bias exists from using aggregate price data to estimate tax incidence for per-unit excise taxes.

Hanson and Sullivan (2009) study the effect of a $1 increase in cigarette taxes in Wisconsin in 2008 on cigarette prices. They conduct a telephone survey of cigarette retailers in Wisconsin, Illinois, Minnesota, Iowa and Michigan and collect data on the price of one un-named generic and one un-named name brand cigarette pack. The paper estimates difference-in-difference models and finds a 1 cent increase in excise taxes increases prices by between 1.13 and 1.18 cents. Furthermore, there is weak evidence that the overshifting of taxes onto prices is smaller for generic cigarettes closer to the Minnesota border, which is a lower-tax border, but the same effects are not present for name brand cigarettes or for other borders. Though it is a methodological advancement over Keeler et al. (1996) through its use of a difference-in-difference analysis to control for spurious price shocks correlated with the timing

[6]For a given per-unit change in taxes, higher quality goods will increase by a smaller percentage than will lower-quality goods. An increase in a per-unit tax thus could cause individuals to alter their consumption bundle and purchase more expensive products. In the aggregate data, it will appear there is over-shifting while in reality at least part of this shift is due to a change in the consumption bundle.

of the tax change as well as its use of micro price data, the focus of this analysis on one state and one product makes it hard to generalize the conclusions. In addition, by using store-level data, Hanson and Sullivan are unable to control for demographic characteristics of consumers that might affect the pass-through of taxes to prices.

Finally, DeCicca, Feng and Liu (2010) use consumer-reported prices from the 2003 and 2006-2007 Current Population Survey Tobacco Use Supplements to estimate the pass-through of excise taxes to consumer prices. They find a pass-through of about 1 and show that this rate does not vary by the intensity with which the consumer smokes. This finding suggests consumer search behavior may be a small part of the consumer burden of excise taxes, as those with more to gain by searching (i.e., heavy smokers) do not appear to pay lower prices.

Overall, the previous literature on cigarette and alcohol tax incidence is suggestive that taxes are more than fully passed on to consumer prices. These analyses are constrained by incomplete or noisy product and price data as well as often very localized samples. Our analysis contributes to this literature by examining how taxes affect consumer prices using a nationally-representative set of consumers whose UPC-level purchases are matched to the store at which each transaction takes place. These data are unique in the tax incidence literature and allow us to overcome many of the data and empirical problems that exist in previous work in this area.

4 Data and Estimation Strategy

4.1 Data

4.1.1 Nielsen Homescan Data

We use 2006-2007 Nielsen Homescan panel data covering a total of 462,967 transactions.[7] The aim of the dataset is to provide marketing intelligence to retailers by

[7]The use of scanner data provides important advantages over more aggregate measures and consequently, there has been a notable increase in the popularity of these data in recent economic studies. Aguiar and Hurst (2007) and Harding and Lovenheim (2010) use these data to study consumer search behavior; Hausman and Leibtag (2005) use them to study the impact of Walmart on retailer competition; Burda, Harding and Hausman (2008, 2009) estimate

constructing a nationally-representative panel of consumer purchases. Recruitment into the panel is ongoing, and interested consumers register on the Nielsen website, after which they are placed on a waiting list. Periodically, consumers over the age of 18 are added to the panel with the explicit aim to maintain a nationally-representative panel, or a "mini-USA" as Nielsen promotional materials emphasize.

Once enrolled, households are provided with a scanner and are required to scan all items following a purchase. The scanner scans the barcode of the product and records the Universal Product Code (UPC) for each product. Households are additionally told to record further information such as the price and quantity for that particular purchase as well as details on whether the item was purchased as part of a specific promotion or whether the household used coupons for the purchase. At the end of the week, households connect the scanner to a computer or telephone and the data are transmitted to Nielsen. Participating households are not paid for their participation, however they earn a set number of points with each data upload. Households are rewarded the longer they stay with the program, and those who already have been in the panel for at least six months receive a substantially larger number of points for each transmission. The points can be redeemed in exchange for products similar to the way credit card points can be exchanged for merchandise in an online store. Furthermore, households are entered into prize draws for special gifts every month. For the purpose of this analysis, it is important to emphasize that participating households have a strong incentive to upload their purchase data to Nielsen.

In order to minimize the effort it takes consumers to enter the data, Nielsen does not require households to record the price of purchases made at certain stores. Instead Nielsen will "impute" the price based on store records for the given week. Typically, this procedure is sound since store prices are unlikely to change too frequently. However, the possibility exists that prices are not recorded correctly if the "Nielsen week" fails to overlap fully with the "store week" or if special prices are

latent consumer preferences with these data and show clustering in the way consumers trade-off between product attributes; and Broda, Leibtag and Weinstein (2009) use Nielsen scanner data to measure inequality in consumption.

offered to loyalty card members in some weeks that are not recorded by Nielsen. The extent to which this practice introduces measurement error recently has been documented by Einav, Leibtag and Nevo (2010) by matching data from Nielsen with data provided by a large retailer. Because such measurement error likely is uncorrelated with excise taxes, it should not cause a bias in our estimates.[8]

A major advantage of the Nielsen data that consumption is monitored at the UPC level, which allows Nielsen to include product characteristics for each purchase in the dataset. Furthermore, the store at which each purchase is made is identified in the data by name, type and zip code. The Nielsen data cover a whole range of retailers such as super-centers (e.g., Walmart) and grocery stores (e.g., Safeway) but also club stores selling in bulk (e.g., Costco), convenience stores (e.g., Seven Eleven) and drug-stores (e.g., Walgreens).

For each household, Nielsen records a wealth of socio-economic characteristics as well as the main place of residence. Means of these characteristics are presented in Table 1 separately for the cigarette-purchasing sample and for the beer-purchasing sample. The table illustrates that cigarette purchases typically are made by smaller households, with 23% of the purchases made by single households. The majority of the household heads are over 40 years old, white, high-school graduates, possibly with some college education and in full-time employment. Note however, that close to 30% of the panel participants are not employed.[9] The demographics for households purchasing beer is similar with some notable differences. Beer typically is purchased by larger households, with only 17% of the individuals being single. The income distribution also is shifted to the right, with roughly twice as many individuals earning above $50,000 purchasing beer than cigarettes. Households purchasing beer tend to be slightly younger and more educated than households purchasing cigarettes

[8]We will use prices as our dependent variables. Because classical measurement error in the dependent variable does not produce a bias in OLS estimates, it is a small concern in this study.

[9]Those not employed are either unemployed or not in the labor force. While Table 1 shows a substantial proportion of our sample does not work, these large percentages are consistent with other data sets. For example, in the 2001 Current Population Survey Tobacco Use Supplement, 25.2% of male smokers are not employed and 34.9% of female smokers are not employed.

as well, with a substantial number of household heads having achieved education at the bachelor level or above. These tabulations reflects the fact that smoking is more prevalent among lower-income and less educated individuals than is beer consumption. In addition, the number of unemployed heads of house is lower for beer than cigarette purchases, and we observe a larger number of Hispanic and Asian households making beer purchases. Overall, these differences among beer and cigarette purchasers tracks differences measured using other data sets, such as the Behavioral Risk Factor Surveillance System (BRFSS) and the National Health and Nutrition Examination Survey (NHANES).

4.1.2 Measuring Distance

Distance between consumers or stores and lower-tax borders is calculated similarly as in Lovenheim (2008) for cigarette taxes and Lovenheim and Slemrod (2010) for minimum legal drinking ages. For each consumer, the data contain the Census tract of residence. For each purchase, we match this tract with the closest lower-tax locality, separately for cigarettes and beer. Using the latitude and longitude of the centroid of the Census tract,[10] we calculate the minimum crow-flies distance from each tract to a road crossing into the lower-tax state that we find using the Census Major Road Tiger Files and GIS software. Note that the lower-tax state often is, but does not need to be, a border state. Once each Census tract and purchase date is matched to the closest lower-tax state, we then calculate the tax difference from purchasing in this state relative to one's home state.

The calculation of the distance between stores and lower-tax border states proceeds similarly. Instead of using the geographic centroid of the Census tract, we use the geographic centroid of the zip code in which the store is located.[11] Because zip

[10] In Lovenheim (2008) and Lovenheim and Slemrod (2010), population-weighted minimum distances are calculated by calculating the distance from each Census block point in the MSA or county to the closest relevant border crossing and then taking the block-point population averages of these distances. Because MSAs and counties are much larger than Census tracts, using the geographic centroid rather than the population-weighted centroid will have negligible effects on the distance calculation for this application.

[11] We do not have store addresses in the data, so we are unable to ascertain at which store in the zip code a consumer shops.

codes are relatively small geographically, particularly in metropolitan areas, using the geographic center rather than the population center likely has little effect on our distance estimates but reduces our computational burden dramatically. We calculate the crow-flies distance from the store's zip code centroid to the closest road crossing of the closest lower-tax state. The difference between the tax in the store's home state and the tax in the closest lower-tax state is the tax difference when we use stores as our unit of analysis.

Table 1 presents means of distances and tax differences calculated from consumers' home Census tract for the cigarette and beer samples. On average, consumers live rather far from lower-tax borders, but the large averages are driven by some consumers who live very far away. The median distance for beer is 106.9 miles and for cigarettes is 81.5 miles. In addition, 17.4 percent of cigarette consumers live within 25 miles of a lower-tax border and 11.5 beer consumers live in this range. These percents are 6.6 and 5.0 within 10 miles of a lower-tax border, respectively. Thus, a significant fraction of the populace lives relatively close to a lower-tax border, and as Table 1 shows the tax savings across these borders are non-trivial. On average, the cigarette tax difference is 38.51 cents, which is 11.1% of the average retail price and 44.9% of the average cigarette excise tax. For beer the savings from cross-state evasion are smaller on average, at 9.75 cents. This difference is 1.2% of the average beer retail price but is 37.5% of the average beer excise tax. We will examine empirically below whether these sizeable tax differences across uncontrolled borders affect how consumer prices react to excise taxes.

4.2 Estimation Strategy

Our baseline estimation strategy is to estimate transaction-level regressions of prices on excise taxes of the following form:

$$P_{uijt} = \beta_0 + \beta_1 \tau_{jt} + \theta X_i + \delta_j + \psi_t + \alpha_u + \epsilon_{uijt}, \tag{1}$$

where P_{uijt} is price per gallon (for beer) or price per pack (for cigarettes) paid for UPC u by household i in state j on day t. The variable τ is the per-unit state excise tax and X is a vector of household demographic characteristics described in Section 4. We also include in most models day-of-purchase fixed effects and, for cigarettes, state fixed effects.

One of the major benefits of our data is that we observe the UPC code of each product purchased. These codes provide extremely fine product descriptions for each good.[12] The UPC codes allow us to include UPC fixed effects in equation (1) (α_u), which control for the potential for consumers to change their purchasing bundle of cigarettes or beer when excise taxes increase. Because these excise taxes are per-unit, a given tax will increase the price of higher quality goods (and thus higher price goods) by relatively less than low quality goods. If product quality enters into consumer utility, the substitution effect implies consumers will upgrade the quality of cigarettes and alcohol when excise taxes increase. However, the income effect implies the opposite effect, so what happens to the bundle of goods purchased when excise taxes increase is an empirical question. Our use of UPC fixed effects allows us to abstract from this change in product quality by examining within-UPC changes in prices when taxes increase.

The state fixed effects control for the fact that some states may have systematically higher prices due to some unobservable factor that may also be correlated with tax levels (such as state anti-smoking sentiment). For the model examining cigarette purchases, the state fixed effects identify β_1, which is the coefficient of interest in equation (1), off of changes in prices in the 12 states that increase their cigarette excise taxes in 2006 and 2007.[13] With the state fixed effects, equation (1) is a difference-in-difference model, such that β_1 is identified by comparing the change in prices among states that increase their taxes relative to those that do not, holding

[12] For example, Marlboro and Marlboro Light packs would have separate UPC codes, and cartons of each also would have separate UPC codes.

[13] These states are New Jersey, North Carolina, Vermont, Arizona, South Dakota, Texas, Iowa, Colorado, Indiana, New Hampshire and Delaware.

household demographic characteristics and UPC fixed effects constant.

During 2006 and 2007, there were no changes in beer taxes. Thus, we cannot include state fixed effects in our beer tax incidence model because the state excise tax is collinear with the state fixed effects. The identification assumption for β_1 is that the time and UPC fixed effects as well as the household demographic characteristics control for any residual price discrimination by suppliers that is correlated with tax levels. Given our extensive set of controls and the fact that the models with and without state fixed effects using cigarette prices and taxes yield similar results suggests this assumption is reasonable.

In addition to estimating the average effect of excise taxes on prices, we test for heterogenous effects based on consumer and store distance to the closest lower-tax border. We estimate the following model for both cigarettes and beer:

$$\begin{aligned} P_{uijt} &= \beta_0 + \beta_1 \tau^h_{jt} + \beta_2 (\tau^h - \tau^b)_{jt} + \beta_3 ln(D)_{ijt} + \beta_4 (\tau^h - \tau^b)_{jt} * ln(D)_{ijt} \quad (2) \\ &\quad + \theta X_i + \delta_j + \psi_t + \alpha_u + \epsilon_{uijt}, \end{aligned}$$

where τ^h is the home state price tax, τ^b is the closest lower-tax state's tax, $(\tau^h - \tau^b)$ is the tax difference between states, D is the distance to the closest lower-tax state, and all other variables are as previously defined.

Equation (2) allows for the pass-through of taxes to prices to be a function of the tax difference between the home and closest lower-tax state, the log distance between the consumer or store and that state, and the interaction between the tax difference and log distance.[14] To better understand the parameters of interest in this model, it is useful to consider the partial effect of a home state tax change on price paid:

$$\frac{\partial P}{\partial \tau^h} = \beta_1 + \beta_2 + \beta_4 * ln(D). \quad (3)$$

[14] Another way to specify equation (2) would be to control for τ^h and τ^b separately and interact each with log distance. This method would relax the assumption that home and border state prices have equal and opposite effects on prices, holding distance constant. We find the data to be consistent with this assumption, and so we use the current form of equation (2) due to its ease of interpretation. Results that relax this assumption are available from the authors upon request.

For a consumer on the border with a lower-tax state, $\frac{\partial P}{\partial \tau^h} = \beta_1 + \beta_2$, and if cross-state competition leads to consumers on the border experiencing no change in price due to the tax change, $\beta_1 = -\beta_2$. If, on the other hand, the existence of the border does not completely wipe out the economic burden of the tax increase for consumers, β_1 will be greater than β_2 in absolute value, though they still will have opposite signs.

As one moves 1 percent further from the border, $\frac{\partial P}{\partial \tau^h}$ changes by β_4. A positive value of β_4 will indicate consumers bear a relatively larger burden of the tax the farther they are from a cross-state evasion opportunity. Note that distance is logged in equation (2). Specifying the functional form for distance is complicated by the fact that the effect of distance on the pass-through of taxes to consumer prices is non-linear. Hundreds of miles from the border, a one mile increase in distance likely has little additional effect on the incidence of excise taxes, while close to the border such a change may have a large impact. A log distance function allows the effect of distance on $\frac{\partial P}{\partial \tau^h}$ to decline with distance, such that far from borders a given distance increase has a negligible effect on the pass-through rate.[15]

As equation (3) illustrates, β_2 and β_4 show whether the availability of lower-priced goods across uncontrolled borders affect the incidence of state excise taxes on cigarettes and alcohol. The parameter β_1 shows the effect of taxes on consumer prices if tax differences are zero. It should equal the estimate of β_1 from equation (1) only when border effects are small, such that the average effect does not mask considerable heterogeneity across space.

The assumption underlying identification of β_2 through β_4 in equation (2) is that neither consumers nor stores make location decisions based on relative tax rates across states. Given that cigarettes and beer are likely to be a small part of any retailers sales, we believe this assumption to be valid.

[15] Lovenheim (2008) also employs a log distance function in cigarette demand regressions that test for heterogeneous effects of home state price changes on consumption. Lovenheim and Slemrod (2010) use distance range dummies to study the effect of minimum legal drinking age evasion of traffic fatalities. Both methods allow for the effect of distance on the pass-through of taxes to prices, but using log distance imposes a stronger parametric assumption on the distance-pass-through relationship than using distance range dummies. We use log distance, however, due to its ease of interpretation - results using distance dummies are qualitatively similar and are available upon request from the authors.

We estimate equation (2) using two sets of tax difference and distance calculations. The first is to use distance from each Census tract to the closest lower-tax border and the distance to this border from the Census tract. Using these measures, the coefficient estimates from equation (2) show how consumer location affects the incidence of cigarette and alcohol taxes. We also measure distance from the zip code of the store at which a purchase is made to the closest lower-tax border from that store's zip code and the tax difference between the store's home state and the lower-tax state. These distance and tax difference measures allow us to estimate how store-level prices are influenced by taxes. These two methods will yield identical results as long as consumers do not change the types of stores at which they purchase cigarettes and alcohol when taxes increase. However, consumers may react to price changes by increasing search behavior by traveling to a lower-price state, searching out local deals, or going to discount stores. In this case, consumer search will yield smaller effects of taxes on prices consumers actually pay than on prices offered at a given store, particularly over the distance distribution because cross-border purchasing is likely a large aspect of consumer search behavior. Comparing estimates using different distance and tax difference measures will give us insight into how much search behavior is influenced by excise taxes with the possibility of cross-state evasion. Because consumer search costs are part of the excess burden borne by consumers, this comparison also will be instructive as to whether our pass-through measure understates the incidence of cigarette and beer taxes on consumers.

As equations (1) and (2) illustrate, although the unit of observation is a transaction, most of the independent variables vary at either the state or Census tract level; within Census tracts, there is little independent variation. All estimates we present below therefore are accompanied by standard errors that are clustered at the Census tract level.[16]

[16]Because excise taxes vary by state, one might argue it is more appropriate to cluster standard errors at the state level. While this level of clustering increases the size of standard errors slightly, it does not affect the results or conclusions of the analysis. However, because there is substantial variation in prices across Census tracts, we believe it is more appropriate to cluster at the Census tract level.

5 Results

5.1 Baseline Results

Table 2 presents baseline parameter estimates from estimation of equation (1) using the Nielsen Homescan data described in Section 4.1. Each column of the table contains estimates from a separate regression that adds fixed effects and demographic controls sequentially across columns in order to understand how each set of controls impacts our estimates. Panel A of the table presents cigarette estimates and Panel B contains beer results.

In column (i), we estimate bivariate regressions of prices on excise taxes. For cigarettes, we find full shifting of taxes to consumer prices: a 1 cent increase in taxes is associated with a 1.03 cent increase in price per pack. While this estimate is different from zero at the 5% level, it is not statistically different from 1 at conventional levels. This estimate is roughly consistent with previous studies that find full to over-shifting. Our bivariate estimate for beer is -0.918, suggesting an almost one-for-one decline in beer prices when excise taxes increase by one cent.

In column (ii), we employ UPC fixed effects, which as discussed in Section 4 no other study has been able to use due to data unavailability. In the cigarette model, we also include state fixed effects. These fixed effects have a small effect on the estimate of β_1 in equation (1); the coefficient is 0.964, which still is not statistically different from one at conventional levels. However, this is the first point estimate we are aware of in the literature that is less than one. The fact that including state fixed effects has a small effect on the tax estimate is suggestive that our inability to employ these fixed effects in the beer model has small effects on our results and conclusions. In Panel B, including UPC fixed effects has a large effect on the pass-through estimate: a 1 cent increase in excise taxes is associated with a 0.122 cent increase in prices. While this estimate is much lower than 1, it now is positive and statistically different from zero at the 5 percent level. At least for beer, UPC fixed

effects have substantive effects on the conclusions, though our estimate still is far below those reported in Kenkel (2005) and Young and Bielinska-Kwapisz (2002).

Why does including UPC fixed effects impact the pass-through estimates? One potentially compelling explanation is that consumers alter their purchasing behavior when taxes increase. We explore this possibility by generating a UPC-level quality index, which is the average national price paid by consumers at the UPC level. We then estimate a regression of this price index on excise taxes, household demographic characteristics and state fixed effects (for cigarettes). Our results suggest consumers' purchasing behavior is affected differently for beer and cigarettes. The cigarette estimates imply a 1 cent increase in taxes increases the quality-level consumers pay by 0.13 cents. This estimate is significantly different from zero at the 5% level. For beer, while the estimate is imprecise, we find a 1 cent increase in taxes reduces the average quality of the purchase by 0.28 cents. These results are suggestive of one reason why our results differ from previous work: per-unit excise taxes cause cigarette consumers to upgrade quality and beer consumers to downgrade quality. Failing to account for the altered purchasing patterns of consumers causes a bias in the estimation of the pass-through of excise prices to taxes.

Adding household demographic characteristics has little effect on the estimates in column (iii). This finding does not necessarily indicate that these characteristics are unrelated to the pass-through rate, but rather suggests that the UPC fixed effects are sufficient to control for endogenous product selection that is correlated with taxes and household demographics. Finally, in column (iv), we employ purchase date fixed effects. For beer, these fixed effects have no effect on the pass-through estimate, but for cigarettes they reduce the coefficient estimate dramatically, to 0.827. The reason adding purchase date fixed effects to the model has such a large effect on the pass-through estimate for cigarettes likely is due to the fact that there is seasonality in cigarette prices that causes a spuriously high correlation between consumer prices and state excise taxes. Since most states increase their taxes in our sample on January

1 or July 1, any price seasonality will be confounded with pass-through rates in our model without purchase date fixed effects. With these fixed effects, we therefore find a lower pass-through of taxes to prices; the coefficient now is statistically different from both zero and one at the 5% level, suggesting consumers and producers split the economic burden of cigarette excise taxes.[17]

5.2 Estimates Including Distance to Lower-tax Borders

Table 3 presents estimates from equation (2) using distance and tax-difference measures from consumers' home Census tracts. In column (i) we include only UPC fixed effects, in column (ii) we add in demographic controls, and in column (iii) we control for purchase date fixed effects. Similar to the results in Table 2, purchase date fixed effects in particular reduce the baseline pass-through rate of cigarette taxes to cigarette prices. For beer, neither demographic controls nor purchase date fixed effects substantively alter the estimates. Because the estimates in column (iii) are identified under fewer assumptions than those in columns (ii) and (i), we focus on the column (iii) results throughout. However, we present these other estimates in order to describe how each set of fixed effects and controls impacts our results.

For consumers on the border, a 1 cent increase in cigarette excise taxes increases cigarette prices by 0.491 (=0.707-0.261) cents. This result is suggestive of a substantial border effect because on the border, less than half of the tax increase is passed through to consumer prices despite the finding in Table 2 of an average effect of 0.83. For each 1 percent increase in distance, this pass-through rate increases by 0.08 cents.[18] At the mean of distance, which according to Table 1 is 126.51, the pass-through rate is 0.87=0.491+ln(126.51)*0.07, which is very similar to the aver-

[17]Purchase date fixed effects do not affect the pass-through rate of beer taxes because there are no within-state beer tax changes in our data. Thus, mechanically, the purchase date fixed effects are uncorrelated with excise tax differences, meaning that including them in the model should not alter our pass-through estimate, which is what we find.

[18]Many smokers purchase their cigarettes in local smoke shops. These cigarettes mostly are generic brands with small individual market shares, and we may miss some of these purchases in our data. Table A-1 shows our estimates for cigarettes, both overall and by distance to a lower-tax border, for generic and premium cigarettes. The estimates are very similar, and since the premium brands are unlikely to be purchased at local smoke shops, we believe it unlikely prevalence of these stores is biasing our estimates.

age estimate in column (iv) of Table 2. Panel A of Table 3 also shows that if there were no tax differences across borders, the pass-through would be 0.71. This result means that border differences serve to *increase* the burden borne by consumers on average, likely because stores far from the border over-shift by more than the under-shifting experienced by consumers closer to borders. Relatively inelastic consumer demand combined with imperfect competition that becomes more competitive closer to lower-tax borders is consistent with such a finding.[19]

Border effects for beer are even stronger than for cigarettes, as shown in Panel B of Table 3. The estimates in column (iii) suggest that on the border, a 1 cent increase in taxes *decreases* prices by more than 1 cent. This result suggests that prices in higher-tax states are lower than those directly across a lower-tax border, which is consistent with a large amount of border competition. As one moves away from the border, the pass-through rate increases dramatically, by 0.351 cents for every 1 percent increase in distance. At the mean of distance, which is 218.14, the average effect of beer excise taxes on excise prices is 0.618. This is substantively larger than the estimate in column (iv) of Table 2, which suggests that ignoring the border effect causes one to understate the effect of beer taxes on prices for the average consumer. At the mean of distance, the incidence of this tax is split almost evenly between consumers and producers. However, if one eliminated the border tax differences, a 1 cent increase in taxes would lead to a 0.202 cent increase in prices, meaning that similar to cigarettes, the border effect causes more of the burden of excise taxes to fall on consumers on average. As Table 3 illustrates, though, the average masks a large amount of heterogeneity in tax incidence that varies systematically with distance to lower-tax borders.

In Table 4, we present estimates that are similar to those in Table 3, but using distance and tax differences calculated from stores at which consumers purchase rather

[19]The available evidence suggests relatively inelastic demand for cigarettes, with a price elasticity of demand around -0.4 (Lovenheim, 2008; Chaloupka and Warner, 2000). See Bergman and Hansen (2009) for a discussion of imperfect competition and pass-through of taxes to prices.

than from Census tracts. The results for both beer and cigarettes are qualitatively and quantitatively similar to those in Table 3. For cigarettes, a 1 cent increase in taxes is associated with a 0.57 cent increase in prices on the border. This is somewhat higher than the 0.491 estimate in Table 3, suggesting that prices respond more at stores at the border than do prices paid by consumers at the border. Furthermore, a 1 percent increase in distance increases the pass-through by 0.057 cents, which is smaller than the distance effect in Table 3. This finding is consistent with more consumer search intensity nearer to lower-tax borders, where the returns to search likely are the highest. Thus, farther from the border, pass-through at the store-level increase at a slower rate than the consumer-level pass-through because the latter incorporates diminished search activity while the former does not.

The estimates in Panel B show that on the border, prices are under-shifted by more than in the Table 3. In addition, a 1 percent increase in distance increases the effect of excise taxes on consumer prices by 0.437, which is larger than estimate in Table 3. These estimates again suggest that store-level prices are more affected by tax increases than the prices consumers actually pay. Overall, the similarity of the estimates between Table 3 and Table 4 suggest that while consumer search behavior does drive some of the relationship between excise taxes and consumer prices, this search behavior is not dramatically affected by cigarette and beer taxes.

5.3 Results by Household Income and Race

An important distributional question surrounding cigarette and alcohol excise taxes is whether and how the incidence of taxation varies across the socioeconomic spectrum. Previous analyses have not been able to examine such heterogeneous effects due to their lack of purchaser demographics. In Table 5, we present the first evidence in the cigarette and beer excise tax literature on how the prices different income and racial groups pay are affected by excise taxes. All estimates come from models comparable to column (iv) of Table 2, so they include state fixed effects (for cigarettes),

demographic controls and UPC and purchase date fixed effects.

For cigarettes, the effect of taxes on prices is non-linear across the income distribution. For low-income households, who earn less than $35,000 per year, there is a 0.780 pass-through, which rises to 0.900 for the middle-income group (making between $35,000 and $100,000 per year) and then falls to 0.728 for the high-income group (with yearly earnings over $100,000). It therefore is among the highest and lowest household income families that the tax increase is passed through the least to prices, though the pass-through rate still is high. That taxes are passed through less to prices for lower-income families has important distributional implications because of the relatively high prevalence of smoking in this group (see Table 1). The lower pass-through rate for the households who consume the most serves to reduce somewhat the regressive nature of cigarette taxes.

The opposite trend is exhibited for beer across the income distribution. Low-income households experience no price increase due to excise tax increases, and the pass-through increases with income, from 0.125 for middle-income households to 0.265 for high-income households. The increased excess burden due to excise taxes thus falls relatively more on higher-income households, though in all cases a large portion of burden of these taxes is passed backward to the supply side.

The effects for households with different racial makeups also vary across products. For cigarettes, it is Hispanic-headed households that experience the largest increase in prices when taxes increase, with a pass-through of 0.884. White-headed households have a tax pass-through of 0.845 and black-headed households have the lowest pass-through, at 0.647. For beer, it is only the white-headed households that experience any increase in prices when excise taxes increase; for black and Hispanic-headed households, prices decline considerably when taxes increase. Thus, for cigarettes, a given tax increase increases the excess burden of white and Hispanic households by more than black households, and for beer, only white households experience any increased economic burden from a tax increase. These findings for both income and

race have potentially important implications for the distributional costs and benefits of these taxes as well as the potential distribution of public health benefits across income and racial groups.

Part of the reason for the average differences across groups may be explained by differences in where consumers of different backgrounds and types live, particularly with respect to lower-tax borders from the home Census tract. Table 6 presents estimates of equation (3), separately by income and household head race group. In Panel A, neither the low-income nor the high-income households exhibit significant price differences in their pass-through by distance to lower-tax borders. On the border, the groups have a pass-through rate between 0.49 and 0.58. The pass-through for the low-income and high income groups is 0.038 higher for every 1 percent increase in distance, which is not statistically significantly different from zero at conventional levels. For middle-income households, however, the pass-through rate on the border is 0.516 and increases by 0.087 for every 1% increase in distance. These differences across the income distribution may be driven by the fact that high income households have a high opportunity cost of time and low income households have a high direct cost of search. The finding from Table 5 that the economic burden of a cigarette tax increase falls more on the middle income households only holds true farther from the border; close to the border, all three income groups experience relatively small increases in excess burden from such a tax increase.

The beer tax estimates follow a clearer pattern over the income distribution. As income increases, the amount of under-shifting of the excise tax on the border increases and the effect of distance on the pass-through increases as well. One cannot reject the null that low-income households bear no costs of a beer tax, regardless of their location relative to the border. And, the amount of the burden falling on high versus medium income households rises with the distance to the border.

Across households with heads of different races, the pass-through of cigarettes taxes to prices is the largest for Hispanics on the border (at 1.63), and the effect of

distance is large and negative at -0.109, although it is very imprecisely estimated. White households exhibit the largest differences across space, while African American households do not experience different pass-through rates at different distances to lower-price borders. Conversely, for beer, it is black households that exhibit the largest change in pass-through of taxes to prices by distance, while there is again little evidence Hispanic households' prices are differentially affected by taxes the closer they are to a lower-tax border. The results by race illustrate the large amount of heterogeneity across different racial groups in the effect of evasion opportunities on the economic burden of cigarette and alcohol taxes. These are again important parameters in assessing the welfare implications of these taxes to the extent that how different types of consumers respond to the availability of nearby lower-price goods impacts how much of the burden they bear of each tax and therefore can significantly affect the distributional consequences of these taxes across racial and income groups.

Finally, in Table 7 we estimate equation (3) by racial and income groups using distances and tax differences from the stores at which consumers shop. As with the aggregate results, these estimates are similar to those using the distance measure from the Census tract. There are some notable exceptions, however. Low-income households have a higher pass-through for cigarettes as distance increases, but for the medium income group the effect of distance is smaller. This finding suggests low income households may increase search intensity as distance increases and middle-income households reduce search intensity.[20] The differences between Table 6 and Table 7 results for beer for each group are similar to the differences between the aggregate Table 3 and Table 4 results in the sense that in Table 7, distance effects are larger than in Table 6 and the pass-through at the border also is larger in absolute value. The only notable difference is that coefficients for the high and medium income households are more similar in Table 7 than in Table 6. These estimates do not point

[20]This difference may reflect the substitution versus the income effect in search costs. As distance increases, search costs increase as the distance to much lower-priced items is higher. But, as store prices increase with distance, poorer consumers may search harder as the opportunity cost of their time, at least in terms of wages, likely is lower. The income effect thus would outweigh the substitution effect. Higher-income households may reduce search as the costs are higher, such that the substitution effect outweighs the income effect.

to large systematic differences in search behavior across groups, particularly for beer.

6 Conclusion

This paper uses Nielsen Homescan data on cigarette and alcohol transactions from 2006-2007 to analyze the incidence of cigarette and beer excise taxes. In particular, we estimate the pass-through of excise taxes to consumer prices, which indicates how much of the excess burden of a tax is "passed forward" to consumers versus "passed backward" to the factors of production. Contrary to the small existing literature, we find cigarette taxes are less than fully passed through to consumer prices on average, and beer taxes have only a small effect on beer prices. One of the reasons for the differences between our results and previous estimates is that we are able to control for endogenous changes in the product mix when excise taxes change using UPC fixed effects.

Using the detailed geographic information on consumer and store locations, we estimate how the pass-through of taxes to prices is affected by distance to lower-tax borders. For both cigarettes and beer, we find evidence of a large amount of geographic heterogeneity in the incidence of these excise taxes that varies systematically by evasion opportunities. On the border with a lower-tax state, a 1 cent increase in excise taxes increases cigarette prices by less than 0.5 cents, and for beer prices actually decline substantially. For both products, the pass-through rate increases with distance to the lower-tax border, although at a considerably higher rate for beer than for cigarettes. Finally, we examine the incidence of these taxes separately by household income and race and find important differences across household type and across products. The burden of cigarette taxation is higher for middle-income households but for beer it increases across the income distribution. Cigarette prices paid by African American households respond less to taxes than do prices paid by white and Hispanic households, but for beer it is only prices paid by white households

that respond positively to excise taxes.

The estimates in this paper provide detailed insight into how consumers are affected by excise taxes. That the effects are heterogeneous across both space and household type suggests that the public health benefits of these taxes also will have differential impacts on households depending on where they live[21] and their demographic characteristics. These results also indicate that consumers and producers split the excess burden of these excise taxes, and among consumers there are often large geographic and socioeconomic differences. While our findings have important implications for how the excess burden of cigarette taxes is distributed among consumers and between consumers and producers, calculating the social welfare cost of these taxes is beyond the scope of our analysis. The results from this analysis are suggestive that this would be a fruitful area for future research.

[21] Lovenheim (2008) and Lovenheim and Slemrod (2010) make this point explicitly with cigarette taxes and alcohol control policies, respectively.

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Figure 1: Tax Incidence

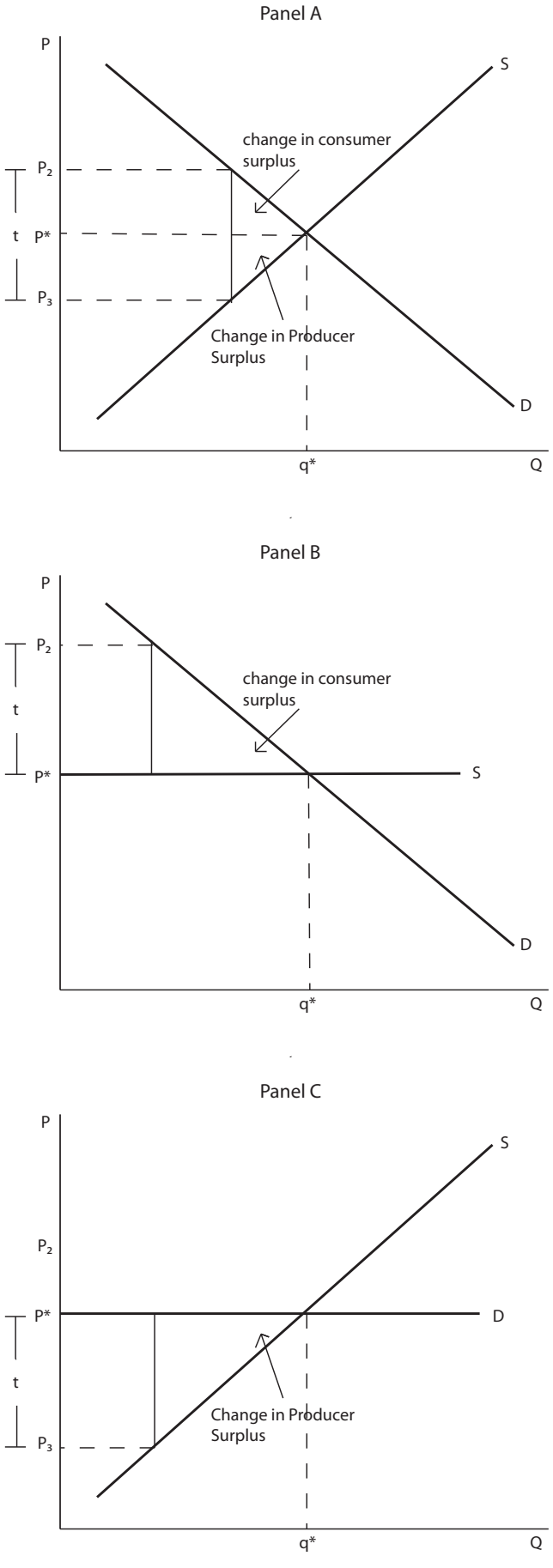

Table 1: Means of Analysis Variables by Product Type

Variable		Cigarettes	Beer
Price (Cents)		346.90	808.59
Tax (Cents)		85.78	25.95
Distance from Home Tract (Miles)		126.51	225.93
Distance from Store (Miles)		128.73	218.14
Border Tax Difference		38.51	9.75
Number of Household Members	1	0.224	0.171
	2	0.418	0.483
	3	0.179	0.164
	4	0.107	0.120
	5	0.050	0.044
	6+	0.022	0.018
Total Household Income	<$5,000	0.052	0.026
	$5,000-$7,999	0.022	0.009
	$8,000-$9,999	0.038	0.019
	$10,000-$11,999	0.062	0.034
	$12,000-$14,999	0.083	0.055
	$15,000-$19,999	0.078	0.056
	$20,000-$24,999	0.098	0.072
	$25,000-$29,999	0.071	0.068
	$30,000-$34,999	0.069	0.062
	$35,000-$39,999	0.071	0.069
	$40,000-$44,999	0.110	0.117
	$45,000-$49,999	0.076	0.100
	$50,000-$59,999	0.117	0.182
	$60,000-$69,999	0.035	0.082
	$70,000-$99,999	0.010	0.021
	≥$100,000	0.010	0.028
Male Household Head Age	<25	0.002	0.002
	25-29	0.015	0.012
	30-34	0.036	0.034
	35-39	0.064	0.072
	40-44	0.142	0.114
	45-49	0.174	0.158
	50-54	0.184	0.164
	55-64	0.257	0.260
	≥65	0.125	0.184
Female Household Head Age	<25	0.003	0.003
	25-29	0.021	0.018
	30-34	0.035	0.044
	35-39	0.063	0.076
	40-44	0.123	0.130
	45-49	0.203	0.172
	50-54	0.164	0.161
	55-64	0.252	0.251
	≥65	0.136	0.145
Male Head Education Attainment	Grade School	0.010	0.010
	Some HS	0.099	0.053
	HS Graduate	0.361	0.270
	Some College	0.315	0.320
	BA	0.178	0.255

	Graduate School	0.037	0.092
	Grade School	0.008	0.007
Female	Some HS	0.052	0.032
Head	HS Graduate	0.368	0.316
Education	Some College	0.356	0.328
Attainment	BA	0.182	0.239
	Graduate School	0.034	0.078
	White	0.833	0.831
	Hispanic	0.046	0.073
Race	Black	0.093	0.067
	Asian	0.005	0.011
	Other	0.023	0.018
Kids Under 18?		0.239	0.233
Male Head	$<$ 30 Hours	0.038	0.045
Weekly	30-34 Hours	0.040	0.028
Labor	$\geq$35 Hours	0.634	0.643
Supply	Not Employed	0.288	0.285
Female Head	$<$ 30 Hours	0.098	0.104
Weekly	30-34 Hours	0.053	0.059
Labor	$\geq$35 Hours	0.408	0.450
Supply	Not Employed	0.441	0.387
Male Household Head		0.733	0.881
Female Household Head		0.897	0.869
Number of Transactions		160,969	301,998
Number of Households		10,784	25,928
Number of Census Tracts		9,501	18,480

Table 2: OLS Estimates of the Effect of Cigarette and Beer Excise Taxes on Consumer Prices

Panel A: Cigarette Prices Per Pack (Cents)				
Independent Variable	(i)	(ii)	(iii)	(iv)
Excise Tax (Cents)	1.034**	0.964**	0.961**	0.827**
	(0.023)	(0.026)	(0.025)	(0.027)
UPC Fixed Effects:	No	Yes	Yes	Yes
State Fixed Effects:	No	Yes	Yes	Yes
Demographic Controls:	No	No	Yes	Yes
Purchase Date Fixed Effects:	No	No	No	Yes
Panel B: Beer Prices Per Gallon (Cents)				
Independent Variable	(i)	(ii)	(iii)	(iv)
Excise Tax (Cents)	-0.918**	0.122**	0.125**	0.125**
	(0.216)	(0.043)	(0.042)	(0.042)
UPC Fixed Effects:	No	Yes	Yes	Yes
Demographic Controls:	No	No	Yes	Yes
Purchase Date Fixed Effects:	No	No	No	Yes

[1] Source: Nielsen Homescan data and state-level excise beer tax rates. State fixed effects only are included in models for cigarette prices because there is no cross-time variation in beer taxes in 2006-2007.

[2] Excise taxes for beer are in cents per gallon. Excise taxes for cigarettes are in cents per pack.

[3] Standard errors clustered at the census tract level are in parentheses: * indicates significance at the 10 percent level and ** indicates significance at the 5 percent level.

Table 3: OLS Estimates of the Effect of Excise Taxes on Cigarette and Beer Prices by Distance to Lower Tax Borders from Home Census Tract

Panel A: Cigarette Prices Per Pack (Cents)			
Independent Variable	(i)	(ii)	(iii)
Excise Tax (Cents)	0.863**	0.866**	0.707**
	(0.039)	(0.039)	(0.041)
Tax Difference with Nearest	-0.210**	-0.209**	-0.216**
Lower Tax State	(0.101)	(0.096)	(0.092)
Log Distance to Nearest	-1.866**	-2.119*	-2.675**
Lower Tax State	(1.048)	(1.003)	(0.985)
Log Distance-Tax Difference Interaction	0.073**	0.074**	0.079**
for Nearest Lower Tax State	(0.022)	(0.021)	(0.020)
Demographic Controls:	No	Yes	Yes
Purchase Date Fixed Effects:	No	No	Yes
Panel B: Beer Prices Per Gallon (Cents)			
Independent Variable	(i)	(ii)	(iii)
Excise Tax (Cents)	0.186**	0.199**	0.202**
	(0.047)	(0.047)	(0.046)
Tax Difference with Nearest	-1.395**	-1.446**	-1.474**
Lower Tax State	(0.376)	(0.373)	(0.374)
Log Distance to Nearest	2.839**	2.691**	2.794**
Lower Tax State	(0.941)	(0.929)	(0.926)
Log Distance-Tax Difference Interaction	0.339**	0.343**	0.351**
for Nearest Lower Tax State	(0.081)	(0.081)	(0.081)
Demographic Controls:	No	Yes	Yes
Purchase Date Fixed Effects:	No	No	Yes

[1] Source: Nielsen Homescan data and state-level excise beer tax rates. State fixed effects only are included in models for cigarette prices because there is no cross-time variation in beer taxes in 2006-2007. All regressions include UPC fixed effects.

[2] Tax Difference with Nearest Lower Tax State is the difference in tax rates between the state of the consumer's home Census tract and the nearest lower-tax state (in cents). Distance to nearest lower tax state is the distance to this lower tax state (in miles) from the Census tract. The distance-tax difference interaction is the interaction of these two variables.

[3] Standard errors clustered at the census tract level are in parentheses: * indicates significance at the 10 percent level and ** indicates significance at the 5 percent level.

Table 4: OLS Estimates of the Effect of Excise Taxes on Cigarette and Beer Prices by Distance to Lower Tax Borders from Store Zip Code

Panel A: Cigarette Prices Per Pack (Cents)			
Independent Variable	(i)	(ii)	(iii)
Excise Tax (Cents)	0.989**	0.982**	0.871**
	(0.040)	(0.039)	(0.040)
Tax Difference with Nearest	-0.321**	-0.326**	-0.297**
Lower Tax State	(0.092)	(0.088)	(0.086)
Log Distance to Nearest	-1.028	-1.250	-1.806**
Lower Tax State	(0.948)	(0.903)	(0.896)
Log Distance-Tax Difference Interaction	0.059**	0.060**	0.057**
for Nearest Lower Tax State	(0.019)	(0.019)	(0.018)
Demographic Controls:	No	Yes	Yes
Purchase Date Fixed Effects:	No	No	Yes
Panel B: Beer Prices Per Gallon (Cents)			
Independent Variable	(i)	(ii)	(iii)
Excise Tax (Cents)	0.203**	0.216**	0.222**
	(0.046)	(0.045)	(0.045)
Tax Difference with Nearest	-1.734**	-1.800**	-1.868**
Lower Tax State	(0.372)	(0.364)	(0.366)
Log Distance to Nearest	2.449**	2.233**	2.241**
Lower Tax State	(0.937)	(0.912)	(0.915)
Log Distance-Tax Difference Interaction	0.414**	0.423**	0.437**
for Nearest Lower Tax State	(0.081)	(0.079)	(0.080)
Demographic Controls:	No	Yes	Yes
Purchase Date Fixed Effects:	No	No	Yes

[1] Source: Nielsen Homescan data and state-level excise beer tax rates. State fixed effects only are included in models for cigarette prices because there is no cross-time variation in beer taxes in 2006-2007. All regressions include UPC fixed effects.

[2] Tax Difference with Nearest Lower Tax State is the difference in tax rates between the state of the purchasing store and the nearest lower-tax state (in cents). Distance to nearest lower tax state is the distance to this lower tax state (in miles) from the store zip code. The distance-tax difference interaction is the interaction of these two variables.

[3] Standard errors clustered at the census tract level are in parentheses: * indicates significance at the 10 percent level and ** indicates significance at the 5 percent level.

Table 5: OLS Estimates of the Effect of Cigarette and Beer Excise Taxes on Consumer Prices, by Household Income and Race

Panel A: Cigarette Prices Per Pack (Cents)						
	Low Income	Medium Income	High Income	White	Black	Hispanic
Excise Tax (Cents)	0.780**	0.900**	0.728**	0.845**	0.647**	0.884**
	(0.046)	(0.031)	(0.077)	(0.028)	(0.082)	(0.088)
Panel B: Beer Prices Per Gallon (Cents)						
	Low Income	Medium Income	High Income	White	Black	Hispanic
Excise Tax (Cents)	0.065	0.125**	0.269**	0.180**	-0.320**	-0.371**
	(0.093)	(0.048)	(0.093)	(0.044)	(0.133)	(0.183)

[1] Source: Nielsen Homescan data and state-level excise beer tax rates. State fixed effects only are included in models for cigarette prices because there is no cross-time variation in beer taxes in 2006-2007. All estimates include controls for household demographic characteristics, UPC fixed effects and purchase date fixed effects.

[2] Excise taxes for beer are in cents per gallon. Excise taxes for cigarettes are in cents per pack.

[3] Low Income households are those whose household income is less than $35,000, medium income households are those with household income between $35,000 and $100,000 and high income households are those with household income higher than $100,000.

[4] Standard errors clustered at the census tract level are in parentheses: * indicates significance at the 10 percent level and ** indicates significance at the 5 percent level.

Table 6: OLS Estimates of the Effect of Excise Taxes on Cigarette and Beer Prices by Distance to Lower Tax Borders From Home Census Tract, by Household Income and Race

Panel A: Cigarette Prices Per Pack (Cents)						
	Low Income	Medium Income	High Income	White	Black	Hispanic
Excise Tax (Cents)	0.578**	0.834**	0.489**	0.705**	0.796**	0.908**
	(0.066)	(0.051)	(0.123)	(0.042)	(0.150)	(0.125)
Tax Difference with Nearest	0.079	-0.318**	0.110	-0.224**	-0.218	0.720**
Lower Tax State	(0.145)	(0.109)	(0.249)	(0.100)	(0.218)	(0.392)
Log Distance to Nearest	-3.525**	-2.195*	-6.086*	-2.679**	-1.072	8.604*
Lower Tax State	(1.595)	(1.125)	(3.679)	(1.008)	(3.146)	(4.507)
Log Distance-Tax Difference Interaction	0.038	0.087**	0.038	0.089**	0.005	-0.109
for Nearest Lower Tax State	(0.032)	(0.024)	(0.056)	(0.022)	(0.049)	(0.080)
Panel B: Beer Prices Per Gallon (Cents)						
	Low Income	Medium Income	High Income	White	Black	Hispanic
Excise Tax (Cents)	-0.011	0.234**	0.334**	0.270**	-0.036	-0.441**
	(0.109)	(0.052)	(0.109)	(0.049)	(0.162)	(0.188)
Tax Difference with Nearest	-0.328	-1.566**	-2.291**	-1.455**	-4.334**	-0.220
Lower Tax State	(0.794)	(0.436)	(0.898)	(0.398)	(1.225)	(1.317)
Log Distance to Nearest	6.501**	2.426**	-0.816	2.985**	-1.082	-1.043
Lower Tax State	(2.143)	(1.039)	(2.226)	(0.955)	(3.679)	(3.460)
Log Distance-Tax Difference Interaction	0.157	0.352**	0.551**	0.342**	0.905**	0.171
for Nearest Lower Tax State	(0.177)	(0.094)	(0.189)	(0.087)	(0.257)	(0.256)

[1] Source: Nielsen Homescan data and state-level excise beer tax rates. State fixed effects only are included in models for cigarette prices because there is no cross-time variation in beer taxes in 2006-2007. All regressions include UPC and purchase date fixed effects.

[2] Tax Difference with Nearest Lower Tax State is the difference in tax rates between the state of the consumer's home Census tract and the nearest lower-tax state (in cents). Distance to nearest lower tax state is the distance to this lower tax state (in miles) from the Census tract. The distance-tax difference interaction is the interaction of these two variables.

[3] Low Income households are those whose household income is less than $35,000, medium income households are those with household income between $35,000 and $100,000 and high income households are those with household income higher than $100,000.

[4] Standard errors clustered at the census tract level are in parentheses: * indicates significance at the 10 percent level and ** indicates significance at the 5 percent level.

Table 7: OLS Estimates of the Effect of Excise Taxes on Cigarette and Beer Prices by Distance to Lower Tax Borders From Store Zip Code, by Household Income and Race

Panel A: Cigarette Prices Per Pack (Cents)						
	Low Income	Medium Income	High Income	White	Black	Hispanic
Excise Tax (Cents)	0.819**	0.948**	0.676**	0.866**	0.955**	0.864**
	(0.068)	(0.045)	(0.108)	(0.042)	(0.100)	(0.119)
Tax Difference with Nearest	-0.207*	-0.348**	0.023	-0.301**	-0.332	0.434
Lower Tax State	(0.123)	(0.105)	(0.216)	(0.092)	(0.209)	(0.309)
Log Distance to Nearest	-1.542	-1.796*	-3.983	-1.819**	0.005	4.920
Lower Tax State	(1.467)	(0.963)	(3.117)	(0.890)	(2.681)	(3.926)
Log Distance-Tax Difference Interaction	0.050*	0.062**	0.001	0.064**	0.003	-0.074
for Nearest Lower Tax State	(0.027)	(0.022)	(0.049)	(0.020)	(0.043)	(0.062)
Panel B: Beer Prices Per Gallon (Cents)						
	Low Income	Medium Income	High Income	White	Black	Hispanic
Excise Tax (Cents)	-0.006	0.268**	0.339**	0.288**	-0.053	-0.405**
	(0.105)	(0.051)	(0.105)	(0.047)	(0.158)	(0.187)
Tax Difference with Nearest	-0.656	-2.132**	-2.074**	-1.906**	-4.572**	-0.330
Lower Tax State	(0.783)	(0.431)	(0.852)	(0.904)	(1.192)	(1.199)
Log Distance to Nearest	5.926**	1.625	-0.532	2.399**	-1.276	-1.362
Lower Tax State	(2.128)	(1.037)	(2.095)	(0.939)	(3.462)	(3.230)
Log Distance-Tax Difference Interaction	0.243	0.473**	0.496**	0.445**	0.972**	0.170
for Nearest Lower Tax State	(0.176)	(0.094)	(0.181)	(0.084)	(0.253)	(0.236)

[1] Source: Nielsen Homescan data and state-level excise beer tax rates. State fixed effects only are included in models for cigarette prices because there is no cross-time variation in beer taxes in 2006-2007. All regressions include UPC and purchase date fixed effects.

[2] Tax Difference with Nearest Lower Tax State is the difference in tax rates between the state of the purchasing store and the nearest lower-tax state (in cents). Distance to nearest lower tax state is the distance to this lower tax state (in miles) from the store zip code. The distance-tax difference interaction is the interaction of these two variables.

[3] Low Income households are those whose household income is less than $35,000, medium income households are those with household income between $35,000 and $100,000 and high income households are those with household income higher than $100,000.

[4] Standard errors clustered at the census tract level are in parentheses: * indicates significance at the 10 percent level and ** indicates significance at the 5 percent level.

Table A-1: OLS Estimates of the Effect of Excise Taxes on Premium and Generic Cigarette Prices

Panel A: Average Effects		
	Premium	Generic
Excise Tax (Cents)	0.842**	0.803**
	(0.032)	(0.048)
Panel B: Effects by Distance		
	Premium	Generic
Excise Tax (Cents)	0.773**	0.635**
	(0.052)	(0.065)
Tax Difference with Nearest	-0.264	-0.251*
Lower Tax State	(0.114)	(0.147)
Log Distance to Nearest	-2.870**	-3.019*
Lower Tax State	(1.227)	(1.599)
Log Distance-Tax Difference Interaction	0.074	0.106**
for Nearest Lower Tax State	(0.025)	(0.031)

[1] Source: Nielsen Homescan data and state-level excise beer tax rates. State and purchase date fixed effects are included in all models.

[2] Tax Difference with Nearest Lower Tax State is the difference in tax rates between the state of the consumer's home Census tract and the nearest lower-tax state (in cents). Distance to nearest lower tax state is the distance to this lower tax state (in miles) from the Census tract. The distance-tax difference interaction is the interaction of these two variables.

[3] Standard errors clustered at the census tract level are in parentheses: * indicates significance at the 10 percent level and ** indicates significance at the 5 percent level.